



# The Influence of Economic Activity on Income in the Regions of the Slovak Republic

Mária Vojtková<sup>1</sup> 

Received: August 22, 2023

Accepted: October 30, 2023

Published: March 16, 2024

## Keywords:

Equivalent disposable income;  
Economic activity;  
EU-SILC;  
Analysis of variance



Creative Commons Non Commercial CC BY-NC: This article is distributed under the terms of the Creative Commons Attribution-Non-Commercial 4.0 License (<https://creativecommons.org/licenses/by-nc/4.0/>) which permits non-commercial use, reproduction and distribution of the work without further permission.

**Abstract:** Household income is one of the important components for the quality of life of individuals in the household, while individuals satisfy their needs through it. This paper aims to assess the influence of the selected factor, namely economic activity, the member standing at the head of the household, on the equivalent disposable income of the household in the regions of the Slovak Republic, broken down according to NUTS3, using one-factor analysis of variance. Due to the non-fulfillment of the conditions for the use of parametric variance analysis, its modification using Welch's variance analysis will be used. The starting source of data is data from the EU SILC sample survey on income and living conditions of households in Slovakia for the year 2021, while the analysis itself is carried out using the statistical tool SAS Enterprise Guide 7.1.

## 1. INTRODUCTION

The standard of living of households or populations is characterized by the availability of a variety and quality of goods and services, which is influenced by the household income that the household has at its disposal and uses for purchasing. Household income includes earnings from employment, self-employment, property or land rental, dividends, social benefits, and other income components. On one hand, household income significantly affects wealth, standard of living, and quality of life for households. On the other hand, household income is influenced by various factors such as the economic activity of the population, the financial burden of the population, and the region in which the household is located (Ilavská, 2019).

The main objective of this article is to assess the impact of a selected factor, namely the economic activity of the head of the household, on the equivalent disposable household income in the regions of the Slovak Republic (SR) classified according to NUTS3, using one-way analysis of variance. An additional goal of the article is to conduct a multiple comparison of equivalent disposable household income in various regions of the SR based on the economic activity status of the head of the household.

The analysis itself will be based on data from the EU-SILC (European Union Statistics on Income and Living Conditions) household income and living conditions survey in Slovakia for the year 2021. In processing this data, the statistical tool SAS Enterprise Guide 7.1 will be utilized.

## 2. EU-SILC STATISTICAL SURVEY

EU-SILC can be defined as a statistical sample survey conducted under the guidance of Eurostat, employing precisely defined comparable methodologies and procedures. This survey

<sup>1</sup> University of Economics in Bratislava, Dolnozemská cesta 1, 852 35 Bratislava, Slovak Republic

aims to provide data about households and their incomes, poverty rates among households, social housing and health conditions, as well as many other pieces of information related to the social circumstances of surveyed households' members. It can be considered one of the most widely used sources for analyzing household incomes, with the survey itself being conducted through questionnaires. Its advantage lies in its applicability for comparing the social situations of households across European Union member states. The implementation of this survey in Slovakia is overseen by the Statistical Office of the Slovak Republic and its staff dedicated to statistics of living standards. The survey's data, in addition to income monitoring, serves as a valuable resource for making important decisions in the realm of social policy management and the design of programs to integrate individuals at risk of income poverty and social exclusion (European Commission, 2021).

The analysis of household income will be based on the aforementioned European Union database, EU-SILC, with a focus on the so-called Equivalent Disposable Income (EDI) of households. Equivalent Disposable Income refers to the income of households divided by their corresponding equivalent household size. The calculation of equivalent household size employs an equivalence scale that follows Eurostat's methodology. This scale is also referred to as the OECD modified scale, assigning coefficients to each member of the household as follows: a coefficient of 1 for the first adult household member; 0.5 for the second and each subsequent adult household member; 0.5 for individuals aged 14 and older; and 0.3 for each child younger than 14 years. Subsequently, within the household, each individual is assigned an income (Vlačuha et al., 2022).

A significant factor concerning income measurement is an individual's position in the labor market, as measured through their Economic Activity Status (EAS). In this article, the focus has been placed on the impact of precisely this selected factor from the EU-SILC database, where the economic activity status of the head of selected households undergoes the following variations (Hurbánková & Sivašová, 2018):

- Employed - individuals who are older than 15 years and engage in economic activity for at least 1 hour during the observed period, receiving income such as wages, salary, or profit from entrepreneurial activities.
- Unemployed - residents aged 15 and older who are without work at the moment of decision and are actively seeking employment, regardless of whether they are registered as job seekers.
- Retirees - residents who receive old-age, early retirement, disability, or service pensions, and the pension is their sole source of income.
- Other inactive individuals - individuals not classified in the previous groups constitute the economically inactive population.

The reason for selecting this factor is a plethora of studies and articles that anticipate its significant influence (Blank et al., 1993; Šoltés, 2018; Košíková & Šoltés, 2020; Želinský et al., 2021). Most of the mentioned studies focus on observing this factor concerning indicators of poverty.

The impact of economic activity on equivalent disposable income in the regions of the Slovak Republic, categorized according to NUTS 3, was examined: Bratislava Region (BA), Trnava Region (TT), Trenčín Region (TN), Nitra Region (NR), Žilina Region (ZA), Banská Bystrica Region (BB), Prešov Region (PO), and Košice Region (KE) (Eurostat, 2022).

### 3. RESULTS AND DISCUSSION

#### 3.1. Analysis of the Dependence of the Equivalent Disposable Income of Households on the Selected Factor

To assess the impact of the selected factor, namely the economic activity of the head of the household, on equivalent disposable income, a decision has been made to employ a one-way analysis of variance. The essence of the analysis of variance is to determine whether statistically significant differences exist among the average values of the dependent variable (EDI) for various levels (or categories, groups) of the independent variable (EAS). The name “analysis of variance” is derived from the fact that judgments about means at different levels of the factor are made by comparing the variability between groups and the variability within these groups.

First, we focus on meeting the assumptions of the one-way analysis of variance: independence, normality, and homoscedasticity of equivalent disposable income (EDI) for different levels of the economic activity factor in all regions of the Slovak Republic.

The condition of independence is ensured by the precisely defined methodology of the statistical survey. In the EU-SILC 2021 survey, a two-stage stratified sampling was used, with a proportional number of households selected by simple random sampling in each stratum (Vlačuha et al., 2022). Given a sufficiently large sample of households in each region, we can also assume that the normality condition for EDI at different levels of EAS is met based on the validity of the central limit theorem. To verify the condition of homoscedasticity, i.e., equality of variances of EDI for different levels of the factor, Levene’s test of homoscedasticity was used. The results of the homoscedasticity test for individual regions of the Slovak Republic are presented in Table 1. Since the  $p$ -values in all regions are lower than our chosen significance level of 0.05, we reject the null hypothesis of equal variances. Due to the violation of the homoscedasticity assumption, it is decided to assess the impact of the economic activity status of household heads on equivalent disposable income using a more suitable Welch’s one-way analysis of variance instead of the parametric analysis of variance.

**Table 1.** Levene’s test for the presence of homoscedasticity

Region	Source	DF	F Value	Pr > F
BA	EAS	3	6.47	0.0002
	Error	904		
TT	EAS	3	6.36	0.0003
	Error	612		
TN	EAS	3	2.77	0.0412
	Error	516		
NR	EAS	3	4.79	0.0027
	Error	543		
ZA	EAS	3	3.70	0.0118
	Error	538		
BB	EAS	3	4.37	0.0047
	Error	555		
PO	EAS	3	5.51	0.0010
	Error	546		
KE	EAS	3	3.64	0.0126
	Error	664		

Source: EU SILC, 2021; own processing in the SAS Enterprise Guide

Welch’s one-way analysis of variance (Delacre et al., 2019; Liu, 2015) reduces the impact of heteroscedasticity in EDI across different levels of the factor. Its application in the context of the Bratislava Region will be illustrated. The primary goal of Welch’s one-way analysis of variance is to test both the null and alternative hypotheses, with their formulations as follows:

$$H_0: \mu_1 = \mu_2 = \dots = \mu_k$$

$H_1$ : The mean differs at least at two-factor levels

where  $\mu_i$  is the mean value for the  $i$ -th level of the factor,  $i = 1, 2, \dots, k$ , and  $k$  is the number of variations of the factor.

As the value of the test statistic is 52.41 and the  $p$ -value is less than the significance level of 0.05, we reject the null hypothesis of equality of means of EDI across different levels of EAS (Table 2). The economic activity status factor has a significant impact on the variable equivalent disposable income in the Bratislava Region. It explains 13.26% of the variability in the dependent variable equivalent disposable income in the Bratislava Region, which is a common result when working with larger datasets. However, this does not imply that the estimated model is of low quality (Table 3). The remaining 86.74% of variability is explained by other measurable or unmeasurable factors not considered in our model.

**Table 2.** Analysis of the impact of the EAS of the member standing at the head of the household on the EDI in the Bratislava Region

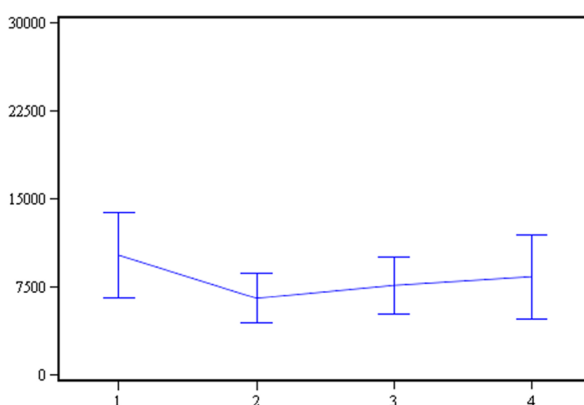
Welch's ANOVA for EDI			
Source	DF	F Value	Pr > F
EAS	3.0000	52.41	<.0001
Error	59.4101		

Source: EU SILC, 2021; own processing in the SAS Enterprise Guide

**Table 3.** Descriptive statistics of EDI depending on the EAS factor in the Bratislava region

R-Square	Coeff Var	Root MSE	EDP Mean
0.132652	35.57557	3223.005	9059.603

Source: EU SILC, 2021; own processing in the SAS Enterprise Guide



**Figure 1.** Mean values of EDI for individual levels of the EAS factor of the head of household in the Bratislava Region

Source: EU SILC, 2021; own processing in the SAS Enterprise Guide

The result of the  $F$ -test using Welch's analysis of variance confirmed the inequality of means of EDI for different levels of EAS, and this finding is also supported by graphical analysis (Figure 1). In the Bratislava Region, households, where the head's economic activity status is "employed" (1), have the highest mean EDI value among all household types.

The assessment of the impact of economic activity on equivalent disposable income in other regions of the Slovak Republic using Welch's analysis of variance is presented in Table 4. In this case, as well, the low  $p$ -value in all regions confirms that the economic activity status of

household heads significantly influences the EDI of selected households in all regions of Slovakia. The economic activity factor of household heads has the greatest explanatory power on the variability of EDI in the Košice Region (22.14%) and the least in the Trenčín Region (16.69%).

**Table 4.** Verification of the impact of the EAS of the member at the head of the household on EDI in other regions of the Slovak Republic

Welch's ANOVA for EDI				
Region	DF	F Value	Pr > F	R-Square
TT	3.0000	16.12	<.0001	0.180735
TN	3.0000	17.33	0.0003	0.114036
NR	3.0000	17.74	<.0001	0.166949
ZA	3.0000	15.16	<.0001	0.190447
BB	3.0000	22.12	<.0001	0.122551
PO	3.0000	34.35	<.0001	0.128952
KE	3.0000	57.93	<.0001	0.221413

Source: EU SILC, 2021; own processing in the SAS Enterprise Guide

### 3.2. Multiple Comparisons of the Means of Regional Equivalent Disposable Income at Different Levels of the Economic Activity Status of the Household Head

From the previous analysis, it is evident that the economic activity factor of the household head has an impact on household EDI. To determine the differences between the levels of mean equivalent disposable income influenced by the economic activity factor, we will employ multiple comparisons using the Bonferroni test (Armstrong, 2014).

Multiple comparisons of the levels of economic activity within the Bratislava Region at a significance level of  $\alpha = 0.05$  are presented in Table 5. Statistically significant differences in the mean equivalent disposable incomes in the Bratislava Region for the year 2021 were observed in the following combinations of economic activity levels of the household head: employed and other inactive person, employed and retiree, and employed and unemployed. In all combinations, based on the Bonferroni test, the positive difference value is observed for the “employed” level compared to the other levels of EAS. The largest difference in equivalent disposable income is seen in the combination of “employed” and “unemployed” levels, with a difference of €3,654.5.

The comparison of mean equivalent disposable incomes across levels of economic activity for the household head in other regions is provided in Table 6. At a significance level of 0.05, for the combinations of “employed” - “other inactive person,” “employed” - “retiree,” and “employed” - “unemployed,” there are statistically significant differences in equivalent disposable incomes of households in all regions. The exception is the Trnava Region, where the average equivalent disposable incomes of households are the same for the combination of “employed” and “other inactive person”. Based on the Bonferroni test, for all these pairs, the “employed” category has a positive difference compared to the other category of the EAS factor.

Aside from the Trenčín and Nitra regions, statistically significant differences can be confirmed in combinations of economic activity categories for the household head, specifically “retiree” and “unemployed,” and “other inactive person” and “unemployed.” In these combinations, the “retiree” and “other inactive person” categories exhibit a positive difference compared to

the “unemployed” category. In the Košice Region, the only region in Slovakia where all combinations of the examined levels are statistically significant, equivalent disposable incomes of households show statistically significant differences. Conversely, the combination of “retiree” and “other inactive person” yields statistically insignificant differences in nearly all regions.

**Table 5.** Multiple comparisons of equivalent disposable income at levels of economic activity status in the Bratislava region

Comparisons significant at the 0.05 level are indicated by ***.				
EAS Comparison	Difference Between Means	Simultaneous 95% Confidence Limits		
employed - other inactive person	1811.1	628.1	2994.1	***
employed - retiree	2544.4	1944.7	3144.1	***
employed - unemployed	3654.5	1420.9	5888.1	***
other inactive person - employed	-1811.1	-2994.1	-628.1	***
other inactive person- retiree	733.3	-476.8	1943.4	
other inactive person- unemployed	1843.4	-625.1	4311.9	
retiree - employed	-2544.4	-3144.1	-1944.7	***
pensioner - other inactive person	-733.3	-1943.4	476.8	
retiree - unemployed	1110.1	-1138.0	3358.2	
unemployed - employed	-3654.5	-5888.1	-1420.9	***
unemployed - other inactive person	-1843.4	-4311.9	625.1	
unemployed - retiree	-1110.1	-3358.2	1138.0	

Source: EU SILC, 2021; own processing in the SAS Enterprise Guide

**Table 6.** Multiple comparisons of equivalent disposable income at levels of economic activity status in other regions

EAS	TT	TN	NR	ZA	BB	PO	KE
1-2	4222.7***	4843.2***	2932.1***	4197.3***	5182.0***	4435.6***	4964.4***
1-3	1050.6	1406.2***	1179.9***	1136.4***	1377.6***	1083.0***	1669.4***
1-4	1490.7***	1870.0***	1358.2***	1362.5***	1942.9***	2154.0***	3415.5***
2-1	-4222.7***	-4843.2***	-2932.1***	-4197.3***	-5182.0***	-4435.6***	-4964.4***
2-3	-3172.1***	-3436.9	-1752.2	-3060.9***	-3804.4***	-3352.6***	-3295.1***
2-4	-2732.0***	-2973.2	-1573.9	-2834.8***	-3239.1***	-2281.7***	-1548.9***
3-1	-1050.6	-1406.2***	-1179.9***	-1136.4***	-1377.6***	-1083.0***	-1669.4***
3-2	3172.1***	3436.9	1752.2	3060.9***	3804.4***	3352.6***	3295.1***
3-4	440.1	463.7	178.3	226.1	565.3	1071.0	1746.1***
4-1	-1490.7***	-1870.0***	-1358.2***	-1362.5***	-1942.9***	-2154.0***	-3415.5***
4-2	2732.0***	2973.2	1573.9	2834.8***	3239.1***	2281.7***	1548.9***
4-3	-440.1	-463.7	-178.3	-226.1	-565.3	-1071.0	-1746.1***

Explanations: 1- employed, 2- unemployed, 3- retiree, 4- other inactive person

Source: EU SILC, 2021; own processing in the SAS Enterprise Guide

#### 4. CONCLUSION

The obtained results confirmed that the impact of the selected factor, the economic activity status of the household head, on the equivalent disposable income of households in the Slovak regions, is statistically significant. The average equivalent disposable income of the selected households in Slovakia for the year 2021 was €8,711.70.

Additional results from the multiple comparisons of mean equivalent disposable incomes in different regions further confirmed that households with an “employed” household head achieved the highest average equivalent disposable incomes in each analyzed region in Slovakia. On



the other hand, households with an “unemployed” household head attained the lowest average equivalent incomes. Based on the *R*-Square indicator, we can conclude that the selected factor explains the variability of the dependent variable (EDI) in each region by more than 10%, confirming its significance. The economic activity status’s impact on equivalent disposable income was only statistically significant in the Košice Region across all categories.

From a methodological perspective, the presented paper offers an alternative for assessing the impact of an independent variable on a dependent variable when the assumption of equal variances in individual categories of the independent variable is not met. This is achieved through the utilization of Welch’s one-way analysis of variance.

### Acknowledgment

This research was supported by the Grant Agency of the Slovak Republic [VEGA grant number 1/0561/21 The impact of the COVID-19 crisis on business demography and employment in the Slovak Republic and the EU].

### References

- Armstrong, R. A. (2014). *When to use the Bonferroni correction*. *Ophthalmic and Physiological Optics*, 34(5), 502-508.
- Blank, R. M., Card, D., Levy, F., & Medoff, J. L. (1993). Poverty, income distribution, and growth: Are they still connected? *Brookings Papers on Economic Activity*, 1993(2), 285-339.
- Delacre, M., Leys, C., Mora, Y. L., & Lakens, D. (2019). Taking parametric assumptions seriously: Arguments for the use of Welch’s F-test instead of the classical F-test in one-way ANOVA. *International Review of Social Psychology*, 32(1), 13.
- European Commission. (2021). *Methodological guidelines and description of EU-SILC target variables*. Luxembourg: Publications Office of the European Union. Retrieved from: [https://ec.europa.eu/eurostat/documents/203647/16195750/2021\\_Doc65\\_EUSILC\\_User\\_Guide.pdf](https://ec.europa.eu/eurostat/documents/203647/16195750/2021_Doc65_EUSILC_User_Guide.pdf)
- Eurostat. (2022). *Statistical regions in the European Union and partner countries NUTS and statistical regions 2021*. Luxembourg: Publications Office of the European Union.
- Hurbánková, E., & Sivašová, D. (2018). *Hospodárska štatistika I*. Bratislava: Ekonóm.
- Ilavská, K. (2019). Family incomes and their quality of life: Kvalita života závislá od prímov rodiny. *Pedagogické diskusie* 3/2019, 49-72.
- Košíková, M., & Šoltés, E. (2020). Analýza ekvivalentného disponibilného príjmu slovenských domácností s využitím príkazov CONTRAST a LSMEANS v procedúre GLM. *Economics And Informatics*, 18(2).
- Liu, H. (2015). *Comparing Welch ANOVA, a Kruskal-Wallis test, and traditional ANOVA in case of heterogeneity of variance*. Virginia Commonwealth University.
- Šoltés, E. (2018). *Chudoba a sociálne vylúčenie v EÚ a v SR: v kontexte stratégie Európa 2020*. Univerzita Pardubice.
- Vlačuha, R., Kováčová, Y., & Kubala, M. (2022). *EU SILC 2021 Indikátory chudoby a sociálneho vylúčenia*. Bratislava: Štatistický úrad SR.
- Želinský, T., Mysíková, M., & Garner, T. I. (2021). Trends in subjective income poverty rates in the European Union. *The European Journal of Development Research*, 1-24.

