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The Impact of the Energy Crisis and Crisis Related to the COVID-19 Pandemic on the Income from the Work of Employees in Selected Sectors of the Czech Economy

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Abstract: The paper deals with the development of the average gross monthly work income from the middle of the first decade of the 21st century to the present in selected sectors of the Czech economy. Both the development of the nominal work income and the development of the real work income are examined, in both cases predictions for the period of the next three years are constructed, too. Exponential smoothing and the autoregressive model are used in the modeling of time series of average incomes from work and for the construction of predictions for the following period. The main objective of this paper is to show the effect of the energy crisis and crisis related to the COVID-19 pandemic on the development of average income from work and to compare this effect with the effect of the global economic crisis, the beginning of which can be dated to the fall of 2008.

Keywords: energy crisis; COVID-19 crisis; income from work; sectors of the Czech economy; exponential smoothing; autoregressive model

JEL Classification: J31; E24; C22

1. Introduction

The inequality of earnings between sectors as the impact of various crises or Covid-19 lockdowns on the earnings of employees is dealt with by a number of researches. The severity of wage cuts in the public sector in response to the economic crisis and subsequent recovery is the subject of research in a study by Vilerts (2018). The study looks at the salary and wage gap in the public and private sectors and examines how this gap has changed based on consolidation. The research found that the mentioned difference is slightly in favour of the public sector, however, when taking into account differences in individual characteristics and sample effects, it is already in favour of the private sector. A study by Di Quirico (2010) find that the global economic crisis in Italy also affected the system, which deteriorated after twenty years of political instability and economic decline. When the country was hit by the global economic crisis, Berlusconi's government faced it in two main ways: supporting banks and big companies and cutting public spending. Western & Rosenfeld (2011) found that between 1973 and 2007, hourly wage inequality increased by more than 40 percent. The authors attribute the decomposition to rising inequality associated with a decline in the weight of the trade union wage distribution. Taking into account the effect of unions on wages shows that the decline in organized labour explains a fifth to a third of the rise in

inequality. A paper by Estupinan and Sharma (2020) estimates job losses and worker wages due to lockdown measures taken by the Indian government to combat the spread of COVID-19. The authors calculated that 104 million workers were at risk of losing their jobs in the first wave of lockdowns, while 69.4 million workers were at risk in the second wave. The authors note that informally employed workers in the unorganized sector suffered a wage loss of Rs 635.53 billion, which is almost equivalent to the union's annual budget allocated to the MGNERGA Employment Guarantee Scheme in 2020–2021. The global energy crisis of 2021–2022 is the subject of a research paper by Ozili and Ozen (2023). As part of the results of the study, it is stated that the energy crisis between 2021 and 2022 was caused by a number of factors, including the global agitation against carbon emissions, the lack of fossil fuel reserves and restrictions on oil production during the COVID-19 pandemic, and the war conflict between Ukraine and Russia. The authors point to rising gasoline prices in Asia, Europe, Africa, the Middle East and the America.

The main objective of this paper is to monitor the development of nominal and real average monthly income from work in the period 2005–2022, including predictions of this development for the period 2023–2025 and to compare the impact of the global financial and economic crisis that began in the fall of 2008 and the recent crises associated with the COVID-19 pandemic followed by the energy crisis associated with the war conflict in Ukraine to the level of labour income in selected sectors of the Czech economy. In the time series analysis, exponential smoothing and arima integrated mixed model were used in the time series analysis.

2. Methodology

The data for this research includes employees in both business and non-business spheres. Wage belongs to the employee for work performed in the private (business) sphere, salary in the budgetary (state, public, non-business) sphere. From the point of view of the analyzed data, the term income from work includes both wages in the business sphere and salaries in the non-business sphere. The period from 2005 to 2022 is the subject of research, the statistical unit is the employee. For the analysis, on the one hand, two sectors of the Czech economy are selected, in which employees consistently achieve the highest earnings, namely the Sector of Information and Communication and Sector of Financial and Insurance Activities, and on the other hand, two sectors in which employees consistently achieve the lowest earnings, i.e. Sector of Accommodation and Food Service Activities and Sector of Administrative and Support Service Activities. Furthermore, two problem sectors of the present time are subjected to analysis, in one of them the employees are currently on strike alert (Sector of Education) and in the other of them there is a threat of reduction of patient care (Sector of Human Health and Social Work Activities). Two basic sectors of the Czech economy are added, i.e. Sector of Industry and Sector of Construction and one often discussed sector from the point of view of subsidy policy, specifically Sector of Agriculture, Forestry and Fishing. The data comes from the official website of the Czech Statistical Office.

Exponential smoothing is suitable for obtaining a short-term forecast of a time series trend. This is a technique that develops the idea of time series smoothing using moving averages. This method uses all previous values of the time series, while the weight of these

observations falls towards the past according to the exponential function $w_t = (1 - \alpha)\cdot\alpha^{n-t}$, where t is a time variable, n is the length of the time series, and α is a smoothing constant taking on values from the interval (0; 1).

Integrated ARIMA mixed model represents a non-stationary integrated mixed ARIMA(p,d,q) model, where "I" means integration. ARIMA models allow the description of processes in which not only changes in level occur, but these changes may have a non-systematic random character. This model stochastically models a trend component in addition to random fluctuations. The construction of ARIMA models does not require stationarity of the analyzed time series.

Figures 1–9 show the construction of time series models of nominal average gross labour earnings by selected sectors in the period 2005–2022, including predictions for the period 2022–2025, using Holt's linear exponential smoothing and integrated mixed ARIMA model, which were evaluated as the best fit based on interpolation criteria. The sample residual autocorrelation function, the sample residual partial autocorrelation function, the Durbin-Watson statistic and extrapolation criteria, such as Theil's mismatch coefficient, were used to verify the suitability of the models.

Time series of nominal average gross monthly labour income from work were converted to time series of real average gross monthly labour income from work with a base in 2005, including predictions for the period 2023–2025, using chain consumer price indices representing the annual rate of inflation. Predictions of chain indices of consumer prices for the period 2023–2025 were also constructed using an autoregressive model, see Figure 10.

Figures 1–10 show only the investigated time series models and give an idea about the accuracy of these models and the predictions constructed based on these models. However, this is only a tool, not the result of the analysis. For this reason, a more detailed interpretation of these figures loses its meaning.

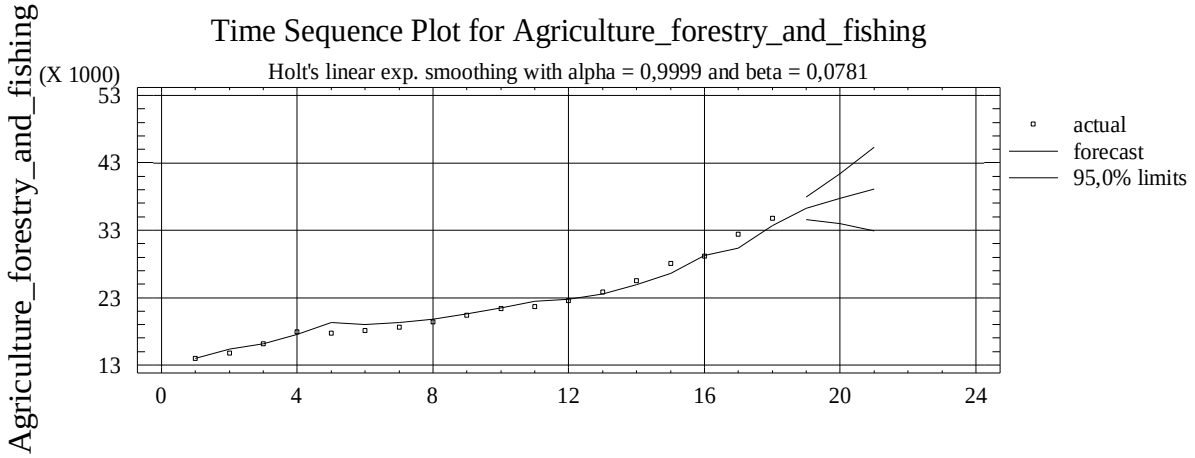

Figure 1. Holt's linear exponential smoothing of the time series of nominal average gross monthly income from work in the period 2005–2022, including predictions for the period 2023–2025 for the Sector of Agriculture, Forestry and Fishing

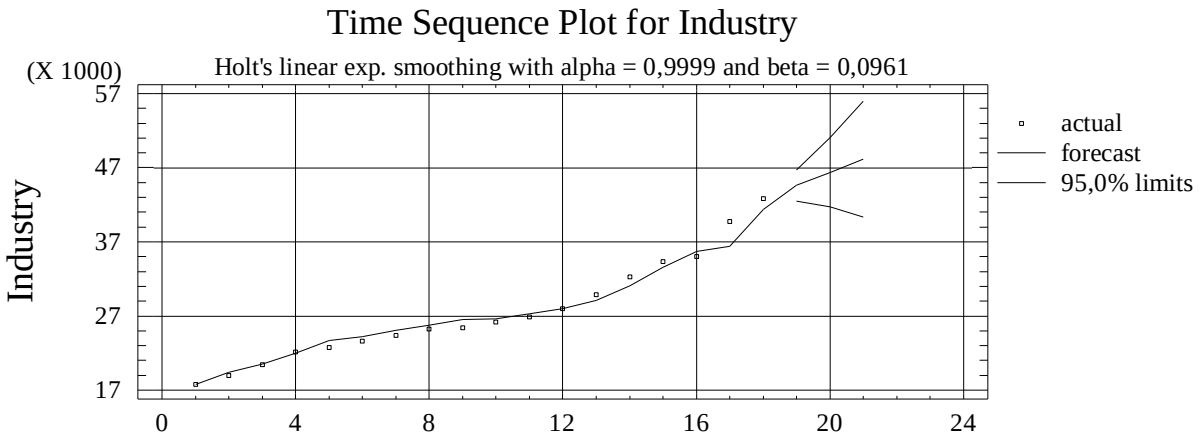

Figure 2. Holt's linear exponential smoothing of the time series of nominal average gross monthly income from work in the period 2005–2022, including predictions for the period 2023–2025 for the Sector of Industry

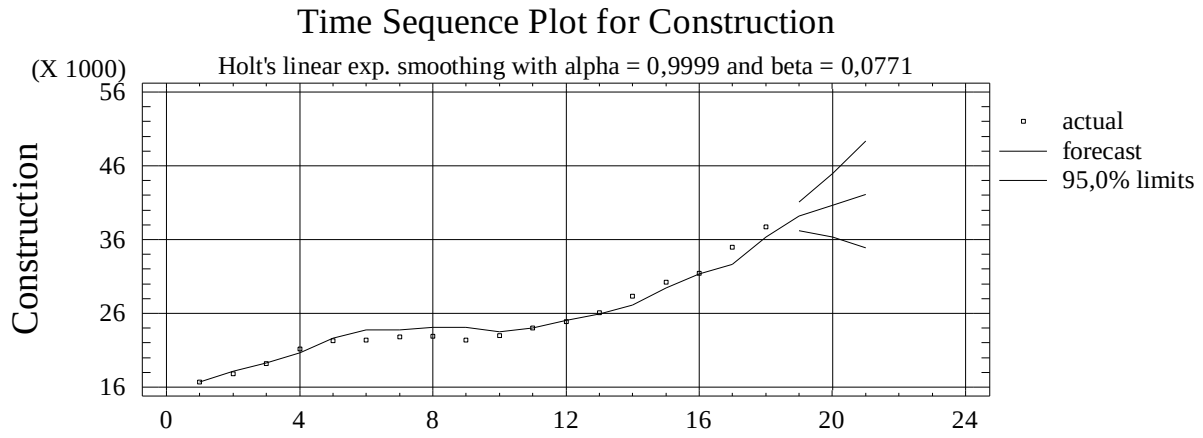

Figure 3. Holt's linear exponential smoothing of the time series of nominal average gross monthly income from work in the period 2005–2022, including predictions for the period 2023–2025 for the Sector of Construction

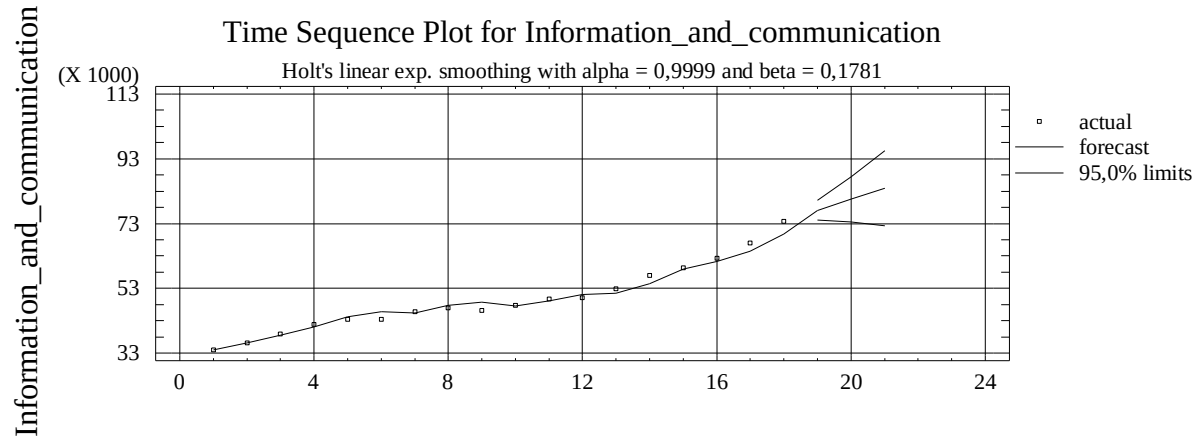

Figure 4. Holt's linear exponential smoothing of the time series of nominal average gross monthly income from work in the period 2005–2022, including predictions for the period 2023–2025 for the Sector of Information and Communication

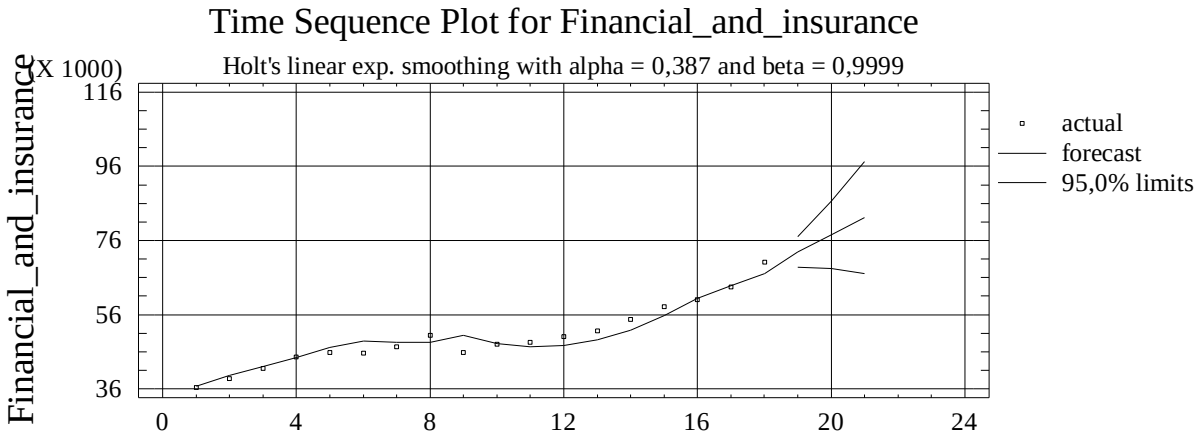

Figure 5. Holt's linear exponential smoothing of the time series of nominal average gross monthly income from work in the period 2005–2022, including predictions for the period 2023–2025 for the Sector of Financial and Insurance Acrivities

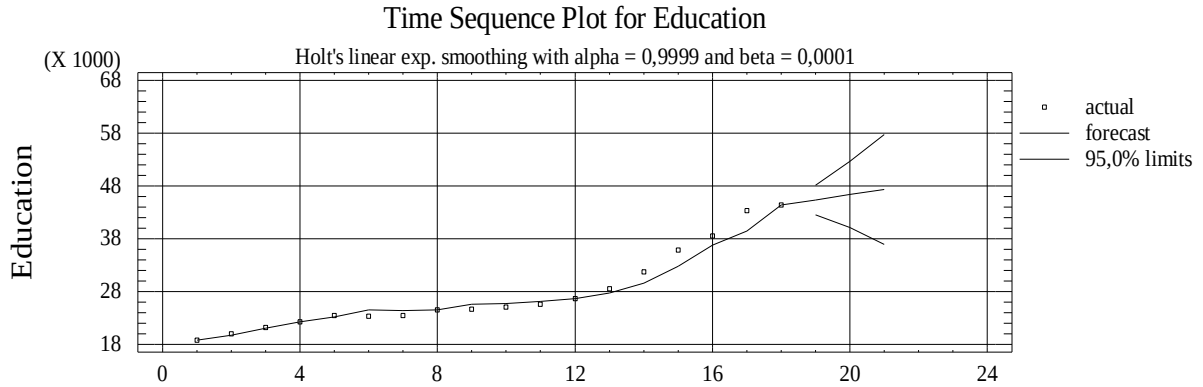

Figure 6. Holt's linear exponential smoothing of the time series of nominal average gross monthly income from work in the period 2005–2022, including predictions for the period 2023–2025 for the Sector of Education

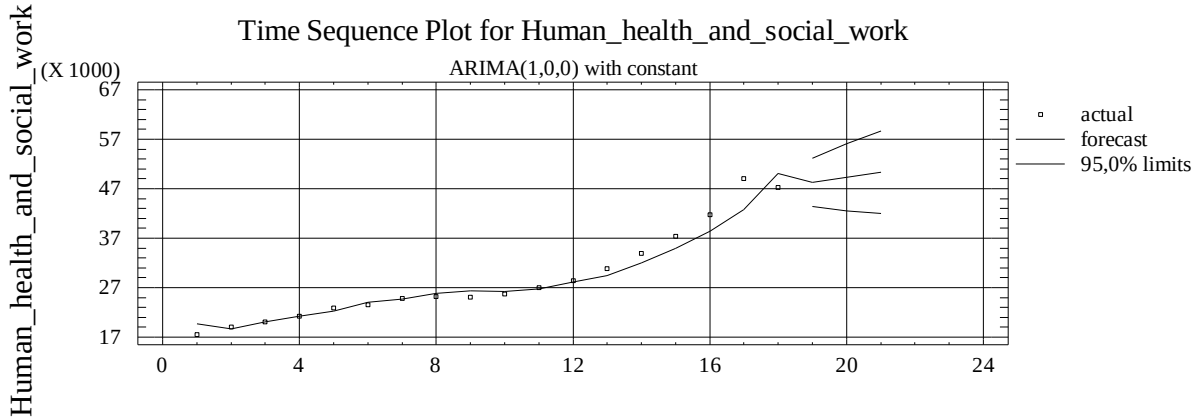

Figure 7. Holt's linear exponential smoothing of the time series of nominal average gross monthly income from work in the period 2005–2022, including predictions for the period 2023–2025 for the Sector of Human Health and Social Work Activities

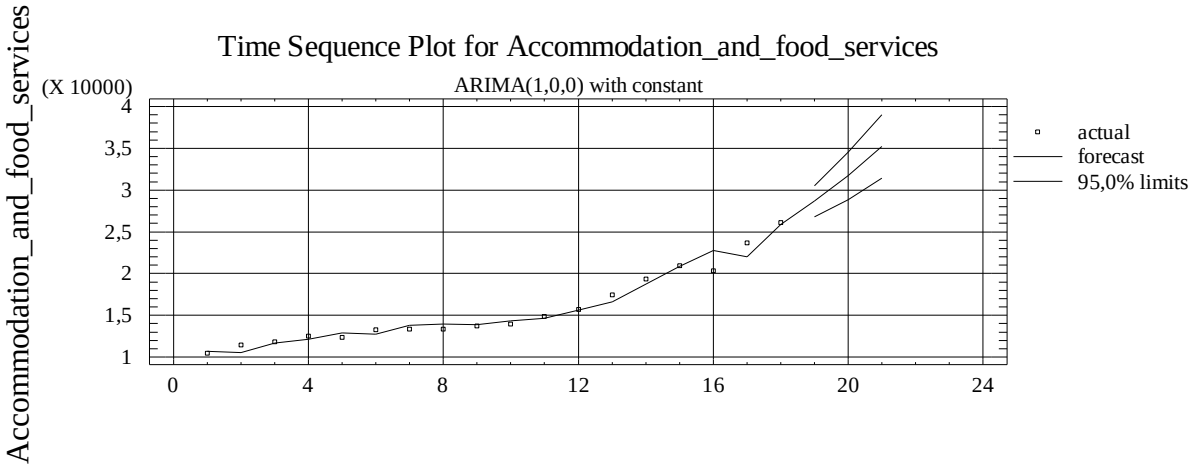

Figure 8. Holt's linear exponential smoothing of the time series of nominal average gross monthly income from work in the period 2005–2022, including predictions for the period 2023–2025 for the Sector of Accommodation and Food Services

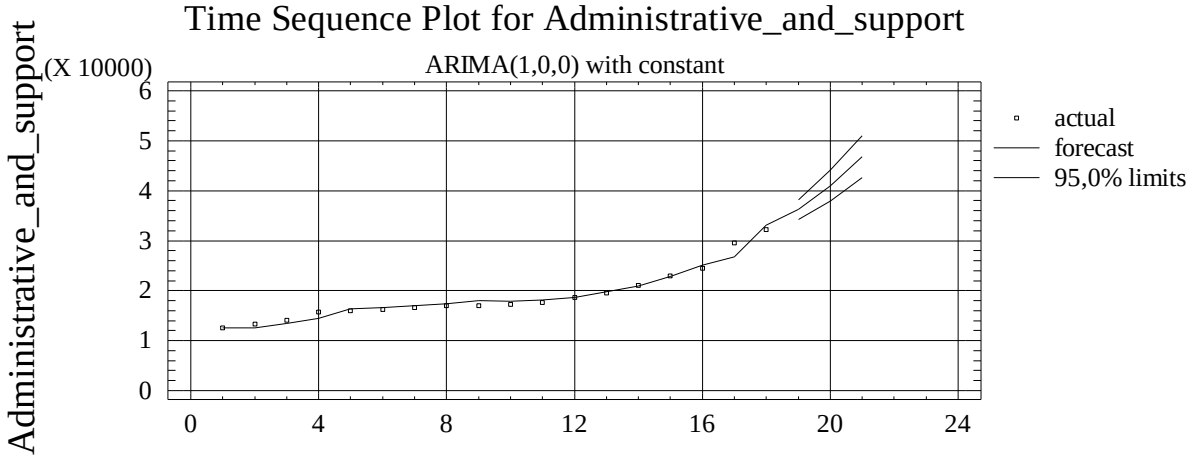

Figure 9. Model ARIMA of the time series of nominal average gross monthly income from work in the period 2005–2022, including predictions for the period 2023–2025 for the Sector of Administrative and Support Service Activities

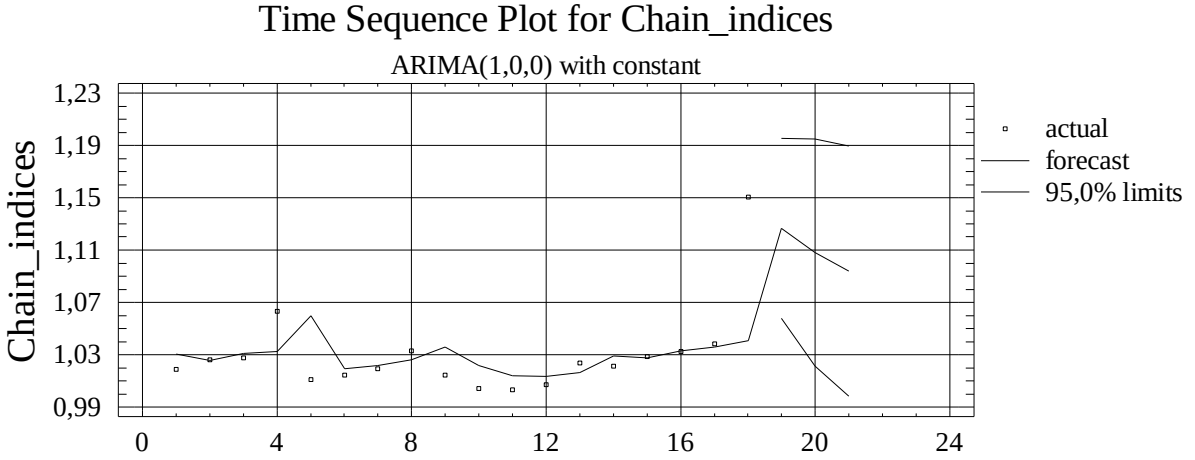

Figure 10. Model ARIMA of the time series of chain indices of consumer prices in the period 2005–2022, including predictions for the period 2023–2025 for the Czech Republic

3. Results

Figure 11 represents the development of the nominal average gross monthly income from work in the period 2005–2022, including predictions of this development for the period 2023–2025 by sectors, and Figure 12 represents the development of the real average gross monthly income from work in the period 2005–2022, including predictions of this developments for the period 2023–2025 by sectors.

Figure 13 shows the development of the growth rate of nominal average gross monthly income from work in the period 2005–2022, including predictions of this development for the period 2023–2025 by sectors, and Figure 14 shows the development of the growth rate of real average gross monthly income from work in the period 2005–2022 including predictions of this development for the period 2023–2025 by sectors.

Figures 11 and 13 show the steady growth of nominal average gross monthly earnings over the period of the crisis related to the COVID-19 pandemic and the subsequent energy crisis in all analyzed sectors, except for the Sector Accommodation and Food Service Activities, which was affected by the crisis related to the COVID-19 pandemic the most. Here we record a drop in nominal average gross monthly earnings by 3.21% in 2020, when the COVID-19 pandemic hit the Czech Republic in full.

Figures 12 and 14 show that the crisis related to the COVID-19 pandemic has negatively affected the real average gross monthly income for work, again mainly in the Sector of Accommodation and Food Service Activities, where we record a decrease of 6.24% in 2020. A slight decrease of this income in 2020 is also evident in the case of the Sector of Industry (by 1.18%) and the Sector of Financial and Insurance Activities (by only 0.7%). In 2021, the real average gross monthly income for work is already growing in all analyzed industries.

A much more serious situation in terms of real average gross monthly income for work occurs in connection with the energy crisis in 2022, when this income decreases in all analyzed sectors. Within the framework of the order from the worst situation, the highest decrease in the real average gross monthly income for work is recorded in the Sector of Human Health and Social Work Activities (even by 16.31%), then in the Sector of Education (by 11.08%), Sector of Agriculture, Forestry and Fishing (by 6.56%), Sector of Construction (by 6.41%), Sector of Industry (by 6.34%), Sector of Administrative and Support Service Activities (by 5.33%), Sector of Information and Communication (by 4.45%), Sector of Accommodation and Food Service Activities (by 4.16%) and Sector of Financial and Insurance Activities, which was hit the least out of all analyzed sectors, where the real average gross monthly income for work decreased by 3.78%, see Figures 12 and 14.

It can be therefore stated that the crisis related to the COVID-19 pandemic had a significant negative impact on real labour income in the Sector of Accommodation and Food Service Activities. The negative impact of the energy crisis on the real average gross monthly income from work was much more pronounced than the impact of the global economic crisis that began in the fall of 2008.

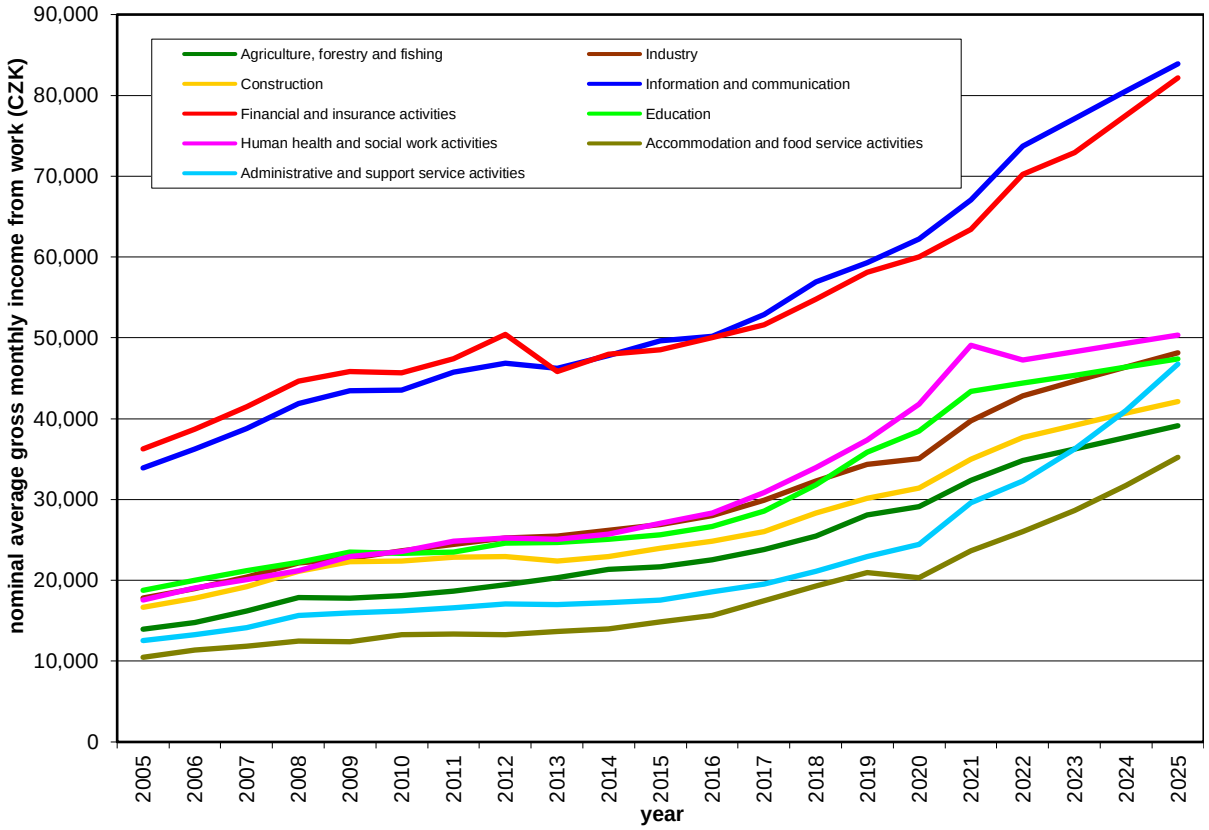

Figure 11. Development of the nominal average gross monthly income from work (CZK) in the period 2005–2022, including predictions for the period 2023–2025 according to selected sectors

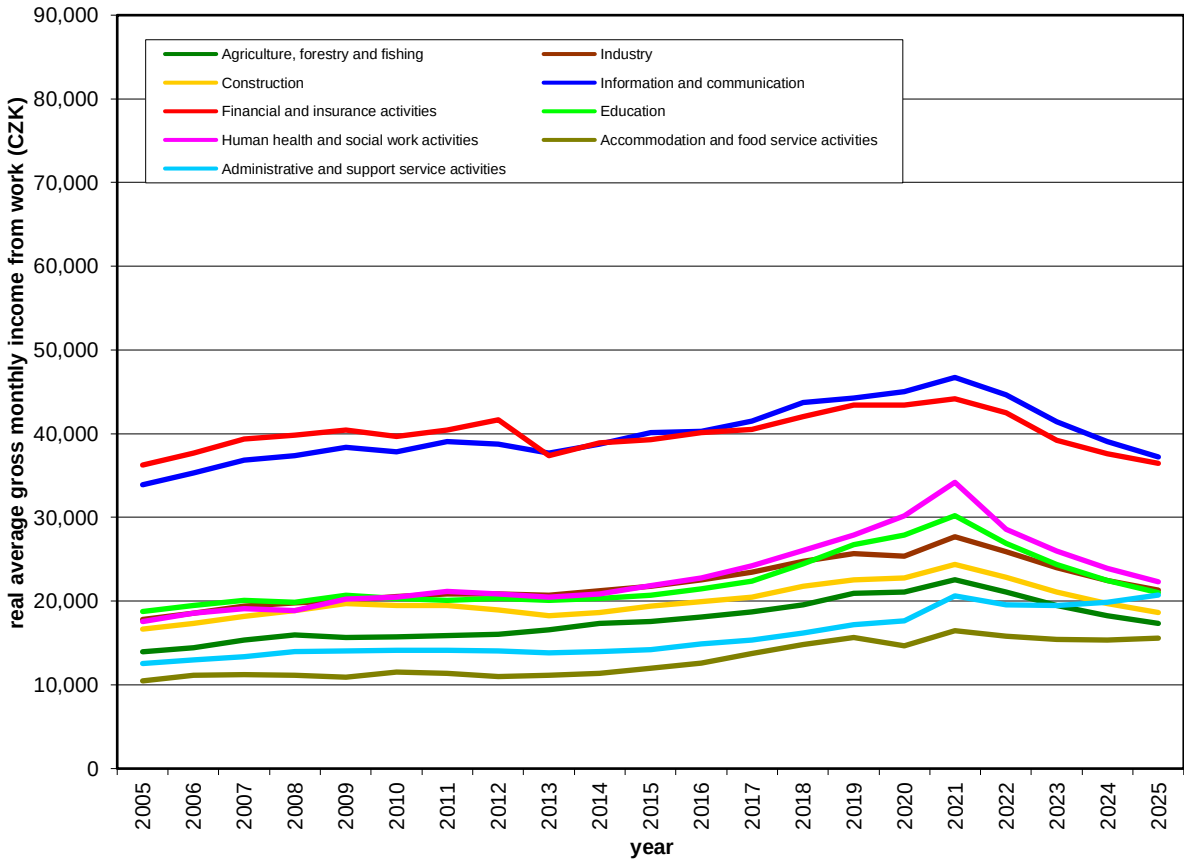

Figure 12. Development of the real average gross monthly income from work (CZK) in the period 2005–2022, including predictions for the period 2023–2025 according to selected sectors

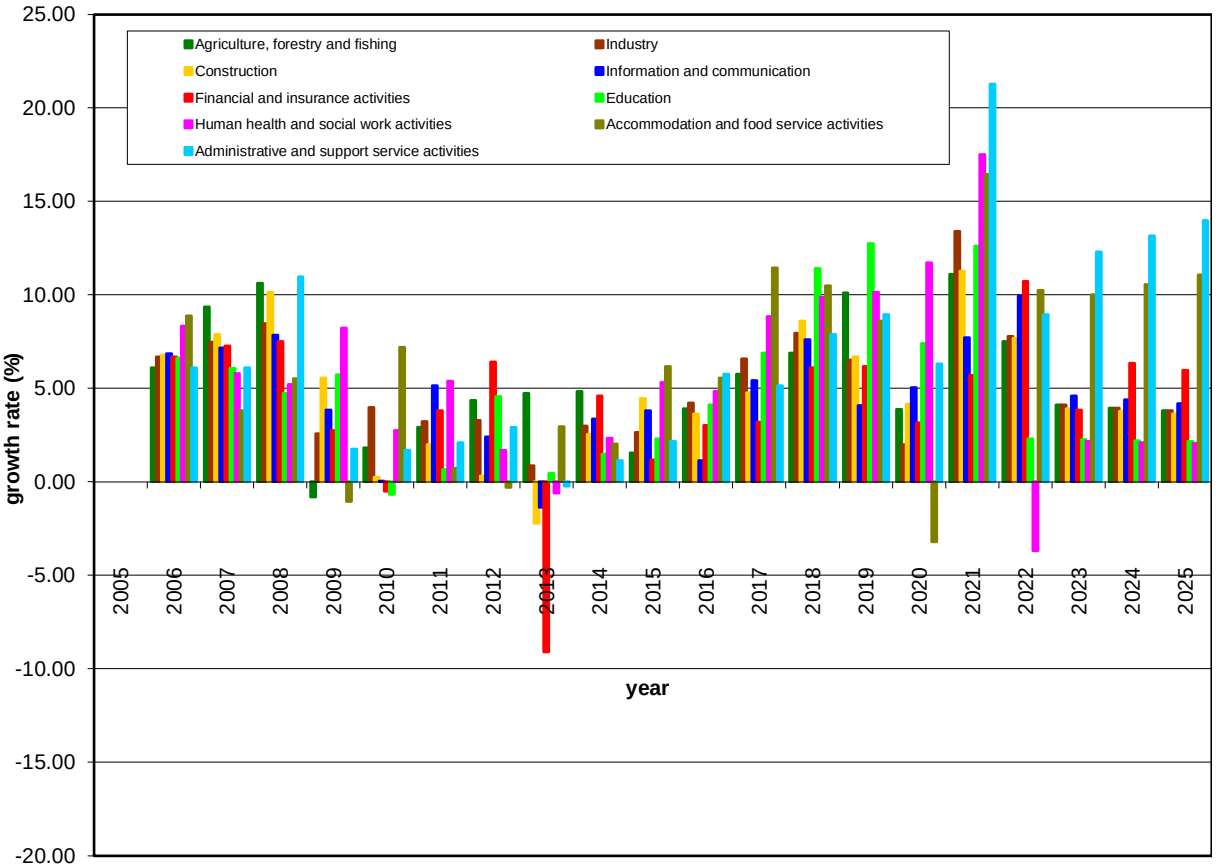

Figure 13. Development of the growth rate (%) of nominal average gross monthly income from work in the period 2005–2022, including predictions for the period 2023–2025 according to selected sectors

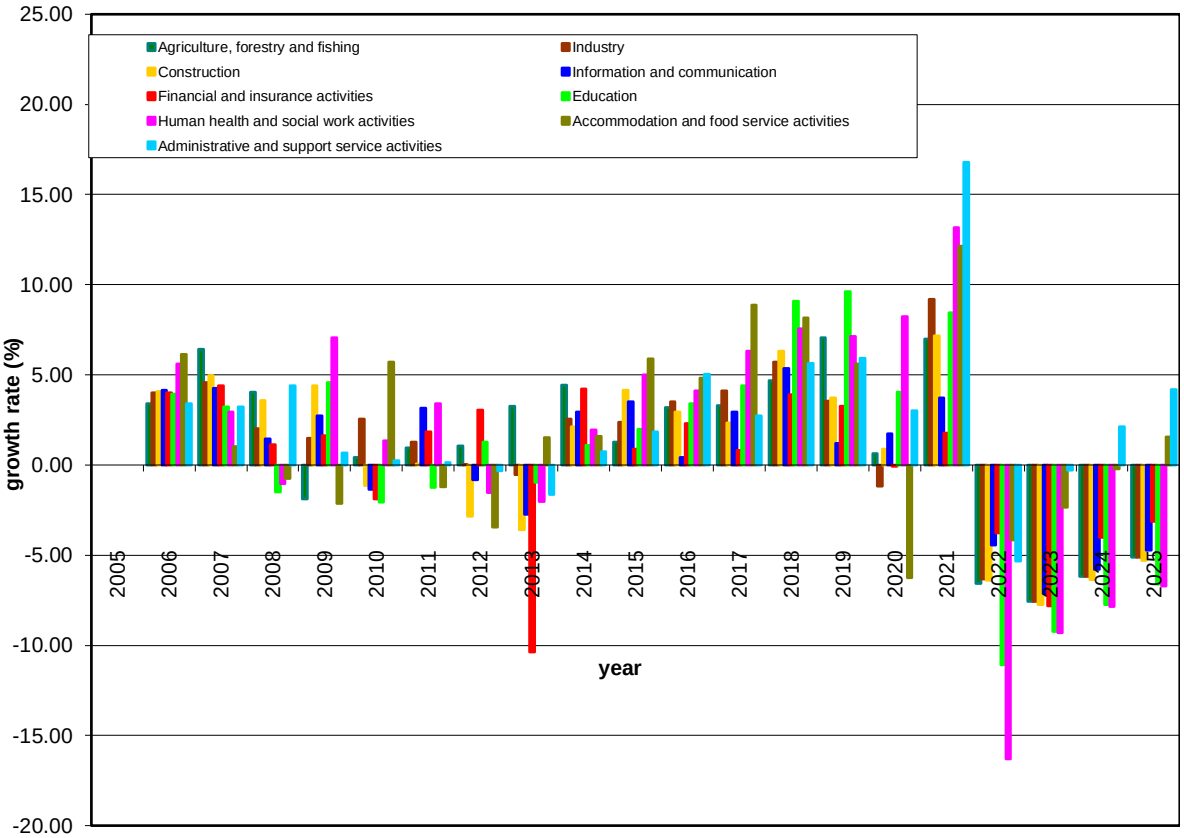

Figure 14. Development of the growth rate (%) of real average gross monthly income from work in the period 2005–2022, including predictions for the period 2023–2025 according to selected sectors

4. Discussion

The limitation of labour earnings is similarly captured by a study by Estupinan, Gupta, Sharma, and Birla (2020) which reveals an initial labour supply shock related to the lockdown measures taken by the Indian government to limit the spread of COVID-19. The author collective estimates the monthly loss of wages and incomes of workers at Rs. 864.5 billion in 2017–2018 prices. The heterogeneous effects of the Canadian economic shutdown due to the COVID-19 pandemic across earnings distributions are addressed in research by Koebel and Pohler (2020). Analyses of the labour market have revealed that workers at the bottom of the earnings distribution experienced a much greater reduction in hours worked than workers at the top of the earnings distribution, which is associated with a substantial reduction in the earnings of low-income workers. The effects of social distancing associated with COVID-19 have resulted in school closures. Psacharopoulos, Collis, Patrinos, and Vegas (2020) expect closures to reduce school attendance and lead to future revenue losses. The research results confirm the loss of marginal future earnings based on a four-month layoff, differentiated by highest educational attainment. The paper by Weber and Yilmaz (2023) focuses on reduced working hours in the period of COVID-19 and labour income replacements that led to the stabilization of employment in Germany. The study presents a collective wage subsidy tool that increases with the loss of labour income or hours worked. The impact of the energy crisis exacerbated by the Russian-Ukrainian war on the general macroeconomic performance and income distribution of the Eurozone is addressed by the pair of authors Lampa and Oro (2023), who estimate the long-term consequences of sanctions and political strategies on global markets.

The development of nominal and real earnings during the period of the COVID-19 pandemic was significantly influenced by factors such as government interventions during the COVID-19 pandemic. The Czech government introduced the ANTIVIRUS program, the measures of which helped companies with the financial impact of the COVID-19 pandemic on their business and thus prevented massive layoffs. In the Sector of Accommodation and Food Service Activities, the impact of the COVID-19 pandemic could be significant, as most establishments were unable to operate, employees were laid off, which could have also an impact on the development of income in this sector. This development could be also related to a significant increase in income in the following period, when employment in this sector increased and the demand for new employees instead of those previously laid off.

Similarly, in the period of the energy crisis, when we recorded growth in nominal earnings in most sectors, however, as a result of strong inflation, the real earnings of employees fell fundamentally. This phenomenon was caused by insufficient government support measures compared to the COVID-19 pandemic.

5. Conclusions

The paper analyzed the comparison of the negative impacts of the energy crisis of 2022, COVID-19 pandemic crisis of 2020 and the global economic crisis of 2008 on the level of real income from work in selected sectors of the Czech economy.

It was found that the crisis related to the COVID-19 pandemic significantly negatively affected the level of real labour income only in the Sector of Accommodation and Food Service Activities, but the level of this real income increased significantly in the following year. The negative effects of the 2022 energy crisis on real labour income significantly affected all sectors analyzed, and these effects were significantly harsher than the effects of the 2008 global economic crisis, which were also more diluted over time in addition.

The limitation of this research can be seen in the availability of data that was taken from the official website of the Czech Statistical Office. There are therefore secondary aggregated data and not primary individual data. The length of the examined time series caused by the change in the methodology of the Czech Statistical Office is also a certain inconvenience.

From the point of view of future research, it is possible to analyze all sectors of the Czech economy in a similar way. It is also possible to focus on work professions.

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Conflict of interest: none.

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