Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 23, Issue 1, 2023
PRINT ISSN 2284-7995, E-ISSN 2285-3952

ASSESSMENT OF THE IMPACT OF MACROECONOMIC FACTORS ON UNEMPLOYMENT: LITHUANIAN CASE

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Abstract

This paper analyses the effect of inflation, gross domestic product (GDP) growth, and average salary on unemployment in Lithuania for the period from 2001 to 2021. First, the theoretical analysis is performed to review the links between inflation, GDP growth, average salary, and unemployment. Considering that the theoretical analysis reveals the effect of three macroeconomic factors, i.e., inflation, GDP growth, and average salary, on unemployment, the methodology of the research is described. It relies on the multiple regression model and its estimation using ordinary least squares (OLS). Econometric analysis reveals that only one out of three macroeconomic factors, i.e., GDP growth, has a statistically significant effect on unemployment and this effect is negative (based on the sign of the regression coefficient). In addition, to address the autocorrelation problem in the regression model, a lagged unemployment variable is included to the model, and it shows a statistically significant positive (based on the sign of the regression coefficient) effect on unemployment. The future study could only cover the agricultural sector since this sector is important for Lithuania and the macroeconomic indicators of this sector are unique compared to other economic activities or general indicators of Lithuania.

Key words**:** *average salary, gross domestic product growth, inflation, ordinary least squares, unemployment*

INTRODUCTION

Unemployment is probably one of the most important macroeconomic phenomena in every country. Scientists define this phenomenon in different ways. Some of them talk about different duration of unemployment, some of them describe different types of unemployment, etc. [24] defines unemployment as a phenomenon that brings social and economic losses and occurs in the labour market when the production factor, i.e., labour, is not fully used, which means the unemployment of economically active (not working but looking for work or ready to work) people. [6] stresses that unemployment occurs when the supply of labour exceeds the demand for labour.

The unemployment rate as an indicator is expressed as the ratio of the unemployed to the labour force and multiplied by 100% to obtain the percentage unit of measurement. It can be observed that when there is a difficult time or crisis in the economy, the unemployment rate in the countries increases, and when the economy grows in a country, unemployment decreases.

Unemployment phenomenon is important because it makes it possible to see how many people in the country are unemployed and how much government spending will have to be allocated in order to pay benefits to the unemployed. This factor can be important not only for the country but also for various companies that need employees. When a business or company expands into new markets, it is very important to analyse the economic situation in the region or country. And one of the factors that they may need to analyse is unemployment. According to that, the company can decide whether it will be difficult to find employees in a new market or whether it will have enough resources.

The focus of this paper is the analysis of the main macroeconomic factors affecting unemployment. These factors are inflation, GDP, and average salary as they are the most commonly used in the scientific literature analysing the effects on unemployment.

The relationship between inflation and unemployment is quite clearly reflected in the

Phillips curve which shows that as inflation increases, the unemployment in the country decreases and vice versa. However, there have been instances when both the country's inflation and unemployment rates have increased. Such a phenomenon is called "stagflation"[5]. [39 and 32] and other scientists also wrote about the relationship between inflation and unemployment.

The second factor that is quite often analysed by many scientists as affecting unemployment is economic growth. According to [4], economic growth can be measured by an increase in a total output of a country, i.e., gross national product, or real gross domestic product. The scientist explains that long-term economic growth has a positive effect on the national income and employment in the country. [11] and [22] also state that country‘s unemployment rate is greatly influenced by the pace of gross domestic product change. [43] who analyses the factors contributing to employment and unemployment, says that higher employment helps country's economy to grow faster. According to [28], economic growth is one of the most important macroeconomic goals as it raises tax revenues, improves the quality of individuals’ lives, attracts public and private sector investment, and helps to create more new workplaces. [26] also explain that economic growth effectively contributes to the reduction of unemployment and poverty but cannot fully affect the unemployment rate on its own. [15] states that there is a negative relation between GDP and the unemployment rate in the short-term span of time. This negative correlation between GDP and unemployment rate is defined by Okun's law [26]. As [10] mention, Okun's law states that when GDP falls by 2-3%, the unemployment rate rises by 1%. However, [25] didn’t find any statistically significant effect of GDP on unemployment.

One more economic factor which has an impact on unemployment is salary. In the salary literature, studies that analyse the minimum salary (e.g., [7]) or average salary (e.g., [11], [37]) can be found. According to neoclassical theory, higher labour productivity is strongly associated with higher salaries [30]. As [7] notice, when companies increase the minimum salary, unemployment rate increases as well. The scientists also mention about the thoughts of Fetullah Akin in 2017 who states that the impact of the minimum salary on the unemployment rate depends on the duration, thus with an increase of the minimum salary, the unemployment rate rises in the short-term. In the long-term, an increase of the minimum salary reduces unemployment rate, as the country's overall demand and production amount increase [7].

It is worth mentioning that [11] and [37] describe inverse dependence of the average salary and unemployment rate.

Scientists also analyse other factors affecting unemployment. For example: tax wedge on labour (e.g., [16], [9], etc.), labour market regulations (e.g., [8], [15], etc.), international trade (e.g., [18], [19], etc.), gross fixed capital formation (e.g., [27], etc.), trade union density (e.g., [3], [38], etc.), wage bargaining coordination (e.g., [36], [29], etc.) and other factors.

Taking all of this into account, the *problem* of the research can be defined as follows: how inflation, gross domestic product, and average salary affect unemployment? The *object* of the research is the impact of some macroeconomic factors on unemployment. The paper *aims* to analyse the effect of the main macroeconomic factors on unemployment in Lithuania.

Few research *methods* were used for this paper. Firstly, comparative analysis of literature was performed. Then the data for the research was collected and the statistical analysis was carried out. Finally, with collected data econometric analysis was conducted using ordinary least squares for time series data.

MATERIALS AND METHODS

The research is conducted using a multiple regression model for time series data. A general form of a multiple regression model is:

$$Y_t = b_0 + b_1X_{1t} + b_2X_{2t} + \ldots + u_t, \quad (1)$$

where:

Y refers to the dependent variable of the model;
X_1 and X_2 are independent variables of the model;
the coefficient b_0 represents the predicted value of Y when all Xs are equal to 0;
b_1 and b_2 coefficients denote the average predicted change in Y from a one unit increase in X_1 and X_2, respectively;
u_t is the error term; t denotes the time period [23].
In this study we analyse unemployment (*Unempl*) as the dependent variable (Y) of the regression model. Other macroeconomic factors that are included to the model, i.e., inflation (*Inflation*), GDP growth (*GDP*), and average salary (*ASalary*), are the independent variables (Xs) of the regression model. The regression model of this research can be presented as the following expression:

$$Unempl_t = b_0 + b_1 Inflation_t + b_2 GDP_t + b_3 ASalary_t + u_t \quad .....(2)$$

The measurement of the model variables is provided in Table 1.

Table 1. Variables of the model

Variable	Variable abbreviation	Indicator
Unemployment	*Unempl*	unemployment rate (% of total labour force)
Inflation	*Inflation*	inflation (annual %)
GDP growth	*GDP*	GDP growth (annual %)
Average salary	*ASalary*	average monthly salary (euros)

Source: Own determination.

Regression analysis of the model consists of few steps.
As the analysis of the relationship between the factors under consideration is described in the Introduction, here, there are mentioned only the steps that are related to the estimation and interpretation of the model.
First, collecting and analysing the data. Statistical analysis process allows to better understand the analysed data, to identify the trends, thus, it is an important step in the analysis.
Second, estimation of the regression model. At the beginning of this step, scatterplots analysis is used to check the spread of the data and to see how each observation interrelates. Scatterplots can show whether there is a linear or non-linear relationship between variables. Also, potential outliers' identification in the dataset is performed using standardized residual method. An observation is considered an outlier if the absolute magnitude of the standardized residual exceeds 3 standard deviations. In this study the ordinary least squares method is used for the estimation of the model. It is a common technique for the estimation of regression coefficients by minimizing the sum of squared residuals [17].
Third, verification of the model estimations and interpretation. The normality of residuals is tested by applying the Shapiro-Wilk test which rejects the hypothesis of normality when the p-value is less than or equal to 0.05. This test is used when the number of observations is less than 50 (the number of observations in this study is 21).
The problems of both multicollinearity and autocorrelation must be checked in the regression model. Bivariate correlation matrix is used to detect the problem of multicollinearity. If correlation coefficient among two independent variables of the model is higher than or equal to |0.8|, it indicates that variables are highly correlated and it causes the problem called multicollinearity. Durbin-Watson *d* test is used to detect the problem of autocorrelation. If the estimated value of *d* is closer to zero, there is evidence of positive autocorrelation, if it is closer to 4, there is evidence of negative autocorrelation, and the closer the value of *d* is to 2, the more evidence there is that there is no autocorrelation [20].
If the problem of autocorrelation is present in the regression model, a lagged dependent variable can be included to the regression model as an independent variable to solve this problem. Then the regression model can be expressed using the following equation:

$$Unempl_t = b_0 + b_1 Inflation_t + b_2 GDP_t + b_3 ASalary_t + b_4 Unempl_{t-1} + u_t, \quad .....(3)$$

where: $Unempl_{t-1}$ refers to a lagged (t-1) unemployment variable.

Durbin *h* statistic is used to check if the problem of autocorrelation is eliminated from the model, or it is still present in the model. This statistic is calculated using the following formula [20]:

$$h \approx \left(1 - \frac{d}{2}\right) \sqrt{\frac{n}{1 - n * \sigma^2}}, \quad \text{.....(4)}$$

where:
d refers to Durbin-Watson *d* statistic;
n is the sample size;
σ^2 denotes the variance of the estimator of the coefficient of lagged Y variable.

If the value of the Durbin *h* test is less than the critical value (in absolute terms; Student's t-test; 95% statistical significance), then there is no autocorrelation in the model; if the value is higher, there is autocorrelation [20].

The coefficient of determination is used to determine the goodness-of-fit of the model. This coefficient ranges from 0 to 1, and the closer it is to 1, the better the model. Also, the statistical significance of both the model (Fisher's F-test; $p<0.05$)) and the parameters / coefficients (using Student's t-test; $p<0.05$)) is evaluated.

Analysis covers the period 2001-2021 (an annual basis) in Lithuania. Data for the research were taken from The World Bank database and The Official Statistics Portal (hereinafter referred to as OSP) of Lithuania (Table 2). Data were analysed using SPSS statistical program.

Table 2. Data sources

Variable abbreviation	Data source
Unempl	The World Bank (2022a)[41]
GDP	The World Bank (2022b) [40]
Inflation	OSP (2022a) [33]
ASalary	OSP (2022b) [34]

Source: Own determination.

Based on the literature review and the research methodology, the following hypotheses were raised:

H1:Inflation negatively affects unemployment. The hypothesis is based on the research done by [5, 39, 32], etc.

H2: Economic growth has a negative effect on unemployment. This hypothesis is based on the previous research, such as [4, 11, 22, 43, 28, 26], etc.

H3: The average salary has a negative impact on unemployment. This is an expected outcome of the study, and it is based on the results of the research of other scientists (e.g., [11, 37, 30], etc.).

RESULTS AND DISCUSSIONS

Statistical data analysis

In this research Lithuanian unemployment, inflation, GDP growth, and average salary are analysed in 2001-2021. While analysing the collected data, first, main descriptive statistics are introduced. Mean, standard deviation (SD), minimum and maximum values of all four research variables are presented in Table 3. Table 4 represents Lithuanian data of unemployment, inflation, GDP growth, and average monthly salary in 2001-2021.

Table 3. Descriptive statistics

Variable abbreviation	Mean	SD	Min	Max
Unempl	10.12	3.93	4.25	17.81
Inflation	2.81	3.11	-1.30	10.60
GDP	4.06	5.15	-14.84	11.11
ASalary	686.94	362.13	284.50	1,579.40

Source: own calculations based on the data from The World Bank and OSP [33, 34, 35,40, 41].

The unemployment rate in Lithuania was not constant, increasing and decreasing trends can be observed in the analysed period. Since 2001 until 2007, unemployment in Lithuania was decreasing, this can be determined by various factors, such as creation of new businesses, the growth of economy, and as a result, new jobs were created, which led to the decreasing trend of unemployment.

Since 2007 until 2010, a sharp jump in the unemployment rate is noticeable, which was caused by the 2007-2008 global financial crisis.

Unemployment fell gradually between 2010 and 2019 in Lithuania.

Table 4. Lithuanian data, 2001-2021

Years	*Unempl*	*Inflation*	*GDP*	*ASalary*	Years	*Unempl*	*Inflation*	*GDP*	*ASalary*
2001	16.84	2.00	6.53	284.50	2012	13.36	2.80	3.84	615.10
2002	13.01	**-1.00**	6.75	293.60	2013	11.77	0.40	3.55	643.30
2003	12.87	**-1.30**	10.57	310.60	2014	10.70	-0.30	3.54	677.40
2004	10.68	2.90	6.57	332.90	2015	9.12	-0.10	2.02	714.10
2005	8.32	3.00	7.73	369.60	2016	7.86	1.70	2.52	774.00
2006	5.78	4.50	7.41	433.20	2017	7.07	3.90	4.28	840.00
2007	**4.25**	8.10	11.11	522.00	2018	6.15	1.90	3.99	***924.10***
2008	5.83	8.50	2.61	623.20	2019	6.26	2.70	4.57	***1,296.40***
2009	13.79	**1.30**	***-14.84***	***595.50***	2020	8.49	**0.20**	***-0.13***	1,428.60
2010	**17.81**	3.80	1.65	***575.80***	2021	7.11	**10.60**	5.00	1,579.40
2011	15.39	3.40	6.04	592.50					

Source: The World Bank and OSP [33, 34, 35,40, 41].

Each country's central bank aims to keep the country's price level stable. Typically, central banks set annual inflation target for the country and usually this target is around 2% in Eurozone countries [21]. As can be seen from Table 4, inflation in Lithuania during 2001-2021 period was quite varied, it both increased and decreased and was negative, which means that there was deflation. Since 2001 until 2003, annual inflation has been decreasing, and in 2002 and 2003 there was deflation, which means there was negative inflation, and the price level was falling or the value of money relative to goods was rising. Inflation increased from 2003 to 2008, but it fell dramatically in 2009. In 2020, inflation decreased, and the annual rate was very close to 0%; this could have been determined by the start of the global pandemic of the COVID-19 virus, and for the same reason, we see that in 2021, inflation increased significantly, and its rate was above 10%.

The biggest GDP drop was in 2009, when GDP fell very sharply, and economic growth turned negative (almost -15%). The main reason was global financial crisis that took place in 2007-2008 and which had a very strong impact on the economies of all countries, including Lithuania. Also, in 2020 economic growth again turned negative (about -0.13%), but it was not as high as in 2009. The reason of this fall was the global COVID-19 pandemic and the restrictions introduced by countries.

Average monthly salary grew for almost entire period of 2001-2021, except for 2009 and 2010, when, due to the global financial crisis in Lithuania, not only economic growth became negative, but also the average monthly salary decreased by about 28 euros. When comparing 2018 and 2019, we see a huge rise in the average monthly salary in Lithuania. During the year it increased by as much as 372 euros. The change in salaries was influenced by the changes in the tax system that came into force in 2019, i.e., the basic amount of the official salary was increased, the minimum monthly salary was also increased, the calculation of the tax-free amount of income changed [44].

Econometric analysis

At the beginning of an econometric analysis, scatterplot analysis is performed to check the spread of the data and to see how each observation interrelates. Scatterplots of the values of Y *vs* the corresponding values of X did not clearly show whether there is a linear or non-linear relationship between the variables under consideration.

The next step in econometric analysis is to check for outliers. They are described as abnormal observations that are far from other observations and that can have a negative impact on the study since they can change the coefficients of the regression model. In this paper, the standardized residual method to identify outliers is used. After analysing the outliers in the dataset using the standardized residual method, we can conclude that there are no outliers.

The Shapiro-Wilk normality test is used in this study to check the normality of the errors. After performing the Shapiro-Wilk normality test, the obtained p-value is equal to 0.07. Since the p-value is greater than 0.05, we conclude that the standard errors have a

normal distribution. We also checked the mean and standard deviation values in the Shapiro-Wilk normality test. Based on the theory, the standard errors of a regression model have a normal distribution with a mean of 0 and a standard deviation of 1. In the case of our model, the mean is 0 and the standard deviation is about 0.92 which means that its value is very close to 1. Therefore, we came to the same conclusion that the standard errors have a normal distribution.

Next in our work, we checked for multicollinearity, i.e., whether the independent variables, in this case GDP, inflation, and average monthly salary, are not related to each other. To detect multicollinearity, we chose to calculate bivariate correlation coefficients. If the bivariate correlation coefficient is greater than |0.8|, then the multiple regression model will have a multicollinearity problem. Looking at the bivariate correlation coefficients in Table 5 and comparing them to |0.8|, we see that they are less than |0.8|, it means there are no highly correlated variables.

Also, since all p-values (Sig. (2-tailed)) of the correlation coefficients are greater than 0.05, the correlations between independent variables are statistically insignificant. We conclude that there is no multicollinearity problem in this multiple regression model.

Table 5. Bivariate correlation matrix

Variables	*Correlation*	*GDP*	*Inflation*	*ASalary*
GDP	Sig. (2-tailed)	1	0.47	0.31
	Correlation		0.17	-0.23
Inflation	Sig. (2-tailed)	0.47	1	0.21
	Correlation	0.17		0.29
ASalary	Sig. (2-tailed)	0.31	0.21	1
	Correlation	-0.23	0.29	

Source: own calculations based on the data from The World Bank and OSP [33, 34, 35,40, 41].

Since we have time series data, we further tested whether our model has autocorrelation problem. We used the Durbin-Watson *d* statistic to determine autocorrelation. After doing this test, we obtained d = 0.71. Since the estimated value of *d* is close to zero, there is evidence of positive autocorrelation in the model. We also tried to see graphically if there is an autocorrelation problem in the model. After including the lagged variable of the standardized residuals (ZRE(t-1); x axis), we drew the graph where the positive autocorrelation was visible since the points in the graph have an increasing trend from the left to the right (Figure 1).

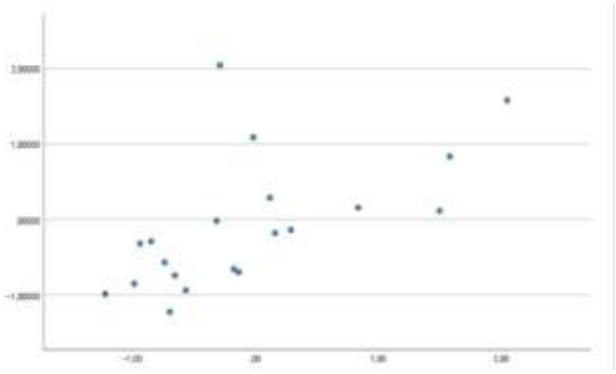

Fig. 1. Positive autocorrelation
Source: own calculations based on the data from The World Bank and OSP [33, 34, 35,40, 41].

In the next step, we removed autocorrelation by including a lagged dependent variable in the model. We created a new model with a lagged unemployment variable:

$$Unempl_t = b_0 + b_1 GDP_t + b_2 ASalary_t + b_3 Inflation_t + b_4 Unempl_{t-1} + u_t \quad .....(5)$$

Now, after running the Durbin-Watson test, we get d = 1.95. The standard deviation of the lagged dependent variable is equal to 0.12. We used Durbin's *h* statistic to check whether autocorrelation is still present in the model or it is eliminated:

$$h = (1 - (1.95/2)) * \sqrt{\frac{20}{1 - 20 * 0.12^2}} = 0.13 \quad .....(6)$$

The critical value of the Student's t-test is equal to 2.09. Since 0.13<2.09, we make a conclusion that there is no autocorrelation in the model. Indeed, the graphical analysis of autocorrelation showed that the model no longer has this problem, as there is no visible relationship between the values (Figure 2).

Finally, the coefficients (three decimal digits since the coefficient of *ASalary* is small) of the regression model are presented in Table 6. Based on these coefficients, the equation of the regression model can be seen as the following:

$$Unempl_t = 3.141 - 0.396GDP_t - 0.001ASalary_t + 0.051Inflation_t + 0.841Unempl_{t-1} \quad (7)$$

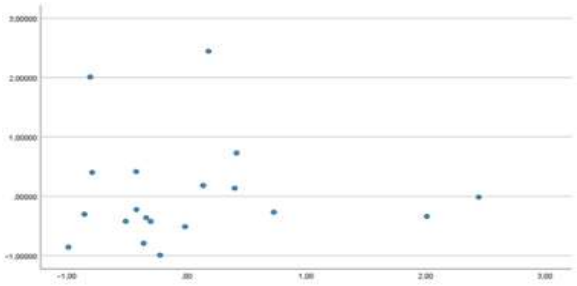

Fig. 2. No autocorrelation
Source: own calculations based on the data from The World Bank and OSP [33, 34, 35,40, 41].

Table 6. Coefficients of the regression model

Variables	Coefficients	p-value
Constant	3.141	0.106
GDP	-0.396	<0.001
ASalary	-0.001	0.505
Inflation	0.051	0.716
$Unempl_{t-1}$	0.841	<0.001

Source: own calculations.

The regression model is statistically significant (p-value of F-test is equal to 0.00). Only two variables in the regression model are statistically significant (p-value<0.05; Table 6). Interpretation of statistically significant coefficients: a one percentage point increase in GDP growth reduces unemployment rate by about 0.396 percentage point, holding other factors constant; a one percentage point increase in the previous year unemployment rate leads to, on average, a 0.841 percentage point increase in unemployment rate, holding other factors constant. Based on these results, we can state that only *H2* hypothesis is confirmed in this research.

The coefficient of determination which evaluates the fit of the model is equal to 0.85. It is close to 1, thus, it means that the model predicts very well. In other words, it means that the independent variables of the model explain 84.5% of the total variation in unemployment.

Agricultural indicators in Lithuania

Agriculture is one of the oldest businesses in Lithuania. From a historical perspective, Lithuania can be defined as an agricultural country and until now this sector is considered a priority sector of the country [2]. In terms of value added in Lithuania's agriculture, it increased in 2001-2021 period (Figure 3). Nevertheless, agriculture accounts only for about 3% in total Lithuania's value added in the same period.

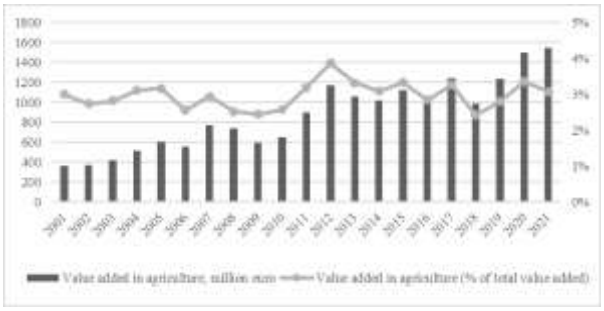

Fig. 3. Gross value added in Lithuania, 2001-2021
Source: own calculations based on the data from Eurostat [12].

According to [42], the importance of agriculture in the Lithuanian economy has been decreasing in the last decade. This was influenced by the decreasing number of rural residents - an average of 9,000 people leave the village and go to the cities every year. Analysing the migration data of the last fifty years, it can be noted that the rural population has halved.

In terms of Lithuanian labor force, a decrease in agricultural employment was observed in 2001-2020 (no available data for 2021) - compound average annual change rate of -5.9% (Figure 4). The share of agricultural employment in total employment sharply decreased in the same period - from 16% in 2001 to 5% in 2021.

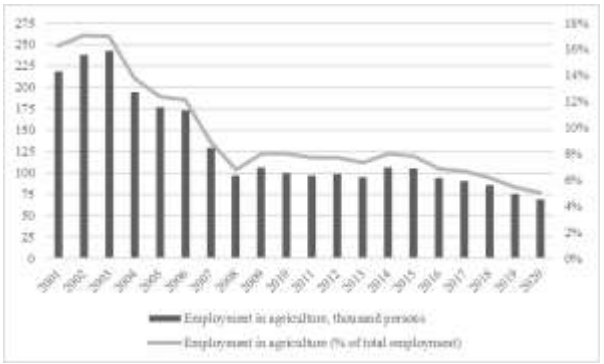

Fig. 4. Employment in Lithuania, 2001-2020
Source: own calculations based on the data from Eurostat [13].

Agricultural income measured as index (2010=100) of the real income of factors in agriculture per annual work unit increased from 45.03 in 2001 to 189.06 in 2021. A rapid growth of agricultural income is observed in 2020 and 2021 (Figure 5).

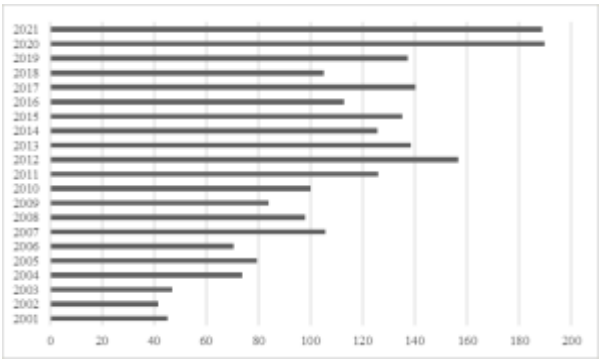

Fig. 5. Agricultural income in Lithuania (thousand euro), 2001-2021
Source: data from Eurostat [14].

Employee compensation as percent of gross value added in 2001-2021 varies between activities in Lithuania (Figure 6). It is the highest in services during the analysed period.

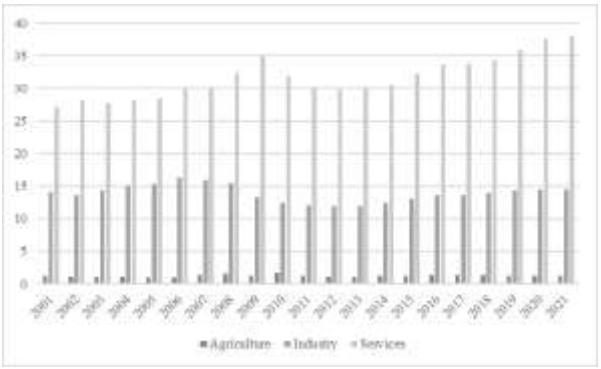

Fig. 6. Employee compensation in Lithuania (% of gross value added), 2001-2021
Source: data from OECD [31].

Inflation rate in agriculture can be reflected by the price indices of goods and services purchased for agricultural production purposes. Such goods and services include seeds, fuels, fertilizers, feeding stuffs, etc. Based on the data of [35], the highest price indices for agricultural production purposes in 2021 were for veterinary expenses (164.3 per cent), compound feeding stuffs for pigs (156.6 per cent), and herbicides (148.6 per cent) (2015=100), while the lowest price indices were for fungicides (65.1 per cent), other plant protection products (74.7 per cent), and PK fertilizers (76.3 per cent).

In conclusion, it can be said that the analysis of the indicators of the agricultural sector revealed that this sector has uniqueness, and this could be the incentive to conduct a study with the methodology applied in this work in the agricultural sector.

CONCLUSIONS

In this paper we analyse how unemployment is affected by such macroeconomic factors as inflation, GDP, and average salary since these factors are the most commonly used in the scientific literature. Based on the theory, each of the factors has a certain influence on the fluctuations of the unemployment rate. However, the empirical analysis revealed that not all factors have a statistically significant impact on unemployment.

The research covers the period from 2001 to 2021 in Lithuania. The methodology of the research relies on the multiple regression model; the method used for the analysis is ordinary least squares. Econometric analysis reveals that only one out of three macroeconomic factors, i.e., GDP growth, has a statistically significant effect on unemployment and this effect, based on the sign of the regression coefficient, is negative. It discloses that when GDP growth increases, unemployment decreases. The results prove the proposition of [1] who states that there is a negative relation between GDP and the unemployment rate. This negative correlation between gross domestic product and unemployment rate is defined by Okun's law [26].

To modify the regression model, a lagged unemployment variable is included, which shows a statistically significant positive (based on the sign of the regression coefficient) effect on unemployment, i.e., when a lagged (t-1) unemployment increases, unemployment (t period) also increases.

Based on the results of the research, hypothesis *H2* can be confirmed: economic growth negatively affects unemployment.

In the next research work the influence of various factors on unemployment in

agriculture can be approached as analysis of agricultural indicators showed that this sector is important for Lithuania and it has various peculiarities.

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