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INTEGRAL ANALYSIS OF SELECTED LABOUR MARKET INDICATORS IN THE CONTEXT OF A COVID-19 PANDEMIC*

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Abstract. Individual indicators linked to labour market developments during the COVID-19 pandemic provide a view of a particular area but fail to capture the issue of the impact of the crisis comprehensively. This problem can be addressed by integrating them using multicriteria methods, resulting in a synthetic indicator of a specific labour market. Thus, the issue of the impact of the pandemic on important macroeconomic and labour market indicators can be evaluated by calculating a single indicator. The main objective of this study is to identify the labour market with the highest positive flexibility in relation to the impacts of the pandemic and thus reveal the critical factor that fundamentally reduces the resistance of the labour market to negative pandemic externalities. During the first wave of the COVID-19 pandemic (2020-Q2), Slovakia reached the highest value of the integral indicator, but in the last recorded wave (2022-Q1), it moved to the last place. Its average integral indicator for all three waves reached the highest average value. However, the highest value of the integral indicator and thus the highest positive flexibility of the labour market during the third wave was recorded by Germany, which evokes the assumption that the approach of the local government and authorities in the mentioned period most effectively protected the labour market from negative fluctuations. The results of the countries during the third wave of the pandemic consider the impact of the most current measures that were implemented at the time of the pandemic.

Keywords: labour market; COVID-19 pandemic; macroeconomic indicators; integral analysis

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JEL Classifications: E24, O47, J24

1. Introduction

The pandemic affected the global economy and individual countries for almost three years. The mix of its effects, impacts, measures to contain or eliminate it, as well as the subsequent socio-economic development in the affected countries is extensive (Adamowicz, 2022; Halmai, 2021; Jain et al., 2022; Ingham, 2022 and others). Various opinions, estimates, expectations, or predictions have come to the fore in the past period. The currents of opinion regarding the COVID-19 pandemic in relation to the labour market have made it possible to understand its opportunities and threats. They have expanded the set of contexts in which the impact of the pandemic can be identified - whether on the labour demand or labour supply side. As a consequence of the

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multifaceted nature of the pandemic's impact, there are a number of issues and questions that should be addressed and answered - e.g. the impact of labour productivity levels on the overall resilience of the labour market to the negative effects of the crisis, the accelerating effects of the pandemic on the development of selected areas of the labour market (home office, ICT work, the shift towards automated production, the introduction of artificial intelligence elements in production and non-production processes, etc.), or the deepening problems of the current labour market (clash of generations, worker turnover, shortage of skilled labour, etc.), these and many others are indicated by several studies (Kapička & Rupert, 2022; Milanović et al., 2023; Casarico & Lattanzio, 2022 and others). The views presented in the preceding section are undoubtedly those of relevant experts in academia and practice, but they were often based on different assumptions, expectations and beliefs, or historical experiences in analogous situations, which to a significant extent determined their narrative value. However, given the topicality of the topic in the recent period, these views cannot be ignored - for a long time after the global outbreak of the COVID-19 pandemic, they were the only source of information and an important factor in economic and political decision-making. But now, after almost four years of monitoring and analyzing this societal issue, it is possible to speak of knowledge confirmed by science and practice.

The data integrated in this study come from public statistical databases, which is due to the nature of the multicriteria methods used in the calculations. The databases of institutions such as Eurostat, OECD, or WHO already have a relatively large set of indicators reflecting the evolution of the pandemic in relation to the functioning of the labour market. The existing data, when further processed, can provide a statistically accurate and scientifically interesting view of the past period of the pandemic crisis. The present study draws on these databases and integrates the individual indicators into a synthetic indicator through scientific quantitative methods. The reason for data integration is the absence of such a scientific approach in similar studies, whose explanatory value is then usually limited by the horizon of the indicator under study. The absence in terms of local research poses an interesting research problem, which implies the existence of a research gap; the need for comprehensive research on labour market resilience by a set of a larger number of indicators is justified, for example, by a Serbian study (Milanović et al., 2023).

When discussing the need to identify the impact of the COVID-19 pandemic on the labour market, it is important to recognize that these impacts and influences are multifaceted, which relates to broad labour market issues. It is well-known that its functioning is closely linked to macroeconomic developments. As the pandemic has affected countries' economies in a cardinal way, it has also affected the various areas of the labour market. We can talk here about the impact on employment, labour productivity, employers' labour costs, the number of vacancies, the organization of work and many other areas. Multicriteria methods capable of integrating disparate data from different areas into an indicator, generalizing the impact of the pandemic, are an option for assessing the impact of the pandemic in an aggregated way.

The main objective of this study is to identify the labour market with the highest positive flexibility in relation to the impacts of the pandemic and thus reveal the critical factor that fundamentally reduces the resistance of the labour market to negative pandemic externalities.

The structure of the paper consists of an introduction, where the rationale for the study and the background of the research are presented. It continues with a literature search, discussing the existing findings of other authors that address the confirmed impacts of the COVID-19 pandemic on the labour market in different regions of the world. This is followed by a methodological section oriented to familiarize with the research parameters and an empirical section where the standardized variable method is applied independently across the three waves of the COVID-19 pandemic through a selected set of eight indicators. The application of the method does not consider absolute values of the indicators, it works with their dynamic expression (most often a fixed-base index). This transformation of the indicator values ensures that the results of the calculation can easily identify the labour market with the smallest negative and the largest positive fluctuations of the indicators under study, i.e. the most positively flexible labour market. The study concludes with a brief discussion, a summary, and a list of bibliographical references.

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2. Theoretical background

The COVID-19 pandemic has become perhaps the most widely used term of the early 2000s. Its impact on human health has been the subject of numerous studies. However, at least as much scientific and research attention has been given to its impact on the global economy or on individual countries. Probably the most significant manifestation of the economic consequences of this crisis has been the fluctuations in major macroeconomic indicators, caused primarily by the introduction of restrictive measures by national governments to minimize its negative manifestations or to address the deepening negative phenomena (rising unemployment, falling GDP, slowing economic growth, rising price levels). The International Labour Organization (ILO) was quite quick to label the COVID-19 pandemic as not only a health crisis but also an economic and labour market crisis (Walter, 2020). As Kollmann (2021) states, the COVID epidemic is a very large, truly unexpected, and exogenous disturbance. According to Lemieux et al. (2020), the COVID-19-related crisis had a key impact on the labour market, household incomes, and changes in gross domestic product. Global disruptions in the supply chain, in turn, played a significant role in the development of inflation, which was related to. i. with the growth of the producer price index (Santacreu, LaBelle, 2022). The labour market and human capital were the first to feel these effects due to rising unemployment, job insecurity and shrinking career opportunities because of the spread of COVID-19 worldwide (Costa Dias et al., 2020). It was often optimal to close businesses and order a quarantine even before the wave reached its peak, but the tax was, e.g., a higher number of vacant jobs (Kapička, Rupert, 2022).

During a pandemic, the labour market cannot function efficiently - it has often been shown to be more effective to close businesses and implement quarantine measures before the peak of the pandemic (Kapička & Rupert, 2022). A negative phenomenon affecting a large proportion of workers was the physical closure of national borders to prevent the spread of the COVID-19 virus. The implementation of this decision cardinally affected the international labour market. Legislative but also de facto barriers posed a major problem for cross-border workers, but also for the companies and society itself (Medeiros et al., 2021). The number of these workers declined rapidly in 2020 - reasons such as concerns about SARS-CoV-2 infection, a preference for home offices or the termination of employment relationships (Böhm, 2021). However, the main reason, which in many ways influenced the previous ones, was the desire to minimize the number of people crossing the border (Novotny, 2021). The restrictions associated with border restrictions are a typical ambivalent impact of the COVID-19 pandemic. On the one hand, they are a major tool for countries seeking to insulate themselves from the external effects of pandemics and new variants of the virus, thereby pursuing the positive goal of protecting the population of a given country. On the negative side, there are the inherent economic problems associated with the restricted international movement of people, but also of capital, goods and services. The application of this policy inevitably leads to the debate as to whether the effects of closed borders do not, in the end, pose greater risks and damage than the potential spread of the virus in society. "Never before has the world faced such a direct conflict between sustaining livelihoods and saving lives, a conflict fraught with ethical, moral, economic and life challenges and pitfalls" (Jain et al., 2022). Over time, this has raised the question of how resilient countries' labour markets are to the impacts of the COVID-19 pandemic (Milanović et al., 2023).

Epidemiological realities at critical stages of the pandemic limited the scope for protracted decision-making. Thus, despite the outlined problem of benefits and risks of measures, most countries focused on developing a legislative framework to implement the programmes and tools needed to minimize further impacts and address emerging problems. In practice, this has meant more intensive government activities oriented towards direct financial support for selected actors in the labour market. Governments that prioritized wage subsidies over other forms of income support were able to reduce labour market instability (Soares & Berg, 2022). It is important to note here that the effects of the pandemic varied across countries, which is related to country heterogeneity. Thus, the impacts of the COVID-19 pandemic were also heterogeneous, e.g. depending on demographic groups (Cortes & Forsythe, 2022). This forced country governments to take a differentiated approach to developing relevant policies - indeed, the target group of beneficiaries was heterogeneous. For example, the most vulnerable groups of workers (young people, temporary workers, low-skilled workers, workers without the possibility to work from home, etc.) were better protected by government policies against

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labour market recessions (Casarico & Lattanzio, 2022). Of course, they are only talking about a period when aid and support schemes had already been in practice for some time.

The COVID-19 pandemic has restructured labour markets with lasting consequences for both firms and workers. In 2020, there was a change in the composition of employment as low-wage workers - many of whom were employed in hard-hit sectors with limited teleworking opportunities - were disproportionately affected by job losses (ILO, 2022). Of the 43% of small businesses that closed during the first weeks of the pandemic, most of these were businesses where introducing home office elements was not feasible (ILO, 2022). It is evident that the work of low-skilled workers is heavily dependent on the specific location of the workplace, and thus, businesses with this type of workforce were more severely affected by the pandemic, which also had an impact on the employees themselves. Particularly affected were temporary workers (i.e. fixed-term contracts, short-term contracts, performance contracts, etc.), workers in low-paid occupations (i.e. low-skilled) and migrants (ILO, 2022). Workers laid off during the pandemic were most often women, migrants, and workers with less than secondary education (Beland et al., 2022). A specific group heavily affected by the COVID-19 pandemic was young workers - a trend confirmed in Northern Europe, where their share of total job losses was as high as 77% in 2020 (ILO, 2022). The authors of a study carried out in Italy also find the same findings - they identify the key groups at risk in the labour market: young workers, low-skilled workers, those on fixed-term contracts and those who do not have the option of working in a home office (Casarico & Lattanzio, 2022).

Labour market inequalities have increased, especially for women, young people, the less educated, lower earners and workers on temporary contracts (Soares & Berg, 2022). A group of authors from Singapore also note existing differences between the impacts of the pandemic on young workers with lower and higher wages, with the lower earning group more likely to experience job loss, a drop in wages, but also feelings of frustration, discouragement, or even chronic anxiety disorders (Ng Yue Hoong al., 2022). The assumption of a lower resilience of the secondary labour market to the impacts of the COVID-19 pandemic is confirmed by other studies. Occupations at higher risk of automation show a more pronounced decline in employment (Egana-delSol et al., 2022). According to them, this also explains the question of why emerging economies are more significantly affected from a labour market perspective compared to developed countries. In emerging economies, it is still the secondary labour market that is still the majority, with a predominantly low-skilled labour force. These workers generally occupy the jobs most vulnerable to the automation of production. If one adds to this the assumption that crises are a catalyst for technological change (Kopytov et al., 2018), which is also confirmed by the research of other authors (e.g., Jaimovich & Siu, 2020; Micco Aguayo, 2019), then the threat of automation to low-skilled labour is very intense in times of crises. The pandemic has precipitated several technological changes related to automation (using chatbots, virtual agents, automated financial messaging, and intermediaries in the supply or purchasing chain) (Autor & Reynolds, 2020). However, to see increasing automation in times of crisis only as a factor threatening a certain part of the workforce would be too one-sided. Indeed, the COVID-19 pandemic has thus also contributed to optimizing workloads and reducing the amount of unnecessary work in many large and small business companies and public institutions (Dvořák et al., 2020).

However, the efforts to stabilize the epidemiological situation in the countries, coupled with, among other things, the closure of businesses, inevitably implied a deterioration in many macroeconomic indicators. As Bloom et al. (2023) reported, the COVID-19 pandemic generally led economies to decline, negatively affecting living standards, public finances and productivity. Balkan & Akyuz (2023) recall the intense deterioration and identify the decline in economic growth and increasing budget deficits of countries as reasons for this. For example, according to an international study, the pandemic, in the context of disrupting the continuity of economic processes, had a significantly negative impact on productivity and labour costs - the cumulative global economic loss amounted to roughly $10.4 trillion in 2020-2022, of which the economic losses of the EU, the US and China amounted to 30.44%, 18.74% and 15.44%, respectively (Cui et al., 2023).

Halmai (2021) warns of the risk that the decline in investment and other labour market problems will have a long-term impact on economic growth and productivity, ultimately exacerbating existing inequalities and negatively affecting social cohesion across social classes. On the other hand, the pandemic may also accelerate the economy and its growth - this is particularly linked to the accelerated implementation of new technologies.

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In addition, a more efficient health system can be envisaged, as such a crisis requires increasing investment in health care. Indeed, all policies implemented during the pandemic were dependent on, among others, the number of infected (Kapička, Rupert, 2022).

Teruel et al. (2023) investigated the correlation between the adoption of digital technologies and the response of firms to the COVID-19 pandemic, considering several factors, including the productivity of the firms in question, their level of digitalization, and the period of economic growth prior to the crisis. They found that firms with higher levels of productivity were less likely to reduce headcount - a finding that the authors argue is valid in both the short and long term. Błaszczyk (2023) examined the effects of the pandemic in Poland compared to the EU and found a sharp deterioration, while the main determinants of this situation were a decline in economic growth and an increase in the budget deficit, with relatively stable unemployment and inflation.

Based on the studies cited and the views presented, it can be concluded that individual authors have examined the various areas of the labour market and macroeconomic development in isolation rather than as a complex area of the economy and society. They focused, for example, on labour productivity, GDP growth, employment, the skills structure of workers, changes in how work is organized or the impact of the pandemic on the development of ICT skills. However, assessing overall labour market flexibility in response to the anti-pandemic measures taken based on separately assessed data is impossible. The only way to evaluate large amounts of disparate data in a mass and simultaneous way is to apply multivariate statistics. For this purpose, the multicriteria standardized variable method was chosen, which makes it possible to measure the overall labour market flexibility in a limited time and space using dynamic values of indicators.

3. Research objective and methodology

The main objective of this study is to identify the labour market with the highest positive flexibility in relation to the pandemic impacts (i.e. with the lowest negative and highest positive fluctuations of the examined indicators) based on the integration of sub-indicators and thus reveal the critical factor that fundamentally reduces the resistance of the labour market to negative pandemic externalities. With the possible analogy of the last pandemic crisis in the future, this study can contribute to a better orientation when making important decisions. Revealing the critical factor will help direct adequate responses to areas that fundamentally distort the flexibility of the labour market and, thus, its overall resilience. Considering the current global interdependence, global threats and the last pandemic experience, the risk of a new pandemic appears to be a completely realistic eventuality of future developments.

To identify the most positively flexible labour market, a number of individual labour market indicators need to be evaluated in aggregate. The calculation of the overall labour market flexibility during the duration of the pandemic is conditional on knowing the flexibility in the active phases of the crisis - for this reason, the results first go through the individual flexibility calculations in each wave. The overall flexibility results for the entire duration of the COVID-19 pandemic form only the final part of the research. Based on the studies presented in the previous section and the intention to make the results as comprehensive as possible, eight labour market indicators were selected to illustrate labour market developments from the perspective of different areas. The list of indicators is contained in Table 1.

Table 1. List of selected indicators

No.	Indicator	Acronym	Source of data	Input value
1.	gross domestic product	GDP	Eurostat	current prices in million €
2.	employment	EMP	Eurostat	percentage of 15–64-year-olds
3.	job vacancy	JV	Eurostat	number of job vacancies
4.	inflation	INF	OECD	consumer price index (CPI)
5.	labour costs	LC	Eurostat	labour cost index (LCI)
6.	work productivity	WP	Eurostat	GDP per hour worked in €
7.	part-time work	P-TW	Eurostat	number of part-time workers
8.	COVID-19 cases	CC-19	WHO	number of Covid-19 cases

Source: own creating

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Since the study works with a wide range of labour market indicators and with different countries, it requires appropriate unification and comparability of the included indicators.

The methodological procedure for the transformation of input data was as follows. First, we converted the input data that did not meet the condition of comparability (due to the different number of inhabitants of the countries or their size) into relative data, which are more suitable for international comparison as follows:
- gross domestic product as GDP per inhabitant of the given country,
- job vacancy as the number of vacant jobs per 100,000 economically active inhabitants of the given country,
- part-time work as the number of part-time workers per 100,000 employed persons in a given country,
- work productivity as the volume of GDP produced in one hour converted per inhabitant of the given country,
- COVID-19 cases as the number of people infected with the disease COVID-19 per 100,000 inhabitants of a given country.

Subsequently (apart from the CPI and LC indices) we recalculated these relative values of the indicators into basic indices according to the formula as follows:

$$S = \frac{X_t}{X_z}$$

where:
Xt – the value of the variable X in period t
X_z - the value of the variable X in base period z (the first quarter of 2020)

The exceptions are inflation and labour costs - in the case of the presented mix of indicators - in this case, the values of the year-on-year percentage change have been retained, as further recalculation is not necessary in view of the relativity of the data and the dynamics of the indicator (the value already meets the parameters of relativity and dynamics when reported, unlike the other indicators). The use of a fixed-base index reflects the intention of the researchers of the present study. The aim is not to identify the best but the most flexible labour market - i.e. the market that, in aggregate, has experienced the best flexibility. The use of a fixed-base index makes this possible, as it does not work with the primary values of the indicators, but with their percentage changes compared to a certain fixed-base period.

For the integration of the sub-indicators, the standardized variable method was chosen. Multicriteria methods, which include the normalized variable method, have been used in the past to assess the performance of enterprises, and later they began to appear in the assessment of the economic level of different units. In many cases, it is not enough to observe only one statistical feature or indicator, but it is necessary to examine the observed entity from several aspects. The characteristics of these methods - universality of use, comparability of results or complexity of findings - led the authors' team to the idea of using their potential also in the assessment of labour market flexibility. With a similar intention, the standardized variable method was applied in a study from 2020, dealing with socio-economic and demographic indicators, where the aim was to identify the arrangement of countries in the EU according to these indicators (Hurbánková, 2020). However, precisely due to the identified research gap, the use of this type of methods is currently sporadic; from this perspective, the use of the standardized variable method represents an opportunity to obtain previously unknown data and a more realistic picture of the labour market based on more than one indicator.

The application of the standardized variable method results in a synthetic indicator for each of the countries studied for a specific quarter. The country with the highest value of the synthetic indicator (the so-called integral indicator) represents the economy with the highest labour market flexibility in the quarter under consideration. For completeness, the calculation of the standardized variable method is carried out separately in three quarters that represent the intense phases of the pandemic (the so-called waves): these are the second quarter of 2020 (2020-Q2), the first quarter of 2021 (2021-Q1) and the first quarter of 2022 (2022-Q1).

For the application of the chosen multicriteria method, the mathematical-statistical methods arithmetic mean and standard deviation were also used.

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We calculate the standard deviation according to the formula:

$$s_{xj} = \sqrt{\frac{1}{n}\sum_{i=1}^{n}\left(x_{ij} - \bar{x}\right)^2} = \sqrt{s_x^2}$$

The calculation of the two aforementioned methods provided the necessary source data for further calculation of the integral indicator values (both the arithmetic mean and standard deviation were calculated for each of the eight selected indicators and each of the three pandemic waves).

Subsequent data processing was carried out according to the formulas of the normalized variable method, which belongs to the group of multicriteria methods: for its calculation we needed to know the formula for the maximizing indicators (GDP, EMP, WP, P-TW indicators):

$$u_{ij} = \frac{x_{ij} - \bar{x}}{s_{xj}} \; x \; 100$$

and minimizing indicators (indicators JV, LC, CC-19):

$$uij = \frac{\bar{x} - x_{ij}}{s_{xj}} \; x \; 100,$$

where:

- x_j is the arithmetic mean of the values of the *j-th* indicator,
- x_{ij} is the value of the *j-th* indicator in the *i-th* country,
- s_{xj} is the standard deviation of the *j-th* indicator,
- u_{ij} is the rating of the *i-th* country for the *j-th* indicator.

The calculation of the value of the integral indicator itself subsequently works with the transformed values of the indices, where the result of the examined countries represents a simple arithmetic average of the minimizing and maximizing indicators of the given country in the given quarter according to the formula:

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$$

The specific indicator within the minimizing and maximizing indicators is inflation, which was classified as one or the other group according to whether it was positive or negative.

With the aim of objectivity and relevance of the results, the following countries were selected: Czech Republic (CZ), Germany (DE), Poland (PL) and Slovakia (SK). These are countries with similar culture, geographic location, composition of the national economy, and legislative frameworks and processes. They are also strongly interconnected business partners. In addition to the above-mentioned reasons, the authors' collective also considered the fact that the representation of European local research in scientific databases is rather marginal when choosing countries. This represents a limited possibility to evaluate the effectiveness of individual national policies and to identify appropriate and inappropriate instruments for similar situations in the future.

The input data are drawn from Eurostat, OECD and WHO databases and are quarterly values in the interval 2020-Q1 to 2022-Q2, where the peaks of all three pandemic waves are dated. The starting value of the indices (base period) is the first quarter of 2020, i.e. j. the first quarter of the outbreak of the COVID-19 pandemic in these countries.

The key findings and outputs of the empirical analysis are presented in the following section of this study.

4. Results and discussion

The application of the methods and the interpretation of the results are presented according to the sequence of the individual pandemic waves for clarity. The base period is the first quarter of 2020.

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4.1 The first wave of the COVID-19 pandemic - 2020-Q2

Table 2 below shows the values of the of fixed-base indexes for each indicator in each country, including the calculated value of the arithmetic mean and standard deviation over the period of interest (2020-Q2).

Table 2. Values of the fixed-base indexes and inflation rates in selected countries in the period 2020-Q2 and the values of the arithmetic mean and standard deviation for the indicators

Indicator/Country	GDP	EMP	JV	INF	LC	WP	P-TW	CC-19
CZ	93,38	99,06	92,62	-6,40	136,20	107,29	92,81	172,97
DE	90,82	99,57	68,78	-8,20	121,90	94,46	97,41	96,84
PL	90,89	99,27	106,36	-7,80	127,50	117,01	94,21	634,11
SK	99,50	98,24	86,05	-4,60	129,00	103,56	106,02	230,87
arithmetic mean	93,65	99,03	88,45	-6,75	128,65	105,58	97,62	283,70
standard deviation	4,0777	0,5722	15,6100	1,6279	5,8881	9,3326	5,9279	239,9697

Source: Eurostat, OECD, WHO, own calculations

The calculated values presented in Figure 1 represent a dimensionless number that is an integral indicator covering all the areas under study. Its calculation works with the values presented in the previous table, with a slight variation for the maximizing and minimizing indicators respectively.

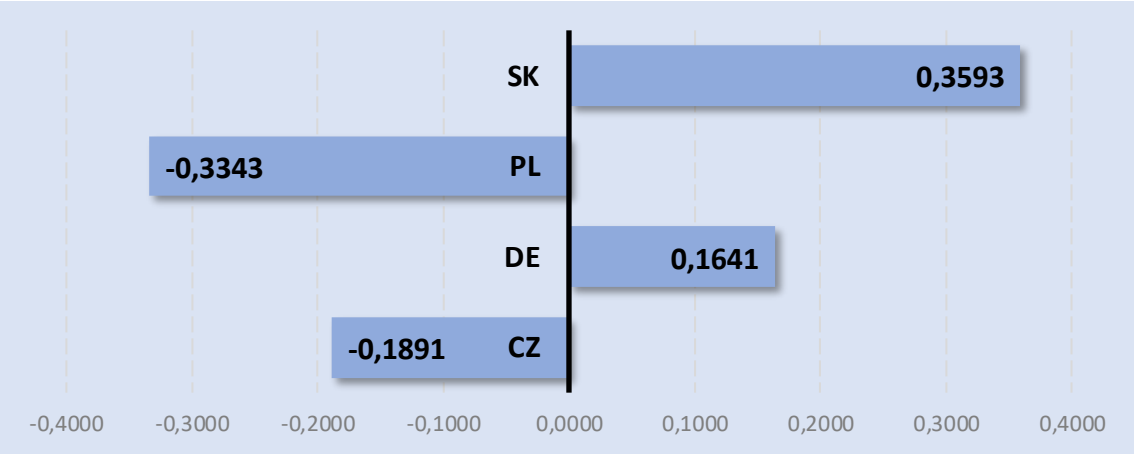

Figure 1. Integral indicator values for selected countries in 2020-Q2

Source: Eurostat, OECD, WHO, calculated by the authors

Figure 1 shows that the highest value of the integral indicator, and thus the most positively flexible labour market, during the first wave of the COVID-19 pandemic was achieved by the Slovak Republic, with a score of 0.3593. The second highest value achieved was 0.1641 points for Germany, followed by the Czech Republic with -0.1891 points and Poland with the lowest value, -0.3343 points. The use of benchmarks allows tracking labour market flexibility and dynamics, as it works with values that are a percentage change compared to the fixed-base quarter (2020-Q1) of each indicator. Simply put, the highest value of 0.3593 points in the case of Slovakia means that in the second quarter of 2020 (2020-Q2), it experienced the smallest negative and the largest positive fluctuations in the eight indicators tracked - depending on whether it was a minimizing or maximizing indicator - compared to other countries. This result was mainly due to partial positive results in the indicators GDP, inflation, and number of part-time jobs. In Poland, the negative result for the integral indicator was mainly due to the indicators number of vacancies and number of cases of COVID-19.

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4.2 The second wave of the COVID-19 pandemic - 2021-Q1

Table 3 shows the values of the benchmark indices for the individual indicators in the selected countries, including the calculated value of the arithmetic mean and standard deviation over the reference period (2021-Q1).

Table 3. Values of the fixed-base indexes and inflation rates in selected countries in the period 2021-Q1 and the values of the arithmetic mean and standard deviation for the indicators

Indicator/Country	GDP	EMP	JV	INF	LC	WP	P-TW	CC-19
CZ	99,32	98,40	85,16	-0,70	125,90	107,73	90,52	17575,78
DE	99,44	99,93	92,17	7,80	99,40	103,57	98,36	1107,80
PL	100,03	101,17	143,79	8,50	130,60	122,13	91,02	27341,03
SK	100,81	99,85	85,86	-2,10	121,10	104,26	97,59	75026,43
arithmetic mean	99,90	99,84	101,74	3,38	119,25	109,43	94,37	30262,76
standard deviation	0,6844	1,1347	28,2053	5,5506	13,7900	8,6652	4,1755	31745,3113

Source: Eurostat, OECD, WHO, own calculations

Based on the data presented in the previous table, the values of the integral indicators have been calculated for each country. The result is Figure 2, which also identifies the change in the notional ranking of countries in terms of the value of the standardized variable in the period 2021-Q1 compared to the previous (first) wave.

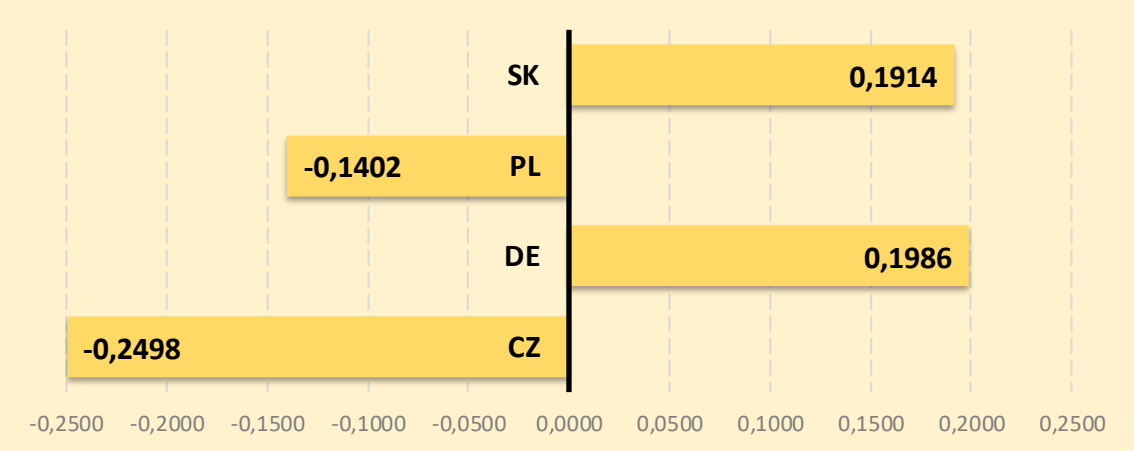

Figure 2. Integral indicator values for selected countries in 2021-Q1

Source: Eurostat, OECD, WHO, calculated by the authors

According to Figure 2, the highest value of the integral indicator during the second wave of the COVID-19 pandemic was reached by the labour market in Germany, at 0.1986 points, closely followed by the Slovak labour market (0.1914 points). Poland and the Czech Republic scored -0.1402 and -0.2498 points respectively. In the case of Germany, its position (as the most positively flexible labour market) was mainly helped by the indicators of labour costs, the number of part-time workers and the number of COVID-19 cases. The Czech Republic's negative ranking was due to negative developments in the indicators of GDP, employment rate and the number of part-time workers.

4.3 The third wave of the COVID-19 pandemic - 2022-Q1

The last period in which the partial results of the selected economies are integrated through the application of the normalized variable method is the first quarter of 2022 (2022-Q1), corresponding to the so-called third wave of the COVID-19 pandemic. At the same time, it is the last period during the duration of the crisis under study in which statistically significant shifts in the development of the indicators under study occurred solely due to

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the impact of the pandemic (in the following quarters the socio-economic development, and thus the situation on the labour market, was already determined by other crises, while the impact of the pandemic itself was only marginal).

Table 4. Values of the fixed-base indexes and inflation rates in selected countries in the period 2022-Q1 and the values of the arithmetic mean and standard deviation for the indicators

Indicator/Country	GDP	EMP	JV	INF	LC	WP	P-TW	CC-19
CZ	116,79	100,27	90,19	23,20	132,90	111,32	94,44	29239,51
DE	107,99	103,29	142,40	26,30	102,20	106,01	101,54	14486,39
PL	114,38	103,80	207,45	18,00	144,70	130,69	88,52	43444,19
SK	110,17	103,82	117,93	14,30	132,50	105,30	97,59	181473,20
arithmetic mean	112,33	102,79	139,49	20,45	128,08	113,33	95,52	67160,82
standard deviation	3,9807	1,7030	50,0752	5,3420	18,1546	11,8824	5,4950	77119,8633

Source: Eurostat, OECD, WHO, own calculations

By analogy with the previous sections, Table 4 presents the input data for the calculation of the standardized variable method. Based on the summarised data, the calculation of the values of the integral indicators for each country is again proceeded - thus, Figure 3 reflects the measured values in the last recorded pandemic wave (2022-Q1) and identifies a notional change in the ranking of the countries.

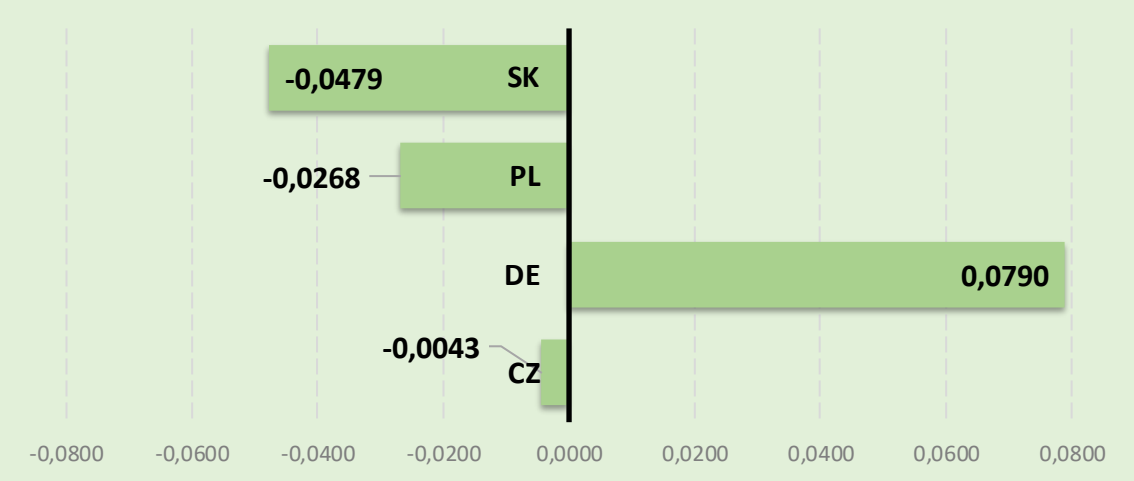

Figure 3. Integral indicator values for selected countries in **2022-Q1**

Source: Eurostat, OECD, WHO, calculated by the authors

Germany was again the labour market with the highest score on the integral indicator during the last recorded wave of the COVID-19 pandemic, with a score of 0.0790 over the period. All three other countries scored negative values. The Czech labour market was closest to Germany's level, with a score of -0.0043, followed by Poland (-0.0268). Slovakia came in last place, where the value of the integral indicator was -0.0479 points. Slovakia's position was mainly driven by negative sub-indicators on labour productivity and the number of COVID-19 cases. Labour costs, the number of part-time workers and the number of COVID-19 cases developed in favour of the German labour market, which thus became the most positively flexible in the third wave.

Comparisons of countries' integral indicator values between pandemic waves have not been made. This is because each quarter studied behaves as a separate calculation in terms of the application of multicriteria methods, i.e. there are no boundaries to the imaginary interval (the highest and lowest calculated values are always a reflection of the fixed-base data of a given quarter, and these differ from quarter to quarter). Thus, if Slovakia scores 0.3593 in 2020-Q2 and 0.1914 in 2021-Q1, this does not mean that it has statistically

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underperformed by the difference between the two values - each value is based on different input data and comparisons.

4.4 Total results (2020-Q1 – 2022-Q2)

Table 5 shows the average values of the integral indicators over the entire pandemic period, represented by three waves. The normalized variable method identifies Slovakia as the statistically best labour market, with an integral indicator value of 0.1676 points, followed by Germany (0.1472 points) by a slight margin of 0.0204 points. In the negative range, the Czech Republic (-0.1478 points) and Poland (-0.1671 points) were ranked in the same order, with a difference of up to 0.3347 points compared to the best value. Overall, the highest integral indicator was 0.3593 points (Slovakia, 2020-Q2) and the lowest integral indicator was -0.3343 points (Poland, 2020-Q2); thus, the distance between the interval boundaries for this value was up to 0.6936 points.

Table 5. Average values of integral indicators of countries during all pandemic waves

Country	the average value of the standardized variable method	difference compared to the best result
CZ	-0,1478	-0,3154 p.
DE	0,1472	0,0204 p.
PL	-0,1671	-0,3347 p.
SK	0,1676	best result

Source: Eurostat, OECD, WHO, own calculations

The position of Slovakia in the analysis suggests that our labour market has responded to the pandemic and its resulting impacts at a comparable level to other countries and even performed statistically better in several indicators, especially during the first wave (2020-Q2). This finding is in line with the results of the analyses of the Institute of Economics of the Slovak Academy of Sciences, which generally describe the impacts of the crisis on the Slovak labour market in that period as smaller than expected and the labour market response as milder than in past economic shocks (Frank & Morvay, 2021).

Discussion

Individual national governments have undoubtedly had a significant impact on the fluctuations of the indicators. It is the importance of the state as a labour market regulator, or the link between state interventions in the labour market and its evolution during a pandemic, that has been demonstrated by several authors (e.g. Milanović et al., 2023; Spencer et al., 2022; Aldieri et al., 2022; Soares & Berg, 2022; Ingham, 2022; Adamowicz, 2022). Other studies have linked the intensity of the pandemic's labour market impacts to the nature of the labour force - consistently arguing that labour markets of countries with a higher share of low-skilled workers were more negatively affected by the COVID-19 pandemic than more flexible labour markets (Cortes & Forsythe, 2022; Kramer & Kramer, 2020; ILO, 2022; Beland et al., 2022; Casarico & Lattanzio, 2022; Egana-delSol et al., 2022). The present study confirms this assumption since the lowest level of labour productivity in the period under study was recorded in Poland, which ranked last in the average results of the standardized variable method (lowest value of the integral indicator).

At this point, it is worth recalling that the analyses' outcome identifies the resilience of the labour market response to an unexpected crisis, rather than long-run developmental differences in indicators relativized in different ways. Therefore, the significance of the present study for science and practice lies primarily in its approach to the use of multicriteria methods, where otherwise, the standard static expressions of indicators have been replaced by a dynamic variant in the form of a base index. The results obtained using multicriteria methods allow the identification of the country with the most effective macroeconomic measures during the COVID-19 pandemic, which would not have been possible if individual developments in labour market indicators had been examined (as they would necessarily only reflect the impact of the measures on a given area, not on the labour market as a whole). In turn, the indicators' dynamic expression ensures the measurement's objectivity as it reflects the change from the base period. From a practical perspective, the most effective measures during the

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COVID-19 pandemic were those implemented during the last wave in Germany. It can thus be assumed that in the case of a similar event, they would have protected the labour market, characteristic of the selected four countries, most effectively.

The present study also has its limitations. The final output of the implementation of the standardized variable method must be viewed strictly in terms of the selection of sub-indicators, the countries, the quarterly periodicity, and finally, the calculation methodology itself - a different composition of indicators, objects compared, or data processing method may lead to different results. To maintain the objectivity of any comparison of results with current labour market changes, it is therefore necessary to strictly be based on this study's research settings.

Conclusions

Interpretation of the results of the application of the standardized variable method indicates that during the observed intervals (individual waves of the COVID-19 pandemic) the labour market situation in the Czech Republic, Germany, Poland and Slovakia was very similar in terms of the regularities of the development of individual indicators. In all four countries, for example, during the intense phases of the pandemic, there were declines in GDP, employment, rising inflation and labour costs, and fluctuations in labour productivity. Job vacancies, the number of part-time workers and the number of people infected with COVID-19 have followed a similar pattern, with some variations. If we are talking about finding some similarities in the evolution of the indicators under study, this is certainly no longer the case for the quantitative nature of their shifts. It is thus evident that there were differences between countries (in the epidemiological evolution, in the response to the crisis, in the economic health of the private sector, etc.) that had a major impact on the evolution of the labour market during the crisis.

Germany is the country where our study has identified the most positively flexible labour market now. In the most recent (third) wave (2022-Q1), the value of the integral indicator reached 0.0790 points, the highest among the four countries compared. For the average values of the countries' integral indicators (average of the first, second and third waves), Slovakia achieved the highest value of the integral indicator (0.1676 points), which was mainly due to the high score difference during the first wave (2020-Q2). The country with the worst average result within the comparison set was Poland, whose average integral indicator reached -0.1671 points (the difference from the highest achieved value was up to 0.3347 points).

Based on the multicriteria analysis conducted, it is possible to identify labour productivity as the main critical factor among the eight indicators examined. The least positively flexible labour market in Poland was characterized by the lowest level of labour productivity among the compared countries during the individual pandemic waves (labour productivity here reached on average 80.9% of the Slovak, 66.2% of the Czech and only 34.1% of the German labour productivity level). As lower levels of labour productivity are associated with a higher share of low-skilled labour, the findings of this study confirm the assumption of greater vulnerability of this type of labour market. Conversely, labour markets with a higher share of highly skilled labour become more stable and are more flexible in adapting to negative externalities, such as the COVID-19 pandemic. This means that decisions taken at the national and international level should, in a comparable situation, be directed mainly towards areas that stimulate the growth of the skill level of the future and current workforce. However, it is obvious that the experience gained and the indefinite time that separates society from the next crisis should lead to adequate decisions and changes today. Initiatives in this area can help to reduce the distorting effects of future crises on labour markets and thus increase their resilience.

Efforts to comprehensively assess the labour market during each wave of the pandemic inevitably generalize to individual developments in input indicators. To some extent, this may obscure the outbreak of problems in specific areas and their severity. On the other hand, tracking the evolution of individual indicators without some form of integration cannot provide a comprehensive view of the evolution of a given labour market, as it is always only one aspect of the market. The integration of multiple data should therefore be seen as an opportunity to look at the labour market under analysis with an emphasis on its overall evolution, considering many otherwise relatively separate areas and processes (e.g. at-risk groups of workers, hiring and firing of

workers, labour market performance, labour market flexibility or macroeconomic developments). As the study focuses on the changes caused by the pandemic, the indicator of the number of cases of COVID-19 captured in the analysis also illustrates the epidemiological factor of the crisis under study.

Unanswered questions remain in areas of the study that could not be pursued further due to objective limitations. It is clear from the research results that Germany has had the most effectively protected labour market, at least in the recent period - but it is unclear which policies and instruments have contributed most to this outcome; indeed, many of the measures have been identical across countries. It is also uncertain whether the sample of indicators is hypothesized to be influenced by a latent variable that acted in parallel with the impact of the COVID-19 pandemic. As the pandemic itself is a non-cyclical and sudden event, the applicability of the experience to future work is questionable. In the case of Slovakia, although, on average, it achieved the best result, it would be useful to identify the state decisions that caused the dramatic drop in indicators in the last wave. There is also the possibility of recalculating the indicators after further revision of the data in statistical databases, which may affect the overall results of the standardized variable method, or of verifying the results of this study by applying a different multicriteria method. These and many other unanswered questions or problems outlined are potential suggestions for further scientific research.

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