

## COINTEGRATION BETWEEN WAGES, LABOR PRODUCTIVITY, YOUTH ACTIVITY RATE AND THE YOUTH UNEMPLOYMENT RATE: AN ECONOMETRIC APPROACH

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### **Abstract**

*A review of the specialized literature regarding the youth unemployment rate reveals that it is approached both as an independent variable—aimed at highlighting the impact of its level and evolution on economic growth and development—and as a dependent variable, with emphasis placed on the analysis of its determinants. The present study follows this line of research, with net earnings, labor productivity, and the youth activity rate being analyzed as influencing factors of the youth unemployment rate. Using a VAR (Vector Autoregression) model covering a 29-year period (1996–2024), it was demonstrated that, in the case of Romania, the identification of a dependency relationship among the analyzed variables is limited to the short-term influence exerted by the youth unemployment rate on the activity rate.*

**Keywords:** youth unemployment rate, determinants of unemployment, activity rate, wages, labor productivity

**JEL Classification:** J64

### **1. Introduction**

Although unemployment is far from being considered a “new” concept, a brief analysis of the Web of Science and Scopus databases regarding the number of articles addressing the issue of unemployment highlights the fact that it continues to attract the interest of researchers. The complexity and the multitude of perspectives that can be analyzed when discussing unemployment lead researchers to focus their analyses on a limited number of aspects, primarily on influencing factors, the consequences of this phenomenon for economic development, as well as the identification of the most effective instruments, measures, and strategies for limiting it.

It can be argued that the importance attributed to obtaining a comprehensive and complex picture of unemployment is also reflected in the large number of indicators currently used to evaluate this phenomenon. These indicators derive from its differentiation according to a series of criteria such as age, gender, level of education, duration, etc. Calculating unemployment both in absolute terms and as a rate allows the quantification of the size and intensity of this phenomenon, thus facilitating the estimation of costs related to the payment of unemployment benefits and the pressure exerted on social protection systems. At the same time, it allows comparisons both within a country or region and between countries and regions, facilitating an evaluation of labor efficiency as well as the effects generated by changes in certain determinants or by the implementation of specific measures, policies, or strategies targeting the labor market at the local or national level.

At the same time, analyzing unemployment according to the criteria mentioned above allows a better localization of problems (among young people, among women, among those with lower levels of education, duration of unemployment, geographical location, etc.), thus making a major contribution to the formulation of effective public policies aimed at preventing and combating this phenomenon considered “undesirable.”

If we focus specifically on youth unemployment in Romania, before the pandemic, in 2019, the youth unemployment rate was 21%, compared with the EU-27 average of 15.7% [9], and more than four times higher than the overall unemployment rate (4.9%) [10]. During the two pandemic years (2020 and 2021), the youth unemployment rate did not exceed the 21% threshold. However, starting with 2022 (22.8%), and unfortunately even today, it has not returned to the levels recorded in the pre-pandemic years. Meanwhile, the European average, immediately after the two pandemic years, fell below the values recorded before 2020 (14.6% in 2022, 14.6% in 2023, and 14.9% in 2024). As for the gap between the two rates, it narrowed due to a more significant increase in the overall unemployment rate compared to the increase in the youth unemployment rate; however, it continues to be more than three times higher [2], [17], [22].

In this context, the present research aims to focus on young unemployed individuals with the intention of analyzing the influence of cost factors (net earnings/wages), economic efficiency factors (labor productivity), as well as demographic and social factors (youth activity rate) on the youth unemployment rate.

The interest in analyzing the influence of nominal net earnings on the youth unemployment rate stems from the premise that an increase in nominal wages leads to an increase in labor costs for employers. If this increase is not counterbalanced by a rise in labor productivity, respectively by sustainable economic growth, it could lead to a reduction in the demand for labor. In such situations, young people are often among the most affected by the contraction of employment.

Testing the influence of labor productivity on the youth unemployment rate considers both implications of productivity growth: on the one hand, increased competitiveness of firms, which may then decide to expand their economic activity and create new jobs, with young people potentially among the beneficiaries; on the other hand, the situation in which productivity growth is achieved through the automation of production processes, in which case the effect may be the reduction of low-skilled jobs, and young people may again be among those affected, but this time in a negative way.

The analysis of the youth activity rate in relation to the youth unemployment rate aims to verify the direct relationship between the two variables, a relationship mediated by labor supply.

In order to carry out such an approach, the paper has been structured as follows: Section 1 – Introduction, Section 2 – Literature Review, Section 3 – Research Methodology, Section 4 – Results, Section 5 – Discussion, and Section 6 – Conclusions.

## **2. Literature review**

Limiting the analysis of unemployment issues only to youth unemployment (15–24 years), the review of the specialized literature highlights several relevant aspects. First of all, most researchers are concerned with identifying the influencing factors and analyzing the way in which these factors lead either to an improvement or, on the contrary, to an increase in the youth unemployment rate. The range of influencing factors analyzed is extremely diverse, ranging from labor market rigidity [27] to economic growth, inflation rate, and temporary employment.

Many studies show that economic growth positively influences the youth unemployment rate [7], [16], in the context in which the analyses refer to different countries (Poland, Turkey, Albania), as well as different periods and time horizons. On the other hand, a rise in inflation appears to increase the youth unemployment rate [7]. Regarding the relationship between the youth employment rate and temporary employment, this has been shown to manifest itself directly and significantly only in the case of Poland [7].

Other factors frequently encountered in analyses concerning the determinants of the youth unemployment rate examine the relationship between education and youth unemployment, either from the perspective of the quality and efficiency of educational systems [16], [23] in ensuring the transition from the education system to the labor market, or from the perspective of how school

dropout [64] or the attainment of a certain level of education contributes to the evolution of youth unemployment [8].

An interesting approach to the causes generating youth unemployment is provided by Bal-Domanska [2], who analyzes the impact of the structure of the national economy on the youth unemployment rate in EU-28 states, highlighting the major influence exerted by the development of the manufacturing sector on the reduction of the female youth unemployment rate, while “the growing importance of the construction sector translated into a decline in the unemployment rate among young men.”

In a study published in 2023, Başol et al. [4] show how the Digital Economy and Society Index (DESI) contributes to reducing youth unemployment, leading them to conclude that “digitalization seems to be one of the strongest policies that can be used to prevent youth unemployment.”

Lack of skills represents another factor contributing to the increase in youth unemployment [19], alongside lack of opportunity. In this regard, Potuzakova and Bilkova [27] highlight how, in Southern EU and post-communist states, the lack of opportunities to find a job in the countries of residence leads to an increase in the youth unemployment rate. The effect also manifests itself in an acceleration of youth emigration, even in situations where the labor market benefits from favorable prospects for development in the near future.

The quality of the educational system, viewed through the competencies, skills, and attitudes acquired in school [13], or the implementation of a dual learning system [23], is often mentioned as one of the most effective ways of ensuring the transition from school to work when it is closely aligned with labor market requirements. Whether we refer to school achievement or improving skills through vocational training [1], empirical results show that these approaches can be even more effective than “incentivizing firms through wage subsidies to hire and train young labor market entrants” [1]. The higher the level of school achievement, the lower the risk of young graduates facing unemployment [18].

Encouraging flexible forms of employment (part-time, temporary work) [21], [23], [28] is often mentioned alongside entrepreneurship [12], [20], self-employment [28], and more recently the implementation of digitalization [4] as effective strategies for reducing youth underemployment and unemployment.

With regard to the analytical framework, it should be noted that it mainly includes local, regional, and national labor markets. The European Union also presents particular interest, especially from the perspective of making comparisons between member states or in relation to the European average.

### 3. Research framework

The methodology used in this study is based on the application of econometric techniques specific to time series analysis, with the objective of identifying both short-term and long-term relationships between the youth unemployment rate and its main economic determinants. In the first stage, the stationarity properties of the variables are tested using unit root tests, followed by cointegration analysis in order to verify the existence of long-term equilibrium relationships between the series. Since the Johansen test did not indicate cointegration, the analysis of short-term dynamic relationships is carried out using a VAR model, which allows the examination of the interdependencies between variables as well as the direction of cause–effect relationships through Granger causality tests.

#### 3.1. Data and variables analyzed

The empirical analysis uses one **dependent variable** and three **explanatory variables**.

The **dependent variable** is the **youth unemployment rate** for the age group **15–24 years**, expressed as a percentage (%).

The explanatory **variables** included in the model are:

- the **average net nominal wage earnings by activities of the national economy**, measured in lei;
- **labor productivity per employed person**, measured in lei/person;
- the **activity rate for the age group 15–24 years**, measured as a percentage (%).

All variables referring to Romania were obtained from the National Institute of Statistics of Romania [11] and are reported in **current prices**.

To ensure the analysis reflects **real economic dynamics**, nominal wage earnings and labor productivity were **deflated using the Consumer Price Index (CPI, 2021 = 100)** [31].

**Figure 1** illustrates the time evolution of the four economic indicators considered in the analysis. It can be observed that both **average net nominal earnings** and **labor productivity per employed person** exhibit a **general upward trend** over the entire period **1995–2022**.

However, labor productivity also displays several periods of **stagnation or decline**, particularly during the **2009–2011 economic crisis**, as well as in the **period immediately following the COVID-19 pandemic**.

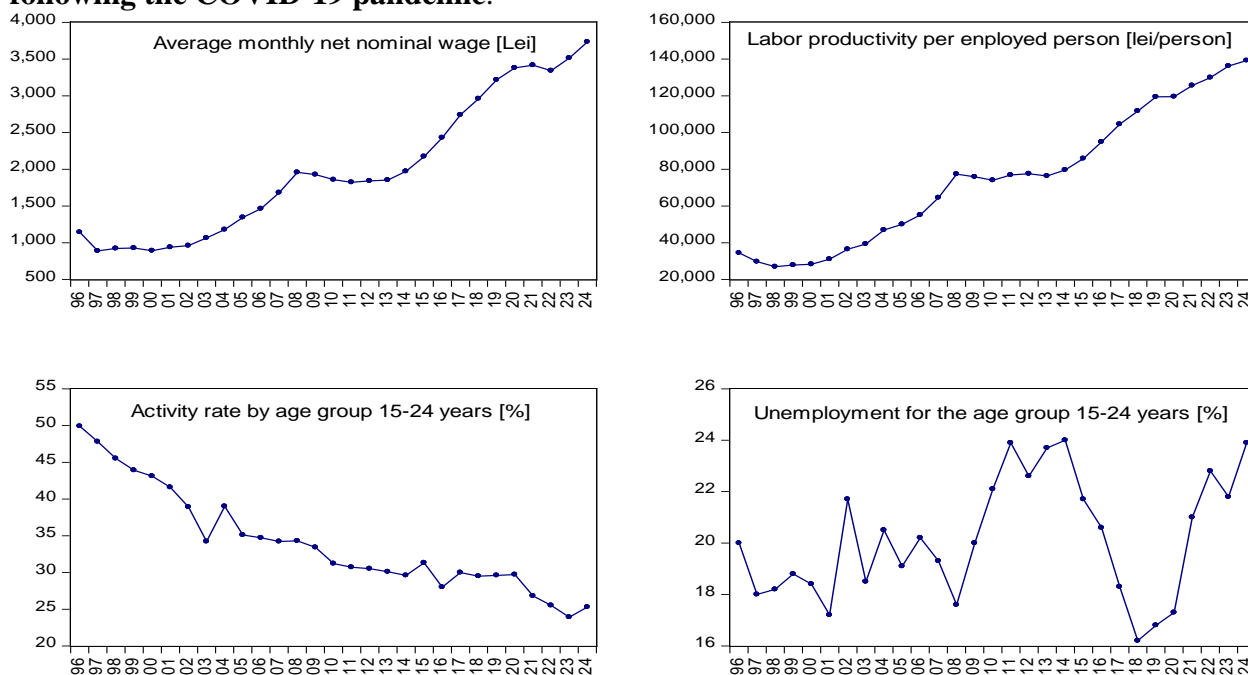


Figure 1. Evolution over time of the analyzed variables. *Source: Authors' processing using Eviews 12.1.*

With regard to the activity rate of young people aged 15–24, a clear downward trend can be observed throughout the analyzed period. While during 1995–1997 more than 45% of young people were actively participating in the labor market, by 2022 this proportion had fallen to below 30%.

This persistent decline reflects significant structural changes in the behavior and opportunities of younger generations. The extension of educational pathways, the increasing share of young people pursuing higher education, the external migration of the young labor force, and discouragement caused by difficulties in labor market integration are among the main factors contributing to this gradual withdrawal from economic activity. Although minor fluctuations occur in certain intervals, they do not alter the overall downward trajectory, suggesting a long-term transformation in youth labor market participation.

The youth unemployment rate for the 15–24 age group displays a volatile pattern, without a clear long-term upward or downward trend, but with considerable variations depending on the economic context. The rate fluctuates between approximately 16% and 26%, indicating a persistently high level of unemployment among young people.

### 3.2. Descriptive indicators and statistical analysis

**Table 1** presents the main statistical indicators calculated for the four variables.

Table 1. Descriptive stats. Source: *Authors' processing using Eviews 12.1.*

	X1	X2	X3	Y
Mean	1983.420	74973.79	34.04483	20.14483
Median	1853.286	76247.54	31.30000	20.00000
Maximum	3734.187	139138.4	49.90000	24.00000
Minimum	887.3239	26874.34	23.90000	16.20000
Std. Dev.	932.7877	36446.19	6.943629	2.333236
Probability	0.280737	0.382062	0.235339	0.443936
Sum	57519.18	2174240.	987.3000	584.2000
Sum Sq. Dev.	24362600	3.72E+10	1349.992	152.4317
Observations	29	29	29	29

The statistical analysis shows the evolution of the **youth unemployment rate for individuals aged 15–24**, which represents the **output variable** in the model. During the analyzed period, the youth unemployment rate recorded an **average value of approximately 20%**, with relatively small variations between **16% and 24%**, indicating a **relatively stable phenomenon without major fluctuations**.

However, the **explanatory variables** show a much more pronounced dynamic. The **average net wage (X1)** has a mean value of approximately **1,983 lei**, but with a wide range between **887 and 3,734 lei**, indicating a **significant increase in wages over time**. **Labor productivity (X2)** records the **largest variation**, ranging from approximately **26,000 lei to 139,000 lei per person**, reflecting **important transformations in economic performance**. The **youth activity rate (X3)** has an average value of **34%**, with moderate variations, suggesting **changes in the level of youth participation in the labor market**.

Overall, the data indicate that the **explanatory variables exhibit sufficient variation to potentially influence the youth unemployment rate**, while the **dependent variable remains relatively stable**, which may lead to a **coherent and interpretable econometric model**.

### 3.3. Stationarity Tests (ADF)

To verify the existence of a **long-term equilibrium relationship** between the **youth unemployment rate** and the explanatory variables (**average wage, labor productivity, and activity rate**), the **Johansen cointegration test** is applied, which is appropriate for systems containing multiple variables integrated of the same order.

In order to **stabilize variance and reduce distribution asymmetry**, all variables were transformed into **natural logarithms**. Subsequently, **stationarity** was tested using the **Augmented Dickey–Fuller (ADF) test**, applied to the **log-transformed series**.

Table 2. Augmented DicKey – Fuller test statistic. Source: *Authors' processing using Eviews 12.1.*

Variable	Test for unit root in	Include in test equation	ADF t-statistic	p-value	Test critical values (5% level)	Interpretare
Log_X1	1 <sup>st</sup> difference D(logX1)	Intercept	-5.616693	0.0001	-2.976263	Stationarity I(1)
Log_X2	1 <sup>st</sup> difference D(logX2)	Intercept	-3.765782	0.0086	-2.976263	Stationarity I(1)
Log_X3	1 <sup>st</sup> difference D(logX3)	Intercept	-8.061448	0.0000	-2.976263	Stationarity I(1)
Log_Y	1 <sup>st</sup> difference D(logY)	Intercept	-5.980414	0.0000	-2.976263	Stationarity I(1)

\*MacKinnon (1996) one-sided p-values

The **Augmented Dickey–Fuller test** applied to the **log-transformed variables** (Table 2) shows that all series become **stationary after first differencing**. For each variable, the **ADF statistics are lower than the critical values at the 5% significance level**, and the **p-values are below the 0.05 threshold**. Thus, all variables are **integrated of order one, I(1)**, which allows the application of the **Johansen cointegration test**.

### 3.4. Johansen Cointegration Test

To verify the existence of a **long-term equilibrium relationship** among the variables included in the model, the **Johansen cointegration test** was applied (Table 3 and Table 4). The test was conducted using the **log-transformed variables integrated of order one**, employing a specification with **intercept**.

**Table 3.** Trace Test – Results of the Johansen cointegration test.

*Source: Authors’ processing using EViews 12.1.*

Hypothesis	Eigenvalue	Trace statistic	Critical value 5%	p-value	Interpretation
$r = 0$	0.4844	38.6673	47.8561	0.2737	The null hypothesis is not rejected
$r \leq 1$	0.3971	20.5713	29.7971	0.3849	The null hypothesis is not rejected
$r \leq 2$	0.0263	2.0670	15.4947	0.9441	The null hypothesis is not rejected
$r \leq 3$	0.0002	0.6687	3.8415	0.4141	The null hypothesis is not rejected

**Table 4.** Maximum Eigenvalue Test – Results of the Johansen cointegration test.

*Source: Authors’ processing using EViews 12.1.*

Hypothesis	Eigenvalue	Max-Eigen statistic	Critical value 5%	p-value	Interpretation
$r = 0$	0.4844	18.0969	27.5843	0.4727	The null hypothesis is not rejected
$r \leq 1$	0.3971	18.5043	21.1316	0.1174	The null hypothesis is not rejected
$r \leq 2$	0.0263	1.3983	14.2646	0.9527	The null hypothesis is not rejected
$r \leq 3$	0.0002	0.6687	3.8415	0.4141	The null hypothesis is not rejected

The **Johansen cointegration test** indicates that both the **Trace statistics** and the **Maximum Eigenvalue statistics** are **lower than the critical values at the 5% significance level**, which means that the **null hypothesis of no cointegration cannot be rejected**.

Therefore, the variables **do not exhibit a long-term equilibrium relationship**.

Since the Johansen cointegration test did not indicate the existence of a **long-term equilibrium relationship between the variables**, the appropriate model for analyzing the dynamics is a **VAR (Vector Autoregression) model estimated in differences**, which captures **only short-term relationships**.

The **VAR model** is a model in which **each variable is explained by its own lagged values as well as by the lagged values of the other variables**.

### 3.5. Estimation of the VAR Model

The **VAR (Vector Autoregression) model** represents one of the most widely used approaches in multivariate time series analysis, introduced by Sims [29] as an alternative to traditional structural models. The **VAR framework** treats all variables in the system as endogenous, allowing

the dynamic interdependencies among them to be captured without imposing rigid a priori causal relationships. In a VAR model, each variable is explained by its own lagged values as well as by the lagged values of the other variables in the system, which makes it possible to capture both direct and indirect effects among the analyzed economic indicators.

A major advantage of the VAR model is its flexibility. It does not require the specification of a complex theoretical structure; instead, it captures the dynamic relationships among variables. In the absence of cointegration among the series, the VAR model is estimated in differences to ensure stationarity and the validity of statistical inference.

Based on the Schwarz lag selection criterion (SC), a VAR model in differences with  $p$  lags was estimated in order to determine the parameters describing the short-term dynamics between the youth unemployment rate and its main economic determinants. The model includes the variables  $D(\text{LOG\_X1})$ ,  $D(\text{LOG\_X2})$ ,  $D(\text{LOG\_X3})$ , and  $D(\text{LOG\_Y})$ , each explained by its own lagged values and by the lagged values of the other variables in the system.

The first difference of a series  $X_t$  is defined as:

$$DX_t = X_t - X_{t-1} \quad (1)$$

When the data series are transformed into logarithms, the first difference of a series is calculated as:

$$D \log(X_t) = \log(X_t) - \log(X_{t-1}) \quad (2)$$

Formally, a VAR model of order  $p$  with  $k$  variables can be expressed as:

$$Y_t = c + A_1 Y_{t-1} + A_2 Y_{t-2} + \dots + A_p Y_{t-p} + \varepsilon_t, \quad (3)$$

where  $Y_t$  is a  $(k \times 1)$  vector of endogenous variables,  $c$  is the vector of constants,  $A_i$  are the coefficient matrices for each lag, and  $\varepsilon_t$  represents the vector of error terms, assumed to be serially uncorrelated.

Based on the lag selection criteria (LR, FPE, AIC, and HQ), the optimal lag for the VAR model is  $p = 1$ . The VAR(1) model was estimated in the logarithmic differences of the analyzed variables. According to the Schwarz criterion, a VAR(1) model in logarithmic differences was estimated for the variables  $y, x_1, x_2, x_3$ .

In the case analyzed here, the VAR(1) model in logarithmic differences, with  $p = 1$  lag, can be written as follows:

$$\begin{aligned} D \log y_t &= c_1 + \sum_{i=1}^1 \alpha_{1i} D \log y_{t-i} + \sum_{i=1}^1 \beta_{1i} D \log x_{1,t-i} + \sum_{i=1}^1 \gamma_{1i} D \log x_{2,t-i} + \sum_{i=1}^1 \delta_{1i} D \log x_{3,t-i} + \varepsilon_{1t} \\ D \log x_{1,t} &= c_2 + \sum_{i=1}^1 \alpha_{2i} D \log y_{t-i} + \sum_{i=1}^1 \beta_{2i} D \log x_{1,t-i} + \sum_{i=1}^1 \gamma_{2i} D \log x_{2,t-i} + \sum_{i=1}^1 \delta_{2i} D \log x_{3,t-i} + \varepsilon_{2t} \\ D \log x_{2,t} &= c_3 + \sum_{i=1}^1 \alpha_{3i} D \log y_{t-i} + \sum_{i=1}^1 \beta_{3i} D \log x_{1,t-i} + \sum_{i=1}^1 \gamma_{3i} D \log x_{2,t-i} + \sum_{i=1}^1 \delta_{3i} D \log x_{3,t-i} + \varepsilon_{3t} \\ D \log x_{3,t} &= c_4 + \sum_{i=1}^1 \alpha_{4i} D \log y_{t-i} + \sum_{i=1}^1 \beta_{4i} D \log x_{1,t-i} + \sum_{i=1}^1 \gamma_{4i} D \log x_{2,t-i} + \sum_{i=1}^1 \delta_{4i} D \log x_{3,t-i} + \varepsilon_{4t} \end{aligned} \quad (4)$$

The estimation of the VAR(1) model (Table 5) in logarithmic differences shows that, in the equation for the youth unemployment rate ( $D\text{LOG\_Y}$ ), none of the included variables are statistically significant. This suggests that short-term variations in unemployment are not influenced by wages, productivity, or the activity rate. In contrast, in the equation for the activity rate ( $D\text{LOG\_X3}$ ), the coefficients associated with the variables  $D\text{LOG\_Y}(-1)$  and  $D\text{LOG\_X3}(-1)$  are statistically significant. This indicates that an increase in youth unemployment in the previous period leads to a decrease in the activity rate in the current period, while the activity rate exhibits a negative autoregressive dynamic.

Table 5. Estimation of the VAR(1) Model

Vector Autoregression Estimates  
Date: 02/20/26 Time: 20:41  
Sample (adjusted): 1998 2024  
Included observations: 27 after adjustments  
Standard errors in ( ) & t-statistics in [ ]

	DLOG Y	DLOG X1R	DLOG X2R	DLOG X3
DLOG_Y(-1)	-0.107281 (0.21004) [-0.51076]	-0.136794 (0.10857) [-1.25994]	-0.067622 (0.11428) [-0.59171]	-0.243207 (0.09568) [-2.54176]
DLOG_X1R(-1)	0.326280 (0.39688) [ 0.82211]	0.002965 (0.20515) [ 0.01445]	0.292793 (0.21594) [ 1.35591]	0.209254 (0.18080) [ 1.15740]
DLOG_X2R(-1)	-0.527200 (0.42038) [-1.25409]	0.357821 (0.21730) [ 1.64669]	0.268124 (0.22873) [ 1.17225]	-0.075787 (0.19150) [-0.39575]
DLOG_X3(-1)	-0.306996 (0.35707) [-0.85975]	0.049259 (0.18457) [ 0.26688]	-0.288352 (0.19428) [-1.48420]	-0.523882 (0.16266) [-3.22065]
C	0.015741 (0.02629) [ 0.59870]	0.036666 (0.01359) [ 2.69792]	0.023796 (0.01431) [ 1.66341]	-0.041915 (0.01198) [-3.49956]
R-squared	0.146052	0.309064	0.428182	0.495160
Adj. R-squared	-0.009211	0.183439	0.324215	0.403371
Sum sq. resids	0.212312	0.056727	0.062851	0.044059
S.E. equation	0.098237	0.050779	0.053450	0.044751
F-statistic	0.940675	2.460212	4.118444	5.394538
Log likelihood	27.10340	44.92084	43.53671	48.33247
Akaike AIC	-1.637289	-2.957099	-2.854571	-3.209812
Schwarz SC	-1.397319	-2.717129	-2.614601	-2.969842
Mean dependent	0.010500	0.053225	0.057267	-0.023564
S.D. dependent	0.097788	0.056194	0.065019	0.057937
Determinant resid covariance (dof adi.)		5.09E-11		
Determinant resid covariance		2.24E-11		
Log likelihood		177.7852		
Akaike information criterion		-11.68779		
Schwarz criterion		-10.72791		
Number of coefficients		20		

**Parameters**

To evaluate whether the VAR(1) model is stable and well specified, a stability test based on the analysis of the roots of the autoregressive polynomial (AR Roots) was applied (Figure 2).

Inverse Roots of AR Characteristic Polynomial

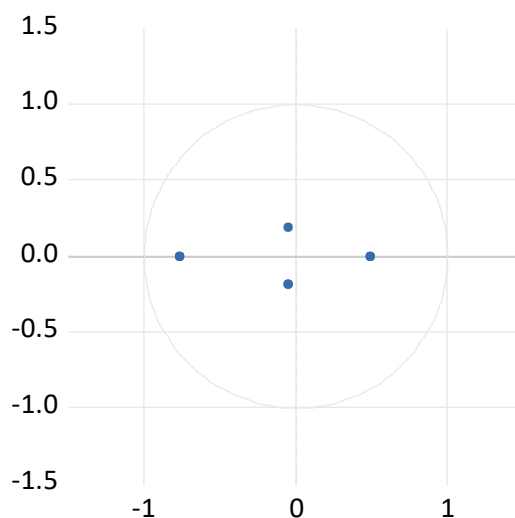


Figure 2. Stability Test of the VAR(1) Model

Since all roots lie inside the unit circle, we can conclude that the VAR(1) model is stable and well specified. Therefore, the impulse response functions and the forecast error variance decomposition can be interpreted in a valid manner.

In order to determine the direction of the dynamic relationships between the variables, the Granger causality test was used, which verifies whether the lagged values of one variable significantly contribute to explaining another (Figure 3).

VAR Granger Causality/Block Exogeneity Wald Tests  
Sample: 1996 2024  
Included observations: 27

Dependent variable: DLOG_Y				Dependent variable: DLOG_X2			
Excluded	Chi-sq	df	Prob.	Excluded	Chi-sq	df	Prob.
DLOG_X1	0.675871	1	0.4110	DLOG_Y	0.350119	1	0.5540
DLOG_X2	1.572745	1	0.2098	DLOG_X1'	1.838501	1	0.1751
DLOG_X3	0.739174	1	0.3899	DLOG_X3	2.202850	1	0.1378
All	3.032755	3	0.3866	All	5.519039	3	0.1375

Dependent variable: DLOG_X1				Dependent variable: DLOG_X3			
Excluded	Chi-sq	df	Prob.	Excluded	Chi-sq	df	Prob.
DLOG_Y	1.587455	1	0.2077	DLOG_Y	6.460540	1	0.0110
DLOG_X2	2.711602	1	0.0996	DLOG_X1	1.339582	1	0.2471
DLOG_X3	0.071225	1	0.7896	DLOG_X2	0.156615	1	0.6923
All	3.707555	3	0.2948	All	12.15189	3	0.0069

Figure 3. Granger Causality

The results indicate the existence of a significant Granger causality relationship from the youth unemployment rate (DLOG\_Y) to the activity rate (DLOG\_X3), with an associated probability of 0.011. This suggests that variations in youth unemployment contribute to explaining the dynamics of the activity rate. For the other pairs of variables, no significant causality relationships were identified.

To evaluate how a shock in one variable influences the evolution of the other variables in the system, the impulse response functions (IRF) derived from the VAR(1) model were analyzed (Figure 4).

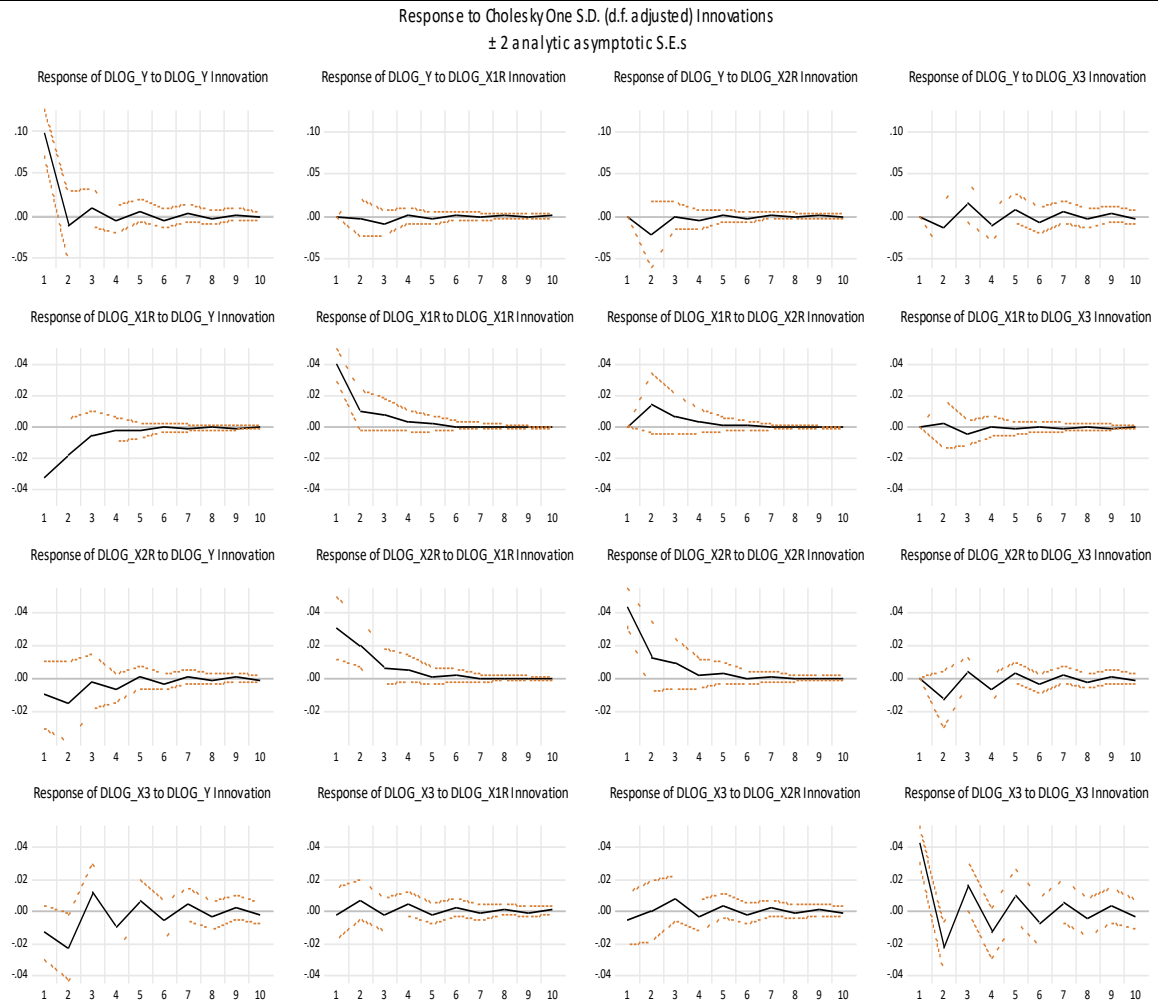


Figure 4. Impulse Response Functions (IRF)

The analysis of the impulse response functions (IRF) shows that most variables display weak or insignificant reactions to shocks in the other variables, indicating limited short-term dynamics within the VAR system. The only clearly identified effect is the negative response of the activity rate (DLOG\_X3) to a shock in the youth unemployment rate (DLOG\_Y), suggesting that an unexpected increase in unemployment leads to a decline in youth participation in the labor market. This result is consistent with the Granger test, which indicates the existence of a causal relationship from unemployment to the activity rate. Otherwise, the responses of the variables are small and fade quickly, confirming the absence of strong short-term interdependencies.

## Variance Decomposition using Cholesky (d.f. adjusted) Factors

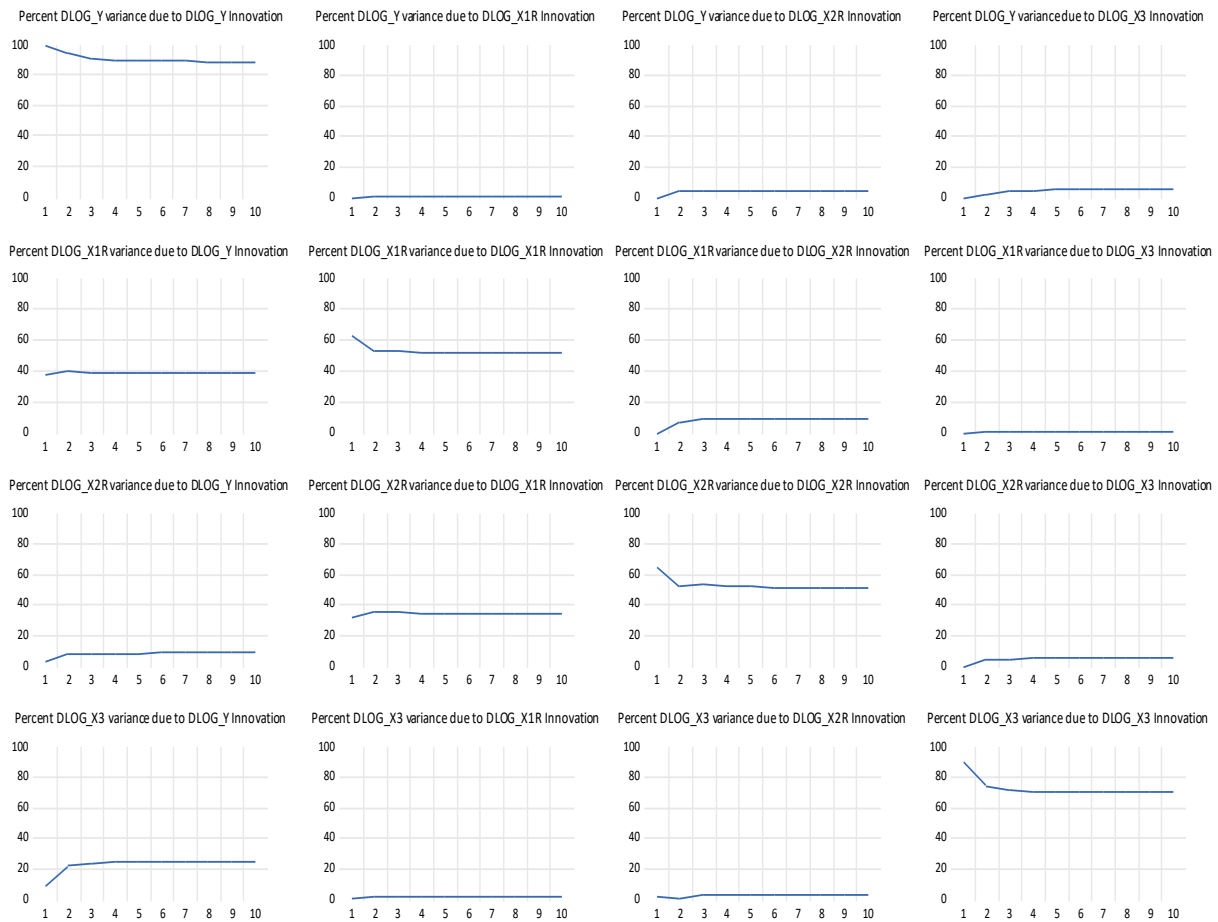


Figure 5. Variance Decomposition (FEVD)

The results of the variance decomposition (FEVD) (Figure 5) show that most variables in the VAR(1) model are mainly explained by their own shocks, indicating strong internal dynamics and limited short-term interdependence. The only notable relationship is observed in the case of the activity rate (DLOG\_X3), for which shocks in the youth unemployment rate (DLOG\_Y) explain a significant part of its variation over longer horizons. This result is consistent with the Granger test and the impulse response functions, confirming that the evolution of youth unemployment influences their participation in the labor market.

#### 4. Interpretation of the results

The analysis carried out using the VAR(1) model provides a clear picture of the dynamic relationships among the analyzed variables. The obtained results indicate that, overall, the system exhibits low short-term interdependence, with most variables being dominated by their own internal dynamics.

The stability test (AR Roots) confirms that the VAR(1) model is stable, as all roots lie within the unit circle. This result validates the specification of the model and allows for the safe interpretation of the subsequent tests (Granger, IRF, FEVD).

The Granger test highlights a single significant causal relationship: the youth unemployment rate “Granger-causes” the activity rate. This suggests that unexpected developments in youth unemployment influence their participation in the labor market, while the other variables do not exhibit significant causal relationships among themselves.

The impulse response functions (IRF) confirm this result. A positive shock in youth unemployment generates a negative reaction in the activity rate in the first periods, indicating that

an increase in unemployment leads to the withdrawal of young people from the labor market. In contrast, the responses of the other variables to external shocks are weak and fade quickly, indicating low sensitivity to short-term influences.

Variance decomposition (FEVD) reinforces the same conclusion. Most variables are explained to a very large extent by their own shocks, indicating a high degree of autonomy in their dynamics. The only notable exception is the activity rate, for which shocks in youth unemployment explain an increasing share of the variation as the time horizon expands.

## 5. Discussions

The results obtained from the application of the VAR (Vector Autoregression) model, appropriate only for testing short-term dynamic relationships among the analyzed variables, show that the youth unemployment rate is not influenced by wages, labor productivity, or the youth activity rate. In fact, these results indicate a high degree of autonomy in their dynamics, without revealing any short-term interdependence among them. Although in this case no correlation between wages and youth unemployment could be identified, the neoclassical perspective and previous studies [23], [28] have shown that increases in the minimum wage may raise youth unemployment when higher labor costs lead to a reduction in labor demand.

Also, in this case no cointegration relationship could be identified between labor productivity and the youth unemployment rate, although in a study published in 2018, Bayrak and Tatli [5] highlighted the existence of a direct relationship between labor productivity and youth unemployment. Previously, Parisi et al. [25], analyzing the relationship between youth unemployment and labor productivity in several European and OECD countries, point out that the relationship is neither simple nor direct, but rather mixed and influenced by other labor market factors, particularly temporary employment. Thus, while in some countries a high level of labor productivity could be correlated with high youth unemployment (Italy, France, Belgium in certain periods), in other countries, such as Ireland, high labor productivity coexists with low youth unemployment rates. At the OECD level, no significant direct relationship appears between labor productivity and youth unemployment.

The application of the Granger test identified a single significant causal relationship, according to which unexpected developments in youth unemployment influence the participation of young people in the labor market. Overall, the results suggest that youth unemployment is the variable with the most important role in influencing the activity rate, while wages and productivity have a limited impact on short-term dynamics.

The model therefore confirms the existence of a discouragement mechanism in the labor market: an increase in unemployment leads to a decrease in youth participation in economic activities.

## 6. Conclusions

Many countries continue to face high unemployment rates among young people. The issue of youth in relation to the labor market is addressed both from the perspective of employment and unemployment, the two processes being complementary. The concern to identify the most effective instruments and strategies for reducing youth unemployment has led researchers to focus on investigating numerous aspects considered relevant in this regard, contributing to the creation of a true “recipe” for ensuring the successful integration of young people into the labor market.

The choice by policymakers of instruments and measures intended to facilitate a smooth transition of graduates into the labor market - by helping them find secure and fairly paid jobs - proves to be conditioned by a wide variety of factors such as the economic context, the structure of the national economy, demographic evolution, and others.

Therefore, one of the limitations of this study is that the analysis considers only a limited number of factors influencing the evolution of youth unemployment. Another limitation is related

to the geographical context, as the analysis examines only the influence exerted by nominal net earnings, labor productivity, and the youth activity rate on youth unemployment in Romania.

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