The question of (un)employment - the impact of the coronavirus pandemic on the business model of SMEs

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Abstract

The authors of this article analysed the impact of the COVID-19 pandemic on the financial situation of employees in small and medium-sized enterprises (SMEs) in the Czech Republic. They conducted a questionnaire survey with 251 respondents in October and November 2021. The structure of the respondents was divided according to the size of the firms, the time of operation in the market, and the focus of business activity, which was presented in detail in the tables. Statistical methods including Quadratic SVM (support vector machine) and Gaussian process regression model were used to evaluate the changes in financial valuation among employees during the pandemic. The analysis results showed that most respondents (SMEs) did not experience a difference in their financial valuation, with the most significant salary retention observed in small-sized enterprises with international operations. The statistical methods of Quadratic SVM and Gaussian process regression model contributed to a better understanding of the financial situation of employees during the pandemic. The Gaussian process confirmed that approximately 80% of the respondents did not experience any change in their salary during the pandemic. One positive finding is some small business owners and businesses that took advantage of compensation programs from the government (e.g., nursing, isolation) with positive financial outcomes for their employees. This shows that appropriately designed subsidy policies can benefit SMEs and help them survive difficult times. Overall, it can be concluded that the COVID-19 pandemic has had an impact on SMEs, some of which have been able to adapt and use state support to maintain employment and financial stability. In supporting SMEs, the government should continue to focus its strategies on maintaining jobs and providing financial support during periods of economic crises such as the pandemic. This research provides valuable insights for the formulation and implementation of effective measures to minimize the negative impacts of crises on SMEs and their employees.

Keywords: SME, economic crises, transformation, unemployment, business strategy.

Introduction

It has been more than two years since the world radically changed and the disease called SARS-CoV-2 hit humanity. This new type of coronavirus caused a global pandemic that affected most countries in the world, including the Czech Republic, in the following weeks and it was only a matter of time before this new situation would affect national preparedness for a pandemic and how these countries would respond (Meramveliotakis, Manioudis, 2021). It is already possible to analyse the different steps that states have taken, and, in the mix, it can be concluded that, at least in the beginning, most states have closed their borders, or rather closed their economies and societies (Rodrigues, Silva & Franco, 2021). In the wake of the following developments throughout Europe and the increase in cases in neighbouring countries, governments began to issue many measures whose priority was primarily to prevent the increasing number of infected people. This has had a significant impact on the business sector. All entrepreneurs, tradesmen, and employees affected by the consequences of the coronavirus epidemic had to react to the restrictions imposed by the state. These changes were reflected in the attitude of employers towards their employees who, on the one hand, dealt with the limitation of contact between employees, but also, in some business sectors, there had to be an inevitable reduction in income, which was compensated by several subsidy programs (Kmencová et al., 2019). Employers have been forced to rethink their approach to the work-from-home, or home-office, format (Kučera, Smolková, 2022). As a result of quarantines and reduced risk to business, companies have had to respond by changing internal regulations and home-office working has often become commonplace (Kraus et al. 2020). Some businesses reduced their employees' wages, postponed pay dates, or stopped paying employees altogether because they were unable to cover wage costs due to the spread of the virus and the shutdown of some production. Other firms introduced unpaid leave, which had a significant negative impact on consumption, especially among low-income groups who were unable to cover their expenses (Lee et al. 2020; Sinčić Ćorić, Špoljarić, 2021). All economic policy measures that were subsequently introduced by individual governments in the interest of public health were intended to reduce the impact on the state's economy, both during the crisis and, above all, to kick-start the state's economy after the crisis. Thus, the role of the state was to create economic rules, to apply such economic instruments and measures to keep the state's economy running, and to prevent the emergence of economic irregularities such as unemployment or stagnation, or reduction of wage levels, including the minimum wage. At the present time, where Europe is facing both the ongoing pandemic and, more recently, the war in Ukraine, which has resulted in a massive influx of Ukrainian refugees, especially to neighbouring countries, it is clear that the role of the state will have an irreplaceable influence on the development of these socio-economic irregularities, and that it is the government that will have to implement such government policies and create such effective measures and use such instruments that will lead to stabilization but also to a transformation to a new sustainable economy (Bowles, Carlin, 2020).

Literature review

Small and medium-sized enterprises (SMEs) make up most businesses worldwide. They are major contributors to job creation and therefore (Bencsink, Juhász & Mura, 2019) have a significant impact on both national and global economic development (Žárská, Sochuľáková, 2022). They play a significant role in the development of the economy in many countries (Thilagavathi et al. 2021). Therefore, it is desirable to create conditions that enable new firms to enter the economy, thereby activating opportunities for job creation, and promoting research, knowledge dissemination, and innovation (Hrmo, Krištofiaková & Barnová, 2020; Domanižová, Milichovský & Kuba, 2020), which ultimately contributes to economic growth (Ahmad Hasan & Barbhuiya, 2021). The example of the Czech Republic can be used to document the impact of SMEs on GDP formation. From the current figures given by the Ministry of Industry and Trade of the Czech Republic in 2021, it can be deduced that it accounts for almost 36% of GDP, a further 54% of value-added and the last very important factor is that SMEs provide more than 60% of unemployment. Similar results are achieved by other European countries, which is why support for SMEs is of the utmost importance. SMEs have a great advantage over large enterprises in that they can better adapt to market changes (Macrohon, Jeng, 2021). Thus, in a turbulent environment, an environment brought about by the covid pandemic among others, SMEs can perceive, seize and respond to opportunities more intensively and effectively (Park, Kim, 2021). When businesses face economic distress, a well-designed subsidy policy increases the likelihood that businesses that take advantage of government subsidies will be able to survive these situations (Bahadur, Baumann, 2021). The effects of government subsidies and support can play major roles in influencing the development of firm performance, but in many cases, they also affect the very existence of SMEs, especially in a risky period, which the COVID-19 pandemic undoubtedly was. Many studies have aimed to make the public aware of the positive impact of financial subsidy incentives on the firm and its performance (Muldoon, Liu & Mchugh 2021). However, it is important to point out the fact regarding the compensation announced in the European area. Most of the covid compensations are considered public aid instruments from the perspective of European and Czech legislation (Office for the Protection of Competition, 2021). Compensation that is granted from public funds and has the potential to favour certain undertakings or specific sectors of the economy, thereby creating the potential to distort the balance of trade between the Member States, may be classified as public aid. The issue of State aid is defined in Articles 107-109 of the Treaty on the Functioning of the European Union ('TFEU'). However, there are exceptions that may be compatible with the internal market. These exceptions allow Member States to use aid for projects in the event of a serious disturbance in the economy of a Member State, such aid must be notified by the provider to the European Commission. The pandemic caused by the COVID-19 disease fulfilled this condition quite clearly, and the European Commission decided that the situation created by this pandemic fully meets the grounds for the use of this exemption and therefore such public aid is compatible with the internal market (European Commission, 2020). On the basis of this adopted exemption,

programs may be announced in the form of Limited amounts of aid, loan guarantees, interest rate subsidies for loans, guarantees, and loans granted through credit institutions or other financial institutions, short-term export credit insurance, research and development support to combat COVID-19, investment support for infrastructure, testing and production expansion, investment aid for the production of products designed to combat COVID-19, tax deferrals or social security contributions, subsidies for wage costs of employees to prevent redundancies during the spread of the coronavirus, recapitalization measures for non-financial enterprises and support for non-covered fixed costs, etc. (Bai, Quayson & Sarkis, 2021).

Authors from non-European countries have reached similar conclusions. An expert article by Kawaguchi, Kodama & Tanaka (2021), examined the causality of the effect of anti-corruption policies applied to small-medium enterprises. The authors concluded that one-time and quick subsidies improved the survival and prospects of small firms, including job retention. A paper by Issenova (2021) examines SMEs in Central Asian countries during the COVID-19 pandemic. Studies for 2020 and 2021 were conducted by international organizations such as the World Bank, the Asian Development Bank, and KPMG (Klynveld Peat Marwick Goerdeler). This analysis led to the conclusion that the recovery potential of SMEs in Central Asian countries is directly dependent on the measures taken by the government, and the main instrument is business support in the form of loan refinancing and administrative support measures. SMEs were exposed to various challenges during the global pandemic and their response affected their chances and resilience to overcome the crisis. However, service-based sectors have been hard hit. In an article by Gregurec, Tomičić Furjan & Tomičić-Pupek (2021), they present how the service sector coped with the disruption caused by the COVID-19 pandemic. This research focused on exploring new technologies, particularly in the context of employee-employer communication, and it appears that SMEs that used digital technologies had a better chance of survival (Sagapova, Dušek & Pártlová, 2022). The operation of small businesses in the industry and the impact of the COVID-19 pandemic were explored in a study that was described in an article by Harel (2021). The study examined the extent to which businesses changed as a result of the global COVID-19 pandemic. However, it found that small businesses whose revenue came from subcontractors and the B2B market were likely to fare better in periods of economic hardship (Konečný, Ruschak & Kostiuk, 2023). The study also found that businesses that are active in international markets were far more successful in adapting to changing demands. As part of this study, research was carried out on the various forms of social support directed at SME employees, which showed that national governments should continue to target businesses with strategies aimed at preserving and restoring jobs and should continue to take this form of assistance into account, either in existing or newly developed strategies and programs (Kollmann, Dobrovič, 2022). Several forms of support for sole traders, firms, and employees have been developed to help firms mitigate negative impacts on business. In the Czech Republic, subsidy systems were provided mainly by the Ministry of Labour and Social Affairs and the Ministry of Industry and Trade. The present article focuses on these facts and examines the impact of the coronavirus crisis on employees and possible changes in

the financial valuation of employees in various SME sectors with different regional business overlaps. A sub-objective is to evaluate the economic and social support of the state for small and medium-sized enterprises. The evaluation focuses mainly on the use of the benefits and supports provided by different ministries (anti-virus, crisis care, "isolation", care for self-employed workers, payment of uncovered costs and rent) and will use specific examples (case studies) to construct model cases and their financial results in the use of different supports for employees (care, isolation) using the wage comparison method (Horák, Mlsová & Machová, 2021). Possible forms and combinations of state subsidies will be applied to small tradesmen in order to analyse the financial benefits of such support used by employees or entrepreneurs themselves (Horák et al., 2020).

Methods and Data

The questionnaire survey was conducted during October and November 2021. Entrepreneurs were approached to participate in the survey through students of VŠTE and members of the Chamber of Commerce of the Czech Republic. The survey involved a total of 251 respondents - entrepreneurs and companies in the category of micro, small, and medium-sized enterprises (hereinafter referred to as "companies involved in the survey" or just as "companies"). The structure of respondents according to size, length of time on the market, and focus of business activity is shown in the tables below.

Table 1: Number of firms participating in the survey by size (number of firms)

Company size	Period of operation of the company on the market				Total
	0–1 year	2–5 years	6–10 years	11 years and more	
0 – freelancer	1	13	2	19	35
1–10 employees – micro company	6	16	23	29	74
11–50 employees – small company		7	8	35	50
51–250 employees - medium-sized company		3	5	84	92
Total	7	39	38	167	251

Source: Own (2023)

To evaluate the firm's approach to the crisis with a specification to detect changes in the status of employee benefits evaluation in the period before and during the COVID-19 pandemic, the authors will use several statistical methods. Among the classification methods, the method that has proven to be the most appropriate for this type of analysis will be selected. The method chosen was the Quadratic SVM (support vector machine) method, which is represented by the authors Cristianini, Shawe-Taylor (2000). This method is one of the relatively newer methods, it is a kind of alternative to the multilayer artificial neural network method (Vochozka, Horák & Krulický, 2020), which is also able to interpret general nonlinear functions. However, the disadvantage of neural networks is that learning is often very difficult, as there is almost always a risk of getting stuck in a

local minimum of the error function. Another risk of using neural weights is the need to find many weights in a multidimensional space. In contrast, the SVM method is a method based on so-called kernel machines, using which linear boundaries can be identified while being able to represent highly complex nonlinear functions (Mitchell, 1997).

$$F1 = x1^2 \tag{1}$$

$$F2 = x2^2 \tag{2}$$

$$F3 = \sqrt{2x1x2} \tag{3}$$

As another method, the Gaussian process regression model will be chosen. Gaussian processes allow us to make predictions about the data. They define a priori distributions over functions or initial knowledge about a parameter is expressed before plausible data is available. When data is observed (observed data D under the parameter condition), the plausibility of the data is verified and the data is converted to an a priori likelihood using Bayes' formula, that is, the resulting function takes into account the observed data D. This approach is described by Bayesian statistics. Gaussian processes are based on a multivariate normal distribution. Based on the continuity or discreteness of the data, Gaussian processes are used for regression. According to Rassmussen, Williams (2006), a Gaussian process is defined by a mean function m(x) and a covariance function k(x, x0), the notation of a Gaussian process is of the form:

$$f(x) \sim GP(m(x), k(x, x0)) \tag{4}$$

The function f(x)represents a random variable at x , or m(x) = 0, (function of the mean values)

We then proceed to the a priori distribution, which can be obtained at arbitrary input points X_* . The apriori distribution represents the expected output values f_* of the inputs X_* without data, and is defined according to the notation of the apriori distribution:

$$f_* \sim N(0, K(X_*, X_*)) \tag{5}$$

Where $K(X_*, X_*)$ is a covariance matrix in which the selected covariance function $k(x_*, x_*)$ is applied to each element. In our case, a linear non-stationary covariance function was used, which has the following form:

$$k(x, x0) = \sigma^2_f x^T x0 \tag{6}$$

Where $\sigma^2_f > 0$ is the total variance.

As the next method in the paper, the data visualization method (Parallel Coordinate) will be used. The Parallel Coordinate (PAC) method, also known as parallel axes (Tricaud et al., 2011) is a very useful method for processing datasets using parallel coordinates.

It is used to process such problems where relationships between variables are compared. The advantage of using this method is the ability to see the dataset globally, which means all the data is in one image. The main purpose of looking at the data visually is to see some significant characteristics or anomalies that can be further explored and thus be able to gain further insights into the data. At the end of the paper, a non-experimental method called a case study will be used. The presented case study was conducted based on a survey of wages or average wages in the Czech Republic. Using a specific example, on specific research units (the conversion to the average wage in the Czech Republic will be made), a model example for each type of employee will be constructed using the wage comparison method. The employee who has benefited from the full support of compensation programs (nursing, isolation) compared to an employee working under standard conditions and without the use of compensation programs. A model financial result will be shown using the wage comparison method and including subsequent interpretation. The same will be done for small tradesmen where different forms of compensatory support will be applied. Finally, a summary of the results thus obtained will be made. The chosen case study will serve to interpret the results already obtained from the statistical methods and will also serve to answer the hypothesis posed.

- RQ1: What was the impact of the COVID-19 pandemic on the financial situation of employees in small and medium-sized enterprises (SMEs) in the Czech Republic?
- H1: The majority of respondents (SMEs) did not experience any change in their financial valuation during the COVID-19 pandemic.
- RQ2: What factors influenced changes in the financial valuation of employees during the pandemic in different types and sizes of enterprises?
- H2: Small-sized enterprises with an international presence will experience less change in financial valuation than enterprises operating only nationally.

Results

The basic pillar of the research is to demonstrate the extent of the impact of the covid pandemic on the financial situation of employees working in SMEs. In this regard, we start from a dataset of enterprises, where the basis for answering the set research questions and hypotheses will be based on the structure of the answers of these respondents while understanding the interdependence of the answers between the different areas under study, we will use a schematic representation using the method for data visualization (Parallel Coordinate) that we have mentioned. Within this method, we chose to observe attributes such as firm size, regional scope, sectoral scope, and time in the market with respect to changes in financial valuation.

Graph 1: Structure of key research areas (view using Parallel Coordinate)
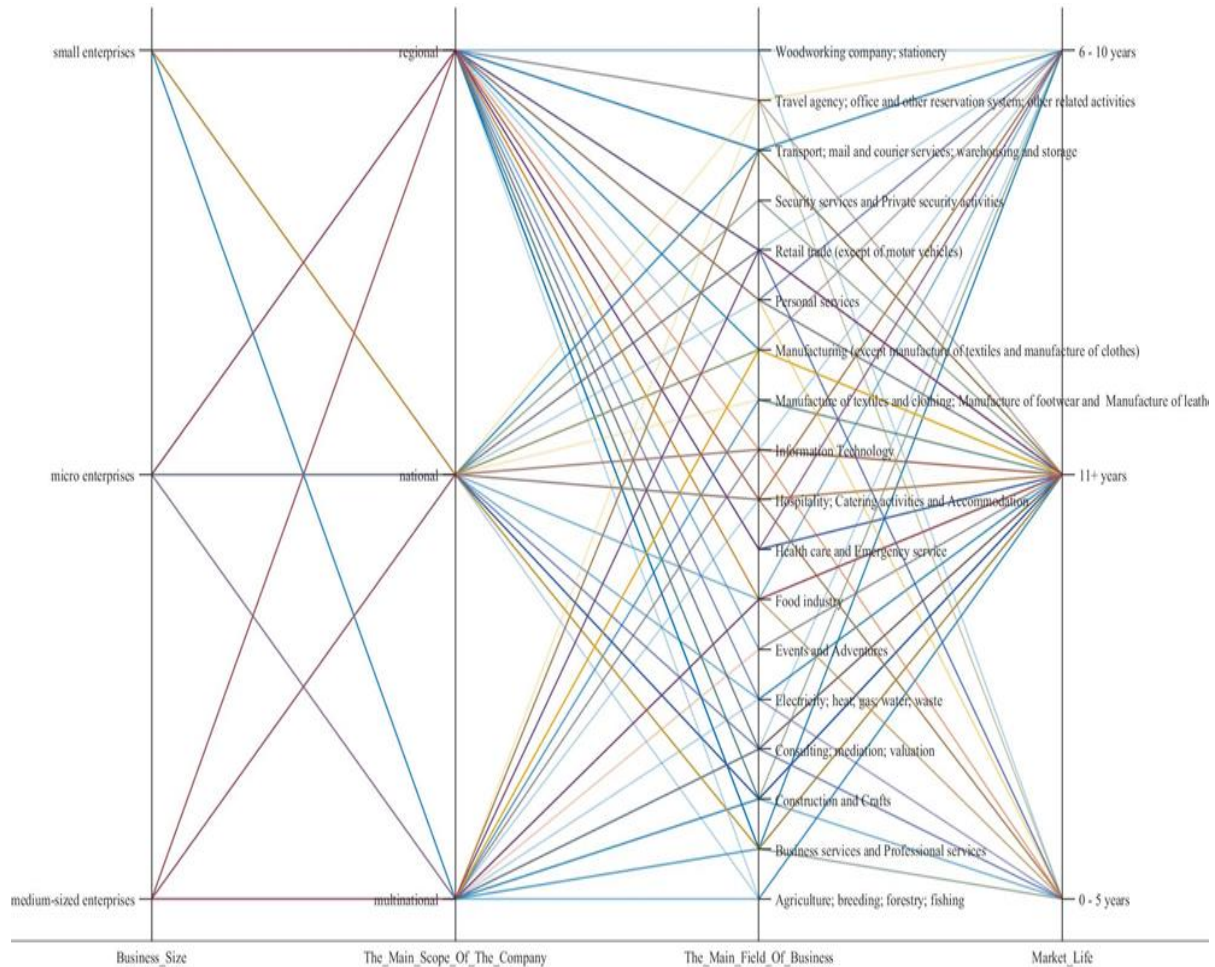
Source: Own (2023)

It is quite evident that, given the chosen colour scale of the legend, most respondents said that they had not experienced a change in their financial valuation. This is all helped by the fact that the pattern of responses on this issue is balanced across the regional area. In terms of size categorization, the largest contributors to this were small-sized businesses - operating internationally - who had not felt the change in any significant way. On the other hand, enterprises of the same size operating at the national level have already experienced a reduction in the pay of their employees. In the primary sector, we see a trend of no salary increase, i.e. salaries remained the same regardless of territorial scope. A temporary reduction in salary conditions was identified in the tourism sector, where this element was most present in enterprises operating at the national and international levels. Conversely, an increase in salary levels was identified in the health sector, where, even in the light of the pandemic, salary conditions increased dramatically. We also find confirmation that the probability of higher employee pays increases as the years of operation of the enterprise increase. With respect to the pandemic situation, it has been observed that, with few exceptions, the labour market has been significantly affected by this macroeconomic intervention.
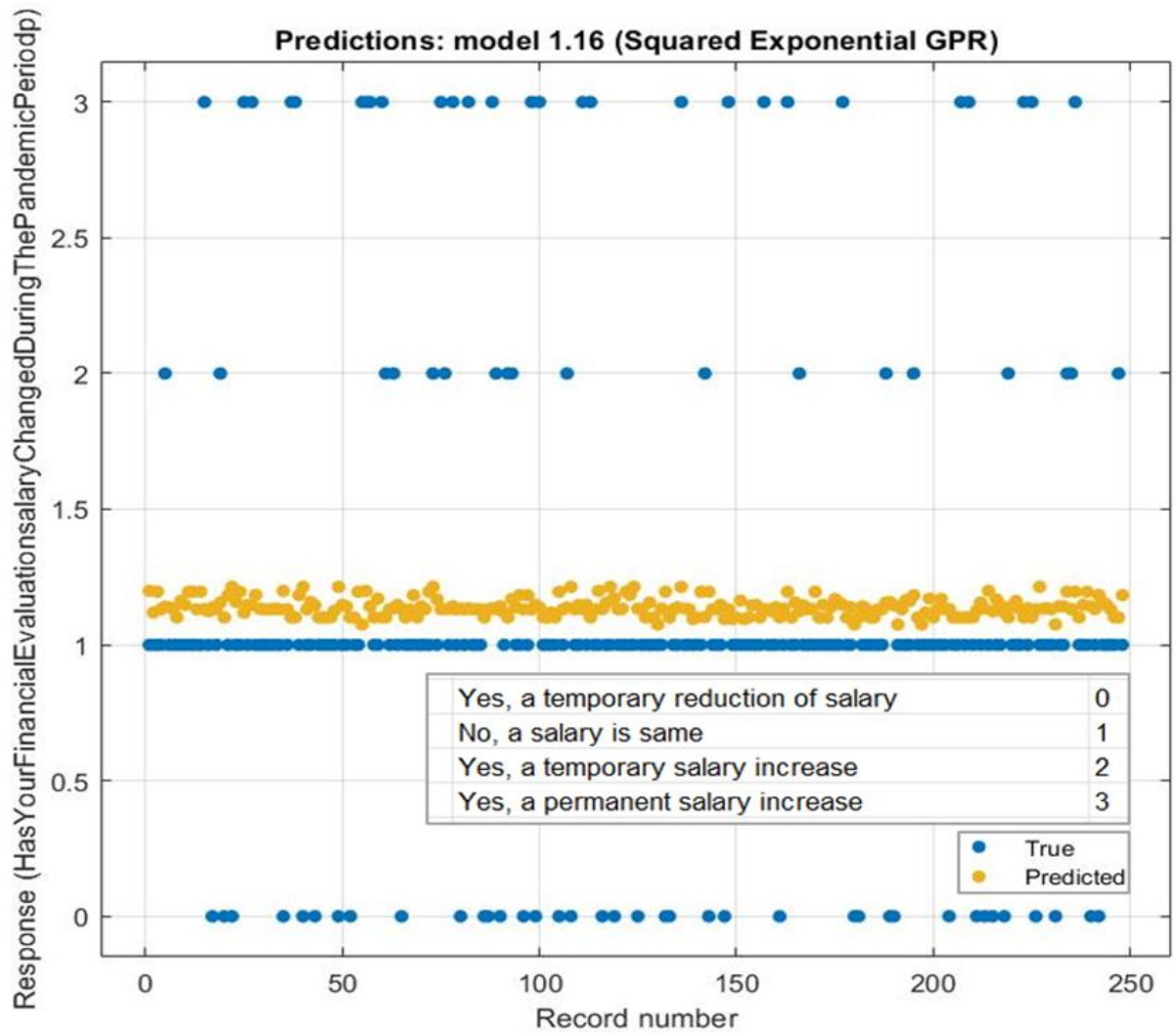
Graph 2: Quadratic SVM: Validation Confusion Matrix: pay change
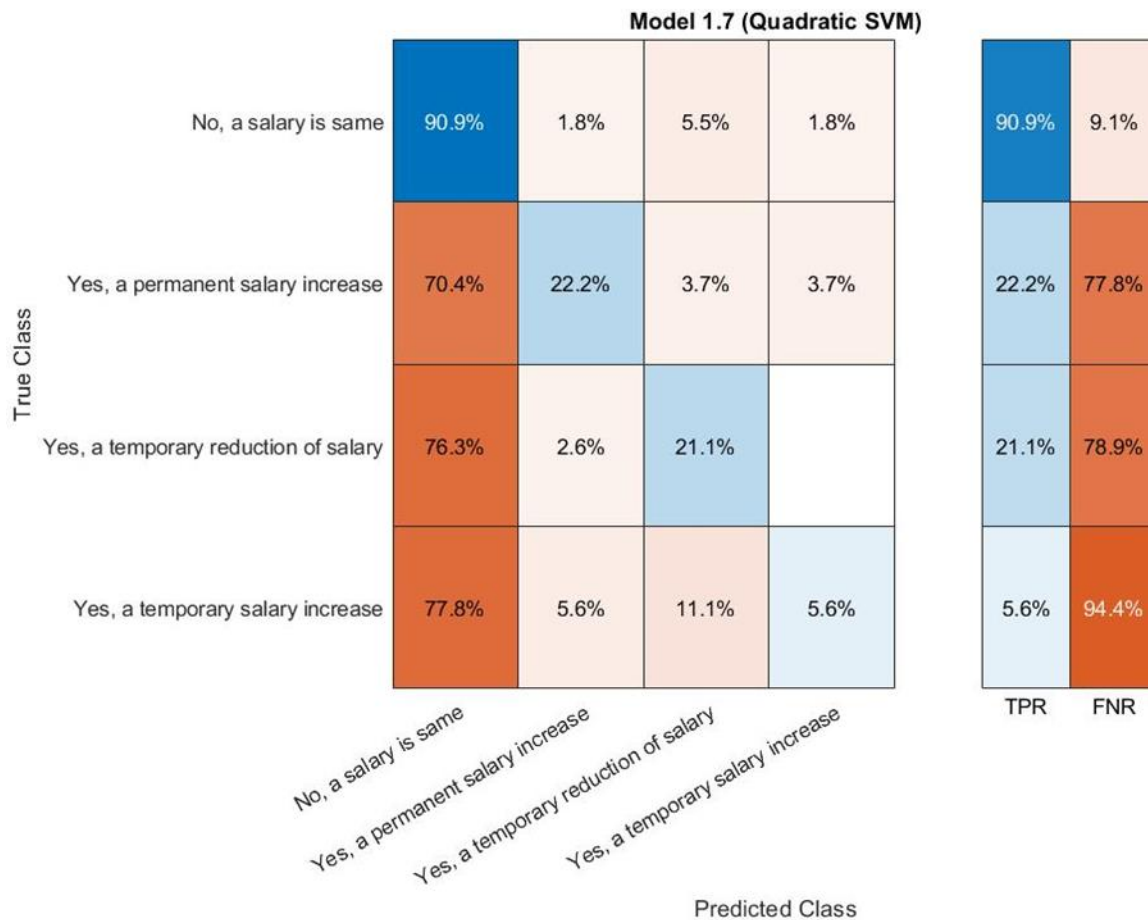
Source: Own (2023)

After testing the data using Classification Analysis, we found that Quadratic SVM (support vector machine) achieved the best results with a success rate of 65% (see colour matrix). Although this method achieved a relatively low success rate, it proved to be particularly significant for responses marked as "No salary". For this reason, we decided to switch to using a Gaussian process regression model. With this regression model, we achieved success rates more than 80%. This mathematical model allowed us to confirm the high incidence of responses in the "No salary" heading and further predict the data in this field with high accuracy. In this way, we achieved scientific understanding and documented the effective application of regression modelling to our specific data. Our findings suggest that this method could be useful for similar problems and further lead us to better understand and predict relevant outcomes. A graphical result from the GPR is shown below.

Graph 3: GPR - regression model

Predictions: model 1.16 (Squared Exponential GPR)

Yes, a temporary reduction of salary	0
No, a salary is same	1
Yes, a temporary salary increase	2
Yes, a permanent salary increase	3

- True
- Predicted

(Response (HasYourFinancialEvaluationsalaryChangedDuringThePandemicPeriodp) vs Record number)
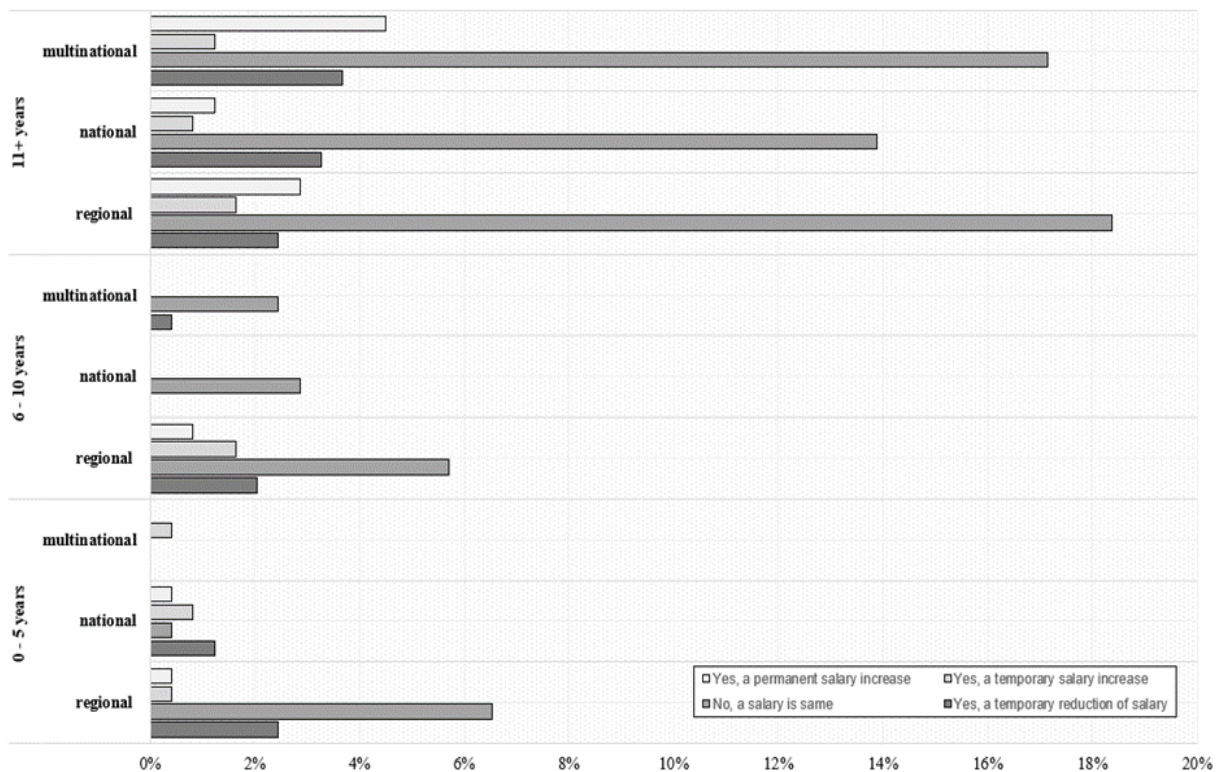
Source: Own (2023)

Here, we have demonstrated the significance of the MSP respondents' responses because their salary ratings did not change during the pandemic. Another result was that there was a gradual decrease in salary ratings, where a significant proportion of respondents are seen, followed by gradual to permanent increases in salaries from a total of 12% of responses. All sectors, such as healthcare, pharmaceuticals, the food industry, and digital technology, have experienced an increase in demand and economic growth, while other sectors, such as tourism, accommodation services, and culture, have been severely affected by restrictions and limitations on mobility. During a pandemic, businesses may have been forced to change their business models or adapt their services and products to new conditions, which could have affected their performance and profitability. Some businesses may have faced financial difficulties and cost-cutting, which could affect their ability to retain existing employees and provide salary increases. For better insight, the following chart shows this trend in the percentage of SME respondents.

The results of the analysis show that during the COVID-19 pandemic, there were significant changes in pay across sectors and depending on the length of time firms had been in the market and the scope of their operations. Within each group of enterprises (0-5 years, 6-10 years, and 11+ years of operation), four scenarios of salary changes were examined: temporary reduction, no change, temporary increase, and permanent increase, the graph can be seen in the following.

Graph 4: Dependence of the evolution of the wage function according to the temporal diversification of firms' functioning in the market and their location by market scope.

Source: Own (2023)

The total of the salary changes in each group of enterprises revealed that enterprises with a tenure of 11 years or more showed the highest overall share of salary changes (71.02%). This suggests that older and more established enterprises were better able to respond to the economic challenges of the pandemic and maintain higher salary levels. Furthermore, different rates of pay changes were observed between regional, national, and international enterprises. Regional enterprises showed more significant changes in pay than national and international enterprises. This may suggest that regional markets were more sensitive to the economic impact of the pandemic and had to respond more quickly to the new conditions. In terms of the different scenarios of salary changes, enterprises with a length of operation of 0-5 years showed the highest percentage of temporary salary reduction (3.67%) and temporary salary increase (1.63%). On the other hand, enterprises with a length of operation of 11 years or more showed the highest percentage of permanent salary increase (8.57%). Overall, the results of this analysis provide valuable insights into changes

in pay during the pandemic that can be useful for strategic employment and economic development decisions across industries and enterprise scales. These results can also serve as a starting point for further research and analysis in this area.

Discussion

In the discussion of this article, the authors focus on the analysis of the impact of the COVID-19 pandemic on the financial situation of employees of companies operating in micro, small, and medium-sized enterprises (SMEs) in the Czech Republic. A questionnaire survey was conducted during October and November 2021, with a total of 251 respondents - entrepreneurs and firms - participating. The structure of the respondents according to the size of the firms, the length of time on the market, and the focus of business activity were described in the tables below. Moreover, the analysis methodology, which involved statistical methods such as Quadratic SVM (support vector machine) and the Gaussian process regression model, was presented to assess the change in financial valuation among employees of firms during the pandemic. The research questions and hypotheses explored the loss of employment by industry differentiation (NACE) during the pandemic and the impact of the pandemic on the loss of employment by size categorization of SME firms. The Parallel Coordinate method was used to visualize the data and understand the interconnectedness of the responses between the study areas, clearly displaying the structure of the key research areas. Most respondents did not experience a change in their financial valuation, particularly true for small businesses operating internationally. However, the Quadratic SVM was only about 65% successful and not accurate enough in determining the "No salary" responses. Thus, the Gaussian process with regression model was used, achieving over 80% success and better modeling the respondents' answers on financial compensation. Kollmann, Dobrovič (2022) focus on key factors of organizational and management structures in forming a competitive strategy, greatly influenced by the financial compensation of employees. Our research thus confirms that competitiveness, particularly the growth of salaries, is conditionally dependent on the size and duration of businesses' operations.

Overall, the paper provides a comprehensive view of the situation of firms and employees in the aftermath of the COVID-19 pandemic. The results enhance understanding of the pandemic's impact on the financial valuation of employees in different types and sizes of firms. This finding is corroborated by Gregurec et al. (2021), who emphasized how the pandemic affected not only business models but also the financial health of employees, with most respondents not recording a change in financial valuation. This may reflect the adaptability of SMEs to the changes caused by the pandemic. The statistical methods and data visualizations discussed have contributed to clarifying and interpreting the obtained results. The paper can be considered a valuable contribution to understanding the economic impact of the pandemic on businesses and employees in the Czech Republic. It would be beneficial to discuss the possible limitations of the paper and its contribution to practice and further research. When analyzing the data, some independent variables, such

as regional coverage or time on the market, could be examined in more detail to identify specific trends and differences in different areas. Other variables that could affect the financial situation of firms, such as specific government measures or changes in consumer behavior, could also be included. The paper should also discuss these results' implications for practice. Identifying the enterprises most affected by the pandemic could provide valuable information for government institutions and economic support organizations. Designing measures and compensation programs targeting these vulnerable enterprise groups could enable them to better cope with the negative impacts of the pandemic. In terms of further research, it would be interesting to broaden the scope of the analysis and examine the pandemic's impact on the financial situation of employees in other sectors or regions. This could provide a more comprehensive view of the overall impact of the pandemic on the Czech Republic's economy and employment. Moreover, conducting longer-term monitoring and data comparison over several years would help understand long-term trends and possible structural changes in the economy.

Future research on the economic impacts of crises and pandemics could significantly contribute to better understanding how these unpredictable events affect businesses and workers and develop more effective strategies to address and limit their negative impacts. A future research direction could focus on identifying key factors influencing financial compensation, extending research to other variables that could influence employee financial compensation, such as the level of investment in technology and innovation, relationship with suppliers, competitive position in the market, etc. Analyzing these factors can provide a deeper understanding of how firms adapt to crises and how this affects wages and employment, as highlighted by Kawaguchi, Kodama & Tanaka (2021), who closely examine the short- and medium-term effects of anti-contagion and economic policies on small businesses.

Conclusion

The COVID-19 pandemic has had a significant impact on the salaries of employees in micro, small and medium-sized enterprises (SMEs) in the Czech Republic. Based on a questionnaire survey with 251 respondents, an analysis of the impact of the pandemic on the financial situation of these enterprises was carried out. The methodology of the analysis included statistical methods such as Quadratic SVM and Gaussian process regression model and used data visualization using Parallel Coordinate method. The results showed that most respondents (SMEs) did not experience a change in their financial valuation during the pandemic, with the most significant salary retention among small businesses with international operations. However, different sectors showed different responses to the pandemic. Healthcare, pharmaceuticals, the food industry, and digital technologies showed an increase in demand and economic growth, while tourism, accommodation services and culture were severely affected by restrictions and mobility limitations. This suggests that different sectors responded differently to the situation, which is an important lesson for further strategic planning and policy decisions. An

important finding was that businesses with a tenure of 11 years or more showed the largest share of salary changes during the pandemic, indicating that older and more established businesses were better able to respond to economic challenges and maintain higher salary levels. There was also a difference in the rate of salary changes between regional, national, and international businesses, with regional businesses showing more significant changes in pay than national and international ones. This suggests that regional markets were more sensitive to the economic impact of the pandemic and had to respond more quickly to the new conditions.

Four scenarios were examined for the analysis of salary changes: temporary reduction, no change, temporary increase, and permanent increase. Enterprises with a length of operation of 0-5 years showed the highest percentage of temporary salary reduction, while enterprises with a length of operation of 11 years or more showed the highest percentage of permanent increase. These findings have the potential to provide deeper insights into salary trends during the pandemic and enable strategic hiring decisions. The research also looked at machine learning methods for predicting "No salary" responses. While the Quadratic SVM achieved a success rate of around 65%, the Gaussian process regression model achieved a success rate of over 80% and was more effective in predicting said responses. This confirmed the effectiveness of regression modelling for specific data and suggested that this method could be useful for similar problems in the future. The findings of the analysis are important scientific knowledge that can serve as a basis for further research and strategic decisions in the field of employment and economic development. Identifying the sectors and enterprises that have been most affected by the pandemic can help government institutions and organizations in designing measures and compensation programs to provide the necessary support to vulnerable groups of enterprises. Extending the analysis to other variables and tracking long-term trends could then contribute to a better understanding of the overall economic impact of the pandemic and help develop more effective strategies for future emergencies.

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References

AHMAD, N., HASAN, M.G., BARBHUIYA, R.K., 2021. Identification and prioritization of strategies to tackle COVID-19 outbreak: A group-BWM based MCDM approach. *Applied Soft Computing,* **111**.

BAHADUR, D., BAUMANN, S.L., 2021. Searching for significance during a pandemic: A muslim perspective. *Nursing Science Quarterly*, **34**(4), 448-453.

BAI, C., QUAYSON, M., SARKIS, J., 2021. COVID-19 pandemic digitization lessons for sustainable

development of micro-and small- enterprises. *Sustainable Production and Consumption*, **27**, 1989-2001.

BENCSIK, A., JUHÁSZ, T., MURA, L., 2019. Consequences of workplace stress – Company case study. *Littera Scripta*, **12**(2), 1-17.

BOWLES, S., CARLIN, W., 2020. The coming battle for the COVID-19 narrative [online] 2020. [accessed: 2021-10-27] Available from: https://voxeu.org/article/coming-battle-covid-19narrative

CRISTIANINI, N., SHAWE-TAYLOR, J., 2000. *An introduction to support vector machines and other kernel-based learning methods*. Cambridge: Cambridge University Press.

DOMANIŽOVÁ, P., MILICHOVSKÝ, F., KUBA, K., 2020. Business Models, Strategy and Innovation in the New World of Digitization. *Littera Scripta*, **13**(1), 17-31.

EUROPEAN COMMISSION, 2020. Temporary Framework for State aid measures to support the economy in the current COVID-19 outbreak. *Official Journal of the European Union*, **63.**

GREGUREC, I., TOMIČIĆ FURJAN, M., TOMIČIĆ-PUPEK, K., 2021. The Impact of COVID-19 on Sustainable Business Models in SMEs. *Sustainability*, **13**(3).

HAREL, R., 2021. The Impact of COVID-19 on Small Businesses' Performance and Innovation. *Global Business Review.*

HORÁK, J., MLSOVÁ, K., MACHOVÁ, V., 2021. Impact of the coronavirus pandemic on the tertiary sector. *Littera Scripta*, **14**(1), 28-39

HORÁK, J., ŠULEŘ, P., KOLLMANN, J., MAREČEK, J., 2020. Credit absorption capacity of businesses in the construction sector of the Czech Republic - Analysis based on the difference in values of EVA Entity and EVA Equity. *Sustainability*, **12**(21), 1-16.

HRMO, R., KRIŠTOFIAKOVÁ, L., BARNOVÁ, S., 2020. Internal system of quality management in the context of ensuring the quality of preparation of managers for future practice. *Littera Scripta*, **13**(2), 70-81.

ISSENOVA, A., 2021. The central Asian economy during the pandemic: an analysis of small and medium business support strategies. *Central Asia and the Caucasus*, **22**(2), 58-67.

KAWAGUCHI, K., KODAMA, N., TANAKA, M., 2021. Small business under the COVID-19 crisis: Expected short- and medium-run effects of anti-contagion and economic policies. *Journal of the Japanese and International Economies*, **61**.

KMENCOVÁ, I., STUCHLÝ, J., POLANECKÝ, L., ŠUTA, M., 2019. Analysing structure of employed and unemployed population of Czech Republic as part of human capital on labour market. *Littera Scripta*, **12**(1), 1-21.

KOLLMANN, J., DOBROVIČ, J., 2022. Key factors of organizational and management structures in the formation of competitive strategy. *Journal of International Studies*. **15**(3), 130-144.

KONEČNÝ, M., RUSCHAK M., KOSTIUK, Y. 2023. *Online Reputation of Public Charging Stations Operators: An Empirical Study on the Czech Market*. In: Doucek P., Sonntag M., Nedomova L. *IDIMT-2023 New Challenges for ICT and Management*. Vol. 31. Linz: Trauner Verlag Universitat, 2023. 337-345, 411 pp.. ISBN 978-3-99151-176-2.

KRAUS, S., CLAUSS, T., BREIER, M., GAST, J., ZARDINI, A., TIBERIUS, V., 2020. The economics of COVID-19: initial empirical evidence on how family firms in five European countries cope with the corona crisis. I*nternational Journal of Entrepreneurial Behavior & Research*, **26**(5), 1067-1092.

KUČERA, J., SMOLKOVÁ, M., 2022. Online communication within a company: Case study of small company. Littera Scripta, **15**(1), 34-56.

LEE, Y., TAO, W., LI, J.Q., SUN, R., 2020. Enhancing employees' knowledge sharing through diversity-oriented leadership and strategic internal communication during the COVID-19 outbreak. *Journal of Knowledge Management*, **25**(6), 1526-1549.

MACROHON, J.J.E., JENG, J.H., 2021. A Real-Time COVID-19 Data visualization and information repository in the Philippines. In: 2021 9th International Conference on Information and Education Technology (ICIET), **9**, 443-447.

MERAMVELIOTAKIS, G., MANIOUDIS, M., 2021. Sustainable development, COVID-19 and small business in Greece: Small is not beautiful. *Administrative Sciences*, **11**(3).

MITCHELL, T.M., 1997. *Machine learning*. Boston: McGraw-Hill, **15**, 414.

MULDOON, O.T., LIU, J.H., MCHUGH, C., 2021. The political psychology of COVID-19. *Political Psychology*, **42**(5), 715-728.

Office for the Protection of Competition / Úřad pro ochranu hospodářské soutěže, 2021. Pandemie covid-19 a pravidla veřejné podpory [online] 2021. [accessed: 2021-10-27] Available from: https://www.uohs.cz/cs/verejna-podpora/pandemie-covid-19-a-pravidla-verejne-podpory.html

PARK, J.H., KIM, B., 2021. Associations of small business closure and reduced urban mobility with mental health problems in COVID-19 pandemic: A national representative sample study. *Journal of Urban Health*, **98**(1), 13-26.

RASMUSSEN, E. C., WILLIAMS, C. 2006. *Gaussian Processes for Machine Learning, Massachusetts Institute of Technology*. ISBN 026218253X.

RODRIGUES, M., SILVA, R., FRANCO, M., 2021. Teaching and researching in the context of COVID-19: An empirical study in higher education. *Sustainability*, **13**(16).

SAGAPOVA, N., DUŠEK, R., PÁRTLOVÁ, P. 2022. Marketing communication and reputation building of leading European oil and gas companies on instagram. Energies. Basel, Switzerland: MDPI, 2022, Vol. 15/2022, No. 22) **2**(14), 8683 s. ISSN 1996-1073.

SINČIĆ ĆORIĆ, D., ŠPOLJARIĆ, A., 2021. The origins of internal communication and employer branding in marketing theories. *Communication Management Review*, **06**(01), 30-45.

THILAGAVATHI, S., NIVETHITHA, K.S., PREETI, P., VIKRAM, D.T., 2021. IoT based smart retail system with social distancing for Covid19 outbreak. *Journal of Physics: Conference Series*, **1917**(1).

TRICAUD S., NANCE K., SAADÉ P., 2011. Visualizing network activity using parallel coordinates. *44th Hawaii International Conference on System Sciences.* doi: 10.1109/HICSS.2011.488

VOCHOZKA, M., HORÁK, J., KRULICKÝ, T. 2020. Innovations in management forecast: Time development of stock prices with neural networks. *Marketing and Management of Innovations.* Sumy, Ukrajina: Sumy State University, 2020, issue: 2, 324-339.

ŽÁRSKÁ, V., SOCHUĽÁKOVÁ, J., 2022. Impact of the Covid-19 pandemic on the operation of small and medium-sized enterprises. *Littera Scripta*, **15**(2), 45-57.

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