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Research article

Unemployment rate and its relationship with government size, trade, inflation, urbanization, and economic growth in Romania

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ABSTRACT

Unemployment is an important phenomenon affecting all economies, especially during crises such as the recent COVID-19 pandemic. Besides, the government size is significant for all the formerly planned and centralized economies, like the Central and Eastern European countries. This study aims to investigate the impact of government size, income tax, economic growth, inflation, trade openness, and urbanization process on the unemployment level in Romania from 1991 to 2021. After testing the nonlinearity property, the findings of the nonlinear autoregressive distributive lag (NARDL), estimations show a positive influence of urbanization on unemployment. Conversely, government size significantly reduces the unemployment rate in Romania. Inflation and trade are negatively associated with unemployment, while taxation has a positive impact. In this regard, the Romanian authorities should adopt appropriate measures to support governmental expenditure, they need to collect budgetary tax that can reduce the unemployment rate, unless some efficiency measures are adopted such as defeating tax evasion which is high in Romania.

1. Introduction

During the last decades, global economies faced increasing unemployment that has determined significant public policy measures to fight this phenomenon and cause large public deficits, public indebtedness, and the resurge of inflation rate and economic growth [1]. The relationship between inflation and the unemployment rate was expressed by the Phillips curve, which stated a negative association between these two macroeconomic variables in the short run. However, this negative relationship doesn't hold in the long run, as the practice of numerous economies showed after the oil crisis of the 1970s, because unemployment depends on an economy's structural variables, while inflation is a monetary variable. After a severe crisis of consumption goods poverty faced during the 1980s,

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Romania started its transition period in 1990. Among the transition costs, Romania bared high inflation, high public deficits, and a high unemployment rate [2]. The rise of inflation in Romania was determined at the beginning of the transition by the corrections of the distortions of the price system and by the collapse of economic growth because of the restructuring of the Romanian economy on market principles. High unemployment was also caused by the bad management of the restructuring process, maintaining the workforce in inefficient sectors with low labor productivity, increasing nominal net wages, and adopting relatively passive employment policy actions that managed effects rather than causes of this phenomenon. However, there is an insignificant relationship between inflation and unemployment in Romania from 1990 to 2009 because unemployment was determined mainly by productivity changes, and regulations [2].

Meanwhile, monetary factors impacted inflation not only labor market factors. So, in Romania, it was difficult for fiscal or monetary policy to fight against the unemployment rate because of the absence of an association between inflation and the unemployment rate. At the beginning of the transition period, deferring privatization and restructuring of state-owned enterprises determined a low unemployment rate because of concealed unemployment. Moreover, Romanian unemployment rate was also determined by early retirements caused by the restructuring of large state-owned enterprises, so the unemployment rate was under-evaluated for a long time. The experience of Central and Eastern European (CEE) countries showed that countries that allowed higher unemployment rate and rapid restructuring recovered their GDP growth before 1989 (Poland, Slovakia, Hungary), while Romania allowed high inflation but low unemployment rate and slow restructuring achieved only in 2004 the same level of economic growth as the one of 1989.

Unemployment is not only associated with inflation but also with the economic growth rate. When economic growth increases, unemployment typically decreases. So, there should be a negative link between these time variables, and this negative relationship could be best observed during the crisis periods. Economic crises generated low labor demand and a decrease in income levels. In crisis times, poverty, unemployment, job insecurity, and social inequality are increasing [3]. Low consumption and production, especially during the crisis periods, reduced access to external financing for an extended period, loss of some traditional foreign markets, informal workers without work contracts, and low funding from education and vocational training generated unemployment and low labor productivity in Romania. The public sector adjusted slowly, deferring restructuring of the labor force after the election period while cutting wages, while the private sector changed instantly. In this regard, many countries liberalized their trade to boost their economic activity and for increasing foreign investment. The positive relationship between trade openness and economic activity was

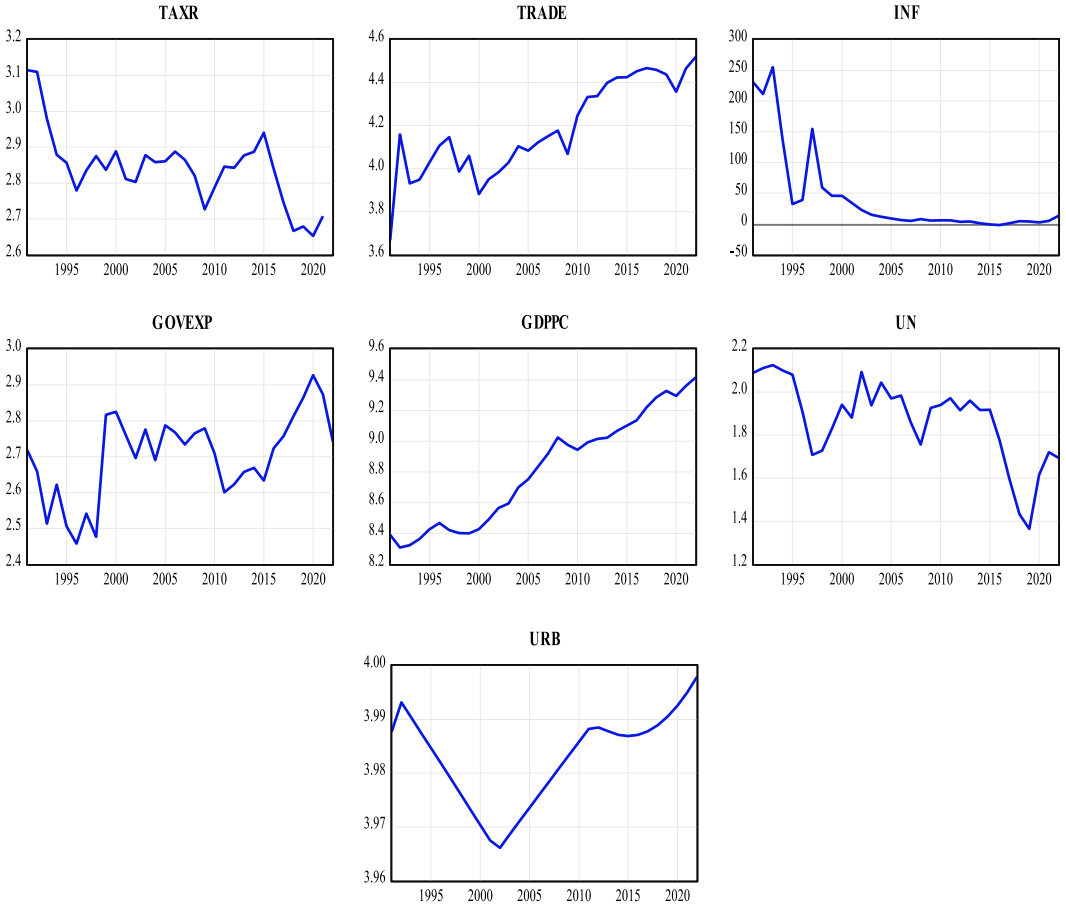

Fig. 1. Trend of the variables in Romania during 1991–2022.

demonstrated in Romania [4]. Nevertheless, in some cases, the relationship between trade openness and investments is negative in Romania. Some other studies also demonstrated a negative relationship because foreign investment inflows depend also on tax rates, labor costs, trade deficits, trade policies and restrictions, and inflation, besides trade openness.

Few studies elaborated for European countries on the nexus between taxation (corporate and labor taxation) and unemployment rate found that corporate taxation determined fewer detrimental effects on the performance of the European labor markets, compared to labor taxation. It affected less labor supply. Still, it induced large welfare costs especially for European countries with the highest trade openness [5]. For Romania, the impact of tax on income on economic activity was found to be positive, against many other studies elaborated for other countries or regions. Consequently, a higher tax rate on income supports economic growth and can diminish the unemployment level [6].

It is also observed a direct association between the unemployment rate and public deficit, inflation, and economic growth for the Middle East and North Africa (MENA) and Eurozone countries [1]. Furthermore, it is also demonstrated that a strong positive relationship between these variables in European countries [7]. On the flip side, this relation can also be negative because a rise in public expenditure for social purposes, reconversion, and training programs can cause a decrease in unemployment in the medium and long run [8].

As for the relationship between urbanization and unemployment, this was under-investigated for EU economies. The rapid urbanization process is related to sustained and robust economic growth that determines new jobs. This relationship for developed, and developing economies and found that urbanization is negatively related to unemployment only in developed economies but negatively related to unemployment for the rest of the country groups [9]. This can be explained by the fact that in developing and emerging economies, urban areas expansion is not always linked to the growth of economic activity but is slightly driven by rapid population growth and high social inequality detrimental to the low-skilled labor force or for young people with no or few experiences in the labor market that acts mostly in the informal sectors.

The unemployment rate has a lot of fluctuations, which had a downward trend from 1993 to 1997, and then went through an upward trend, and in the years 2015–2019, it again had a downward trend, and then an upward trend. Its highest value was reached in 1993, and its lowest was in 2019 (Fig. 1). In 2022, the unemployment level was 5,44 % against 6,2 % in the entire EU area. However, although unemployment peaked in 1993, Romanian unemployment levels were among the lowest in the Central and Eastern European Union (CEEU) because of the early retirement system allowed by the state during the privatization of state-owned enterprises. This process generated a massive exodus of the labor force to Western European countries after the collapse of the communist regime. Concerning the per capita income growth variable, the facts and figures show that it has gone through an upward trend during the years, except for the years 1992, 1997–1999, 2009, 2010, and 2020. These years represent periods when Romania faced deep crises. During 1992–1993 the price system was liberalized after the communist era, and during 1997–1999 the exchange rate was liberalized. During both periods, there were significant fluctuations in the inflation and exchange rates simultaneously with the restructuring process of the entire Romanian economy. It can be seen that 2007–2009 was the period when the international financial crisis erupted worldwide. In 2020, the pandemic crisis stopped economic activity generating unemployment, recession, and inflation, while the public deficit increased to sustain the economies during the health crisis.

Regarding the urbanization variable, its graph is similar to the letter V, which shows a complete downward trend from 1992 to 2002 and then upward. Urbanization trend was also determined by the restructuring of the economy on sectors, increasing the role of the tertiary sector significantly after 2000, and early retirements during the 90s′ during the privatization process in the first decade of transition. Inflation and government size also show fluctuations. The inflation variable showed an almost downward trend when it reached its lowest level in 2014. Governmental spending of GDP represented 39.7 % in 2022 (against an EU average of 50 %), after its peak level of 41.5 % in 2020. Trade openness displayed a dynamic increasing trend during the entire investigated period, especially after 2007 when Romania joined the EU, 2022 reaching its highest level of 91.98 %. Tax revenues (share of GDP) displayed a descending trend, except for a short period after the financial crisis of 2008–2011, when they slowly increased. In 2022 they represented 30.98 % of GDP in Romania against the EU average of 45.4 %. In 2022, corporate tax was 16 %, the lowest level in the EU, except for Bulgaria (World Bank database).

This study aims to investigate the determinants of the rate of unemployment in Romania based on the non-linear ARDL model, which includes as explanatory variables economic growth, inflation, urbanization, trade openness, and tax rate on income and government size for an extended period from 1991 to 2022. The research gap that we are trying to fill is represented by building a model by including urbanization and government size as explanatory variables because this relation was under-investigated for the former communist countries, which display large government sizes inherited from the former centralized structure of their economies. We also added as control variables economic growth rate and inflation because these relations, although investigated, have led to mixed results. Also trade openness is a significant variable for a highly open economy such as Romania which has joined the EU and largely developed its intra-trade. Government size is essential for former communist countries with a large public sector. Also, Romania is a particular case considering that unemployment is determined by informal work, early retirements allowed by the legislation and an intense migration process. Urbanization was forced during the communist era, and also faced a rapid trend ever since the communist era as a result of the industrialization process Romania faced back then.

After a period of decreasing trend back in the 90s, the urbanization rate has started to increase sharply as a result of the development of the services sectors in Romania, the tertiary sector, while agriculture faced a decrease in its share of GDP and the rural area remained under-developed. Income tax is also a definitory variable for the Romanian economy since tax evasion was estimated at a level higher than 10 % of GDP in Romania in 2023 (National Institute of Statistics, 2023), the highest tax evasion among EU countries (Eurostat database). Romania displayed high labor taxation, but lower capital taxation among European countries to attract foreign investors. Starting with 2023, the Romanian government adopted a fiscal measures package meant to increase taxation on income for

the private sector to diminish excessive budgetary deficit and adopted some measures that aim to diminish tax evasion here. However, high taxes on income and tax evasion are highly positively correlated.

All the explanatory variables are intercorrelated and display their effects on the unemployment rate. Urbanization can support unemployment decrease in the context of adequate labor skills of people, skills that can be achieved by public investments in the education sector and training sessions financed and organized by governmental organizations. Trade openness supports the boosting of economic activity, and that can determine new jobs into the economy. Inflation can support economic activity up to a certain level, and then, at high levels, the effects are detrimental to the entire economy. Inflation also depends on taxes on income and government expenditure. Higher taxation can reduce inflationary pressures on the economy, but it can determine tax evasion and affect the economic growth rate. While government expenditure feeds inflationary pressures and can reduce unemployment in the short run.

Considering all these explanatory variables, and their inter-correlations it is important to settle their impact on the unemployment rate for Romania, which is an open European economy, with high and robust economic growth rates, large government size, and forced urbanization inherited from the communist era and with a low tax on income comparing to the rest of the European countries. This is the first study investigating the relation between government size and unemployment in Romania, considering these socio-economic determinants such as economic growth, inflation, taxation, urbanization and trade openness.

2. Literature review

2.1. Economic growth and unemployment nexus

Many studies have examined the link between unemployment and economic growth in economics literature. One of the first notable theories to investigate the association between real output unemployment is Okun's Law, which proved a reverse relationship between unemployment and economic growth. Okun revealed that an increase in real GDP leads to an increase in employment (Okun, 1962). Indeed, this rule generally demonstrated that with a one percent rise in the growth rate, unemployment would decline by 0.5 %, provided that the actual GDP growth rate is lower than its potential growth [10].

The linkage between unemployment and GDP growth demonstrates a correlation between them. An increase in economic growth will lead to an expansion in employment or a diminution in unemployment. The increase in the growth of any country in the economic dimension leads to an increase in the volume of economic growth and productivity improvement, which can ultimately create new and more job opportunities in the country (Hjzeen et al., 2021). In many countries, the economy is not at full employment, or due to low productivity, the labor force has low efficiency, and its full capacity is not used. In this case, it will grow production by growing the labor force's productivity deprived of employing a new labor force if demand increases. Likewise, unemployment specifies the incidence of poor economic performance and shows that the available resources have not been used to the maximum levels [11].

Unemployment is a macroeconomic variable of particular interest to countries due to its importance in economic and social dimensions. Unemployment originates from the economic structure of a nation, and the cause of its existence is dissimilar in different regions. For example, unemployment in developed countries is caused by technological advances, and in underdeveloped countries; a lack of capital causes it. Managing the economy in a situation with a high unemployment rate and balancing the supply and demand of labor is very difficult. Studies on the association between unemployment and economic growth can be divided into three groups. Initially, this revealed a negative relationship between the study time series. In this regard, Ceylan and Şahin [12] demonstrated a negative association between economic growth and unemployment from 1995 to 2005 in Turkey. Furthermore, Ruxandra [13] proved the existence of Okun's law during 2007–2013 by using the Hodrick-Prescott filter and correlation method in the case of Romania. With the linear mixed-effects approach, Bartolucci et al. [14] showed an inverse linkage between unemployment and growth in developed and developing economies. Besides, Olaniyi et al. [15] surveyed the connection between unemployment and GDP growth in Nigeria from 1980 to 2015. The estimated results indicated a negative and positive linkage between growth and unemployment in the short and long run, respectively. Moreover, Siddiqa [11] investigated the factors affecting unemployment in selected developing countries from 2000 to 2019 and showed that GDP negatively affects unemployment. Moreover, Padder and Mathavan [16] surveyed the link between GDP and unemployment in India from 1990 to 2020. The results of linear regression and causality methods indicated the negative relationship between mentioned variables.

Also, the causal relationship between them was not observed. Al-kasbah (2022) reviewed the connection between GDP growth and unemployment in Jordan with the ARDL method and confirmed the existence of Okun's law. It means that a 1 % reduction in GDP leads to a 0.276 % rise in unemployment. Besides, Panaite et al. (2022) examined the causal link between GDP and unemployment in Romania and showed unidirectional causality from unemployment to GDP. Moreover, Liu et al. [17] surveyed several variables affecting unemployment and showed the negative linkage between GDP and unemployment in OIC countries by using the DCCE method. Su et al. [18] investigated the impact of the COVID-19 pandemic on unemployment in European countries. This study found that slowing the pace of economic activity in industry and services generated high unemployment rates in all European countries that claimed a rapid public response in public policy worldwide to reduce the impact of growing unemployment levels. Conversely, Leasiwal et al. (2022) studied the factors affecting Indonesia's unemployment from 2001 to 2020. The outcome revealed a direct linkage between unemployment and growth. Finally, the last group is studies that have shown an insignificant relationship. Finally, Thapa et al. [19] showed that the association between unemployment and growth in Nepal is insignificant. Also, the existence of Okan's law was not confirmed in Nepal.

Based on the previous findings we elaborated the following hypothesis:

Q1. Economic growth reduces unemployment.

2.2. Urbanization and unemployment nexus

Studies have shown that urbanization causes unemployment in urban areas due to high population growth and rural-urban migration. Migration from the countryside to the city is caused by the lack of jobs, which increases the percentage of urbanization. Urbanization is a process in which the urban population increases through natural population growth, rural-urban migration, and physical expansion of cities [20]. Urbanization, which is the result of rapid and uncontrolled rural-urban migration, does cause the labor market to face severe problems with the movement of the population from villages to cities.

In classical theories, urbanization is a phenomenon defined by the widespread rural-urban migration in search of job chances in the non-agricultural sector and the transformation of rural people into urban people. The lack of welfare and financial facilities and services leads to the stimulation of people to rural-urban migration to find better jobs and higher income. This issue affects young people more because urbanization increases the possibility of using technology and better facilities [21]. With the decrease in household income due to unemployment and the emergence of social problems such as poverty and the increase in marginalized and poor areas, the possibility of crime will also increase [22]. Even though employment opportunities in urban areas are more than in rural areas, employment in urban areas also requires higher skills. Consequently, the competition for employment is more in urban areas. Planned urbanization can be considered a positive factor in improving life quality [20]. However, unplanned urbanization can harm the life quality in rural and even urban areas through the change of land use and the reduced cultivated area, increasing agricultural sector unemployment (Gossop, 2011). Additionally, Sati et al. [20] revealed that urbanization increases unemployment in rural areas and areas near the urban region. Finally, it can be claimed that few researchers have directly surveyed the impact of urbanization on the unemployment rate.

Q2. Urbanization decreases unemployment.

2.3. Inflation and unemployment nexus

The continuous general price level increase in the long term is called inflation. In other words, inflation occurs when the general price level surpasses its average level, and the value of the national currency decreases. Estimating and investigating the association between unemployment and inflation is imperative for several reasons. Many central banks pursue the goals of price stability and full employment. Nevertheless, these goals may be incompatible and not in the same direction. Therefore, it is very important to fully and adequately understand the relationship between these two variables.

Furthermore, after the financial crisis of 2008, unemployment had an increasing trend despite the constant inflation rate. In the classical general equilibrium, there is no unemployment, except where labor markets are subject to rules such as setting the minimum wage. But today's world economy is not entirely classical. Since the early 1970s, the continuous rise in prices in the long run period in developed and developing countries caused the inflation problem to be more attention. One of the first studies on the linkage between inflation and unemployment was conducted by Phillips [23]. After the study of Phillips [23], which has an inverse linkage between unemployment and wages, the link between unemployment and inflation became known as the Phillips curve. Samuelson and Solow (1960) extended the Phillips theory, took inflation rather than wage in the model, and proved an inverse linkage between wage and unemployment. Many researchers have claimed that the Phillips curve is only valid for explaining the short-term relationship between inflation and unemployment [24]. Friedman [25] criticized the Phillips model and raised the issue that unemployment is related to inflation and unanticipated inflation. Therefore, the issue was raised that the Phillips curve is vertical [24,26].

Despite the criticisms of the Phillips curve over the years, many studies have been conducted, and each has presented different results. Additionally, Reinbold and Wen [27] proved the association between unemployment and inflation is still significant and inverse. However, many other studies found a significant negative relationship between inflation and the unemployment rate in Romania [28,29]. Moreover, Iordache et al. [30] investigated the Romanian case during 2004–2014, and they found a negative relationship between inflation and unemployment. Still, its intensity modified over time, especially in 2007, once the financial crisis erupted, so the slope of the Phillips curve was diminished. Furthermore, Erdal et al. (2015) indicated a reverse link between inflation and unemployment in Turkey and confirmed the existence of the Phillips curve by using the VAR approach. Additionally, Bokhari [26] argued that there is a long-term negative causal link between inflation and unemployment in Saudi Arabia. But in the short run, there is an insignificant association between the mentioned variables. Also, Aliu et al. [24] surveyed the association between inflation and unemployment in former Yugoslav countries. The outcomes showed a reverse association between inflation and unemployment in Slovenia, Croatia, and Montenegro. In contrast, the model showed a direct linkage between unemployment and inflation in Kosovo, North Macedonia, Serbia, and Bosnia. In addition, Fratianni et al. [31] used the Wavelet method in the UK and proved the inverse and persistent association between wage inflation and unemployment.

Q3. Inflation decreses unemployment.

2.4. Government size and unemployment nexus

Over the past three to four decades, humanity has experienced rapid and extensive changes across nearly all areas of social life. These developments have spurred the accumulation of knowledge in various fields, from economics and finance to education, health, and international relations. Consequently, this progress has inevitably influenced the political processes and public administration systems of states [32]. Economists have always tried to determine the role of the government in the economy. In contrast to the Keynesians, who believed in the effectiveness of the government in the path of economic growth, the classics were against the

enlargement of the government and believed in price mechanisms. Consequently, the relationship between the government and unemployment is considered a challenging issue [33]. Scully (1989) stated that the size of the government and the unemployment rate are not only related, but for some reason, this relationship has deleterious effects on economic growth. Regarding the reasons, it can mention the things that affect the work motivation of the workforce. The first is that with the growth in the size of the government, the tendency to increase taxes rises, which affects the workforce's working hours and leisure time and has a diminishing effect on work motivation.

On the other hand, rising taxes increase unemployment by reducing disposable income and aggregate demand [33]. Secondly, as the size of the government increases, the costs of providing health insurance, unemployment insurance, and welfare services will also enhance. This issue can have a reducing effect on the workforce's motivation by reducing the cost of unemployment. Thirdly, pressure on private investment may lead to unemployment. Also, government expansion may reduce labor market efficiency by tightening regulations. Finally, increasing the size of the government will restrict the private sector from employing the existing workforce because the salaries paid by the government will be significantly different from the private sector. Furthermore, Ahmet and Dökmen [34] showed a positive effect of Government expenditure (% of GDP) on unemployment. In addition, Afonso et al. [35], in emerging market countries using the DOLS approach, revealed the direct linkage between Government size (expenditure) and unemployment. Moreover, Abouelfarag and Qutb [36] in Egypt, using data from 1980 to 2017 and the VECM approach, demonstrated the negative effect of Government expenditure on unemployment. By using the SUR method, Almula-Dhanoon et al. [33] demonstrated the reverse link between government size and unemployment in MENA countries. Likewise, Shighweda [37] also revealed the same result for Namibia using the ARDL method. Besides, Anjande et al. [38] applied the GMM and PMG methods and indicated a reverse linkage between government expenditure and unemployment in African countries. Reducing public expenses during economic crises determines low financing of education, lower investments, poverty, and an increase in unemployment because of austerity measures [8].

Q4. Government size decrease unemployment.

2.5. Trade openness and unemployment nexus

Trade openness is also considered one of the most influencing factors affecting the process of unemployment. In this pursuit, Dutt et al. [39] studied the linkage between international trade and unemployment and proved a positive and negative relationship in the short and long run respectively in a panel of 90 economies. Similarly, Nwaka et al. [40] showed a significant role of economic growth in reducing unemployment and vice versa a surge effect of trade openness in unemployment in Nigeria. Besides, Gozgor (2014) concluded that a rise in trade openness leads to a decline in unemployment in G-7 economies. Indeed, the results showed a negative association between trade and unemployment. Also, Anjum and Perviz [41] bid to detect the effect of trade openness on unemployment in labor and capital-abundant economies. The results stated an inverse and direct linkage between the mentioned variables in countries with an abundance of labor and capital respectively. Alkhateeb et al. [42] showed a positive impact of trade openness and economic growth on employment in the long run by performing the ARDL technique in Saudi Arabia. Kılıç and Kutlu [43] exhibited a diminishing effect of trade openness on unemployment in 17 transition economies by performing the dynamic panel approach. Additionally, Liu et al. [17] carried research out on the linkage between unemployment and trade openness in OIC countries and revealed a reverse and direct relationship between the mentioned variables in the lower-income and higher-income respectively. Furthermore, Ali et al. [44] along with the DCCE method proved an inverse linkage between trade openness and unemployment in low-income OIC economies against the direct link in high-income economies. Nguyen [45] along with the VAR model showed that a rise in trade openness and GDP can lead to a surge in unemployment in South Asia countries.

Q5. Trade openness decreases unemployment.

2.6. Tax rate and unemployment nexus

Planas et al. [46] showed that dropping the taxation can help to reduce unemployment in European countries. Seward [47], using a panel approach in industrialized countries, found that a 1 percent increase in labor tax leads to a 0.53 percent increase in unemployment. Berger and Everaert [48] studied the influences of tax on unemployment in Nordic countries, the EU, and the UK. The outcomes presented a positive impact of tax just in EU countries. Aghazadeh et al. [49] along with the VAR method proved that increasing taxes has a vital role in the unemployment surge in Iran. Domguia et al. [50] surveyed the effects of tax on employment by GMM and Two Stage Least Square (2SLS) approaches in OECD and non-OECD countries and caught the surprising results. The outcomes stated that the taxes have a positive effect on total employment, fiscal policies will create new jobs in environmental protection areas. Also, the employment of men will be positively stimulated by the imposition of taxes. Zuo et al. [51] claimed that in China a reduction in the income tax rate can boost total employment by affecting employee wages and asset returns. Also, tax reduction can raise the employment of private companies, but it has an insignificant effect on the employment of government companies.

Q6. Tax increases unemployment.

2.7. Research gap

This study stands out in the literature on unemployment through its integration of innovative aspects and focused analysis, offering a comprehensive and distinctive perspective. By employing the nonlinear NARDL model, the study explores both short- and long-term

effects of key macroeconomic variables on unemployment, highlighting the asymmetric impacts of taxation. This nuanced approach, which separates positive and negative effects, bridges a critical gap in existing research that predominantly assumes linear relationships.

The inclusion of variables such as urbanization and government size as primary determinants enriches the analysis, particularly for Romania's unique context as a transition economy. These factors, often overlooked in similar studies, are essential to understanding the structural transformations and policy challenges of economies with post-communist legacies. Romania's economic history—marked by forced urbanization and centralized policies—provides a fertile ground for investigating the interplay between macroeconomic factors and unemployment. By examining this specific context, the study generates insights that extend beyond Romania, offering lessons applicable to other transitioning economies.

3. Theoretical underpinning

Government size is often measured by public sector employment or government expenditure and may influence the rate of unemployment. Theoretically, a larger size of government can generate more jobs in the public sector, leading to lesser rates of unemployment level. Furthermore, government strategies, for example, regulations in the labor market and social welfare agendas can affect the unemployment proportion. For instance, substantial unemployment assistance may dishearten people from vigorously seeking jobs, possibly leading to sophisticated unemployment rates. Additionally, international integration and trade openness can distress the rate of unemployment. Hypothetically, augmented trade can tend to profession formation in the course of foreign direct investment and export-oriented industries. Economies that specialize in industries with a comparative advantage may practice lower rates of unemployment own to augmented demand for their products and services. Nevertheless, in a few cases, trade liberalization can also lead to job dislodgment, mainly in industries that aspect augmented race from imports [52]. The association between the unemployment rate and inflation is designated by the Phillips curve theory. Conferring to the Phillips curve, there is a negative association between unemployment and inflation in the short run. This suggests that lower unemployment rates are linked with higher inflation rates, and vice versa. The justification behind this association is that when the economy operates at low unemployment levels, enlarged labor demand can lead to rising compression in wages, after higher inflation [53]. However, urban areas offer more employment prospects compared to rural areas owing to the meditation of services, industries, and infrastructure. As urbanization rises, people residing in rural areas may migrate to cities in search of employment, possibly dipping the rate of unemployment. Additionally, economic growth is frequently connected with lower rates of unemployment. Theoretical influences recommend that as an economy develops, it generates more job openings, leading to a decline in the rate of unemployment [54]. Higher economic growth encourages investment, upsurges productivity, and raises business development, all of which subsidize job formation. On the other hand, economic recessions or downturns can tend to higher rates of unemployment as industries diminish their labor force to cut budgets. The associations between these intended time series in Romania may be influenced by precise appropriate features, policy outlines, and other country-specific appearances. Consequently, directing an empirical analysis employing suitable econometric methods, such as the NARDL test can help regulate the direction and strength of such associations in the context of Romania.

4. Data and research methods

4.1. Data description

This study examines the impact of government size, trade openness, economic growth, and tax revenues on unemployment by controlling the other factors affecting unemployment such as urbanization and inflation in the case of Romania. The period of the present study is 1991–2022, which was chosen based on the availability of data. Table 1 shows symbols, index definitions, and data sources. Equation (1) expressed the unemployment function which can be drawn as follows:

$$\ln(UN) = \beta_0 + \beta_1 \ln(GDP_t) + \beta_2 \ln(URB_t) + \beta_3 \ln(INF_t) + \beta_4 \ln(GOVEXP_t) + \beta_5 \ln(TAXR_t) + \beta_6 \ln(TRADE_t) + \varepsilon_t \quad (1)$$

where, ln represents natural logarithm, URB represents urbanization and INF represents inflation, GDP denotes economic growth, GOVEXP is government size, TAXR is tax income and Trade is trade openness. The unemployment rate is the dependent variable and targets the level of economic unemployment.

The descriptive statistics of the variables are presented in Table 2. It is observed that there is no big difference between minimum,

Table 1
Definition of index and data source.

Variable	symbol	Definition of index	Source
Unemployment	UN	Percentage of total labor force (modeled ILO estimate)	[55]
GDP	GDP	Constant 2015 US$	[55]
Urbanization	URB	Percentage of total population	[55]
Inflation	INF	Consumer prices (annual %)	[55]
Government expenditure	GOVEXP	Percentage of GDP	[55]
Tax revenue	TAXR	Percentage of GDP	[55]
Trade Openness	TRADE	Sum of exports and imports of goods and services measured as a share of GDP	[55]

maximum and mean values of all intended variables, which depicts that the minimal chances of structural break in the data set.

This correlation analysis inspects the linear associations between the intended variables. Table 3 presents the bivariate correlation analysis between each pair of time series along with the corresponding p-values. In this regard, TAXR has a negative correlation with TRADE and a positive correlation with Inflation. Besides, TRADE has a negative correlation with INF. Moreover, GOVEXP has a negative correlation with TAXR and a negative correlation with INF. In addition, GDP has a negative correlation with TAXR and a positive correlation with TRADE. However, the UN has a positive correlation with INF and a negative correlation with TRADE. Furthermore, URB has a positive correlation with TRADE and a positive correlation with GDP growth.

4.2. Unit root and cointegration test

In econometric modeling of time series, the stationarity of time series variables should be examined. For this purpose, unit root tests, including the generalized Dickey Fuller (1979), were used. In this test, an AR (1) autoregressive relationship is estimated as in eq. (2):

$$\Delta y_t = \alpha + \beta y_{t-1} + \mathscr{E}_t \;\; ; \quad \varepsilon_t \sim i.i.d \; N(0, \sigma^2) \tag{2}$$

The above relationship, Δy_t represents the first-order difference, α is the drift term and β is the pattern coefficient. Also, the disturbance term ($\mathscr{E}_t$) represents a white noise process with zero mean and constant variance, where $\mathscr{E}_t$ is uncorrelated for t≠s. In the univariate test, the t-statistics of the residuals are compared with Dickey-Fuller's critical values [56]. In the Dick-Fuller test, the null hypothesis indicates a unit root and the opposite hypothesis indicates the existence of a stable root [57]. If the residuals remain correlated in the first-order autoregressive model, the test is generalized by Δy_{t-1} to so-called higher-order autoregressive processes [58]. If the process is null, then the null hypothesis is rejected. Johansson and Juselius derived the likelihood ratio test for autocorrelation vectors. The autocorrelation rank can be obtained with two Tris statistics and the maximum eigenvalue, as per eq. (3) and eq. (4):

$$X_t = \alpha + \sum_{j=1}^{n} B_j X_{t-j} + \sum_{i=1}^{k} \gamma_i Y_{t-i} + u_{1t} \tag{3}$$

$$X_t = \beta + \sum_{j=1}^{n} \lambda_j X_{t-j} + \sum_{i=1}^{k} \sigma_i Y_{t-i} + u_{2t} \tag{4}$$

4.3. Nonlinear BDS test

Before using non-linear tests, this study performs the BDS non-linearity test proposed by Brock et al. [59], 1996) to determine the presence of non-linear dependence in the data. The BDS test is applied to the residuals of the economic freedom series [60]. If the test statistic is greater than the critical value of the standard normal distribution at normal levels, non-linearity is indicated. The BDS nonlinearity test is based on the correlation integral of the time series as in equation (5):

$$W_m(\varepsilon, T) = \frac{\sqrt{T}[C_m(\varepsilon, T) - C_1(\varepsilon, T)^m]}{\sigma_m(\varepsilon, T)} \tag{5}$$

where $W_m(\varepsilon, T)$ is the BDS test statistic, $\sigma_m(\varepsilon, T)$ stands for the standard deviation of $C_m(\varepsilon, T)$, m is the embedded dimension, while ε represents the maximum difference between the considered pair of observations in calculating the correlation integral. The BDS test statistic is asymptotically distributed without mean and unit variance (for example [N (0,1)].

Table 2
Descriptive statistics and correlation.

	TAXR	TRADE	INF	GOVEXP	GDPPC	UN	URB
Mean	2.842944	4.173955	43.99277	2.701197	8.792653	1.877384	3.982460
Median	2.845857	4.146387	7.850803	2.718028	8.835452	1.918392	3.985812
Maximum	3.114488	4.467701	255.1669	2.926755	9.360310	2.125012	3.995058
Minimum	2.652135	3.667022	−1.544797	2.457289	8.308263	1.363537	3.966132
Std. Dev.	0.105067	0.210385	72.63372	0.119185	0.349021	0.191007	0.008243
Skewness	0.595357	−0.162223	1.909012	−0.368630	0.080152	−0.986513	−0.532260
Kurtosis	4.133945	2.300178	5.265360	2.499356	1.557377	3.580507	2.078947

Table 3
Correlation analysis.

	TAXR	TRADE	INF	GOVEXP	GDP	UN	URB	VIF
TAXR	1.00000							2.06
	–							
TRADE	−0.51342	1.00000						5.43
	(0.0031)	–						
INF	0.67453	−0.57492	1.00000					5.87
	(0.0000)	(0.0007)	–					
GOVEXP	−0.41752	0.24041	−0.38463	1.00000				2.12
	(0.0194)	(0.1926)	(0.0327)	–				
GDP	−0.62414	0.85962	−0.67858	0.52448	1.00000			8.18
	(0.0002)	(0.0000)	(0.0000)	(0.0025)	–			
UN	0.71089	−0.59473	0.40801	−0.43873	−0.63437	1.00000		–
	(0.0000)	(0.0004)	(0.0227)	(0.0135)	(0.0001)	–		
URB	−0.04582	0.54035	0.17888	−0.03314	0.46265	−0.23379	1.00000	4.35
	(0.8066)	(0.0017)	(0.3356)	(0.8595)	(0.0088)	(0.2056)	–	

Note: P-values are reported in parentheses.

4.4. NARDL tests

The implication of Eq. (1) is that the unemployment rate is affected by the level of economic growth, urbanization, inflation, Tax revenue and government size. This study aims to address the following key research question:

4.4.1. How do economic factors such as government size, urbanization, trade openness, inflation, and tax revenue—particularly the asymmetric effects of tax revenue—affect the unemployment rate in Romania?

The traditional autoregressive distributed lag (ARDL) test is a widespread econometric approach applied to examine the long-run and short-run associations between candidate variables. Whereas it has numerous advantages, it is significant to deliberate its possible assumptions and limitations made during the empirical analysis. In the framework of ARDL precise examination, there are a few possible limitations such as the ARDL approach needs stationarity assumption. If the variables are non-stationary, spurious regression results may occur, leading to unreliable conclusions. Moreover, it also considers the omitted variable bias, and endogeneity issues like ARDL adopts that the explanatory variables are exogenous, meaning they are not influenced by the dependent variable or other variables in the model. Moreover, ARDL requires specifying the appropriate lag lengths for the dependent and independent variables. Choosing the optimal lag length can be subjective and may impact the results. Additionally, ARDL estimates may suffer from low statistical power and imprecise parameter estimates, when the sample size is relatively small. Finally, ARDL does not consider the sensitivity analyses, robustness checks, and comparisons with alternative models that can help strengthen the reliability of the findings. Finally, it also does not consider the nonlinear relationship between variables. In this regard, to investigate nonlinear and asymmetric cointegration between variables, the method of autoregression band test with multivariate nonlinear distribution breaks (NARDL) developed by Shin et al. [61] is used. To do this, firstly we applied linear ARDL developed by Ref. [62] and modified by Ref. [63] after that we converted it into the NARDL framework.

The NARDL method distinguishes between short-term and long-term effects of independent variables on the dependent variable. Even if all the previous facts can be tested in a non-linear threshold error correction model (VECM) or a smooth transition regression model, these models suffer from the convergence problem caused by the expansion of the number of parameters. However, the NARDL model does not have this problem [64]. In addition, unlike other error correction models that require the variables to be of the same level, the NARDL model does not have this limitation, regardless of whether the variables are I (0), I (1) or a combination of both. As shown in the study by Hoang et al. [65], this flexibility is very important. Finally, this method also helps to solve the multiple collinearity problem by solving the appropriate interval for the variables [61]. The NARDL model proposed by Shin et al. [61] shows the asymmetric error correction model as in eq. (6):

$$\begin{aligned}\Delta ln(UN_t) = {} & \alpha_0 + \rho\, ln(UN_{t-1}) + \theta_1\, ln(GDPPC_{t-1}) + \theta_2\, ln(URB_{t-1}) + \theta_3\, ln(INF_{t-1}) + \theta_4\, ln(GOVEXP_{t-1}) + \theta_5\, ln(TRADE_{t-1}) \\ & + \theta_6^{+}\, ln\left(TAXR_{t-1}^{+}\right) + \theta_7^{-}\, ln\left(TAXR_{t-1}^{-}\right) + \sum_{i=1}^{P} \alpha_1 \Delta ln(UN_{t-i}) + \sum_{i=0}^{q} \alpha_2 \Delta ln(GDPPC_{t-i}) + \sum_{i=0}^{q} \alpha_3 \Delta ln(URB_{t-i}) \\ & + \sum_{i=0}^{q} \alpha_4 \Delta ln(INF_{t-i}) + \sum_{i=0}^{q} \alpha_5 \Delta ln(GOVEXP_{t-i}) + \sum_{i=0}^{q} \alpha_6 \Delta ln(TRADE_{t-i}) + \sum_{i=0}^{q} \alpha_7 \Delta ln\left(TAXR_{t-i}^{+}\right) + \sum_{i=0}^{q} \alpha_8 \Delta ln\left(TAXR_{t-i}^{-}\right) \\ & + D_t + \mu_t \end{aligned} \tag{6}$$

In Eq. (2), α_i are short-term coefficients, while θ_i indicates long-term coefficients with i = 2, 1 … Short-term analysis is considered to evaluate the immediate effects of changes in the exogenous variable on the dependent variable, and on the other hand, long-term analysis is used to measure the reaction time and speed of adjustment towards an equilibrium level. Furthermore, the independent variables are divided into their positive and negative partial values for increase and decrease as in eq. (7) and eq. (8):

$$X_t^+ = \sum_{j=1}^{t} \Delta X_j^+ = \sum_{j=1}^{t} \max\left(\Delta X_j, 0\right) \tag{7}$$

$$X_t^- = \sum_{j=1}^{t} \Delta X_j^- = \sum_{j=1}^{t} \min\left(\Delta X_j, 0\right) \tag{8}$$

To test the presence of asymmetric long-term cointegration, Shin et al. [61] suggest the border test, which is a common test of all levels of regressions. Two tests are used for the existence of long-term co-accumulation: t-statistic from Banerjee et al. [66] and F-statistic from Pesaran et al. [63]. The t statistic tests the null hypothesis $\theta = 0$ against the alternative hypothesis $\theta < 0$. The F statistic examines the null hypothesis $\theta^+ = \theta^- = \theta = 0$. These two statistics are used in the present study. If the null hypothesis of no co-accumulation is rejected, the existence of a long-term relationship between the variables is confirmed.

5. Results and discussion

The first step of the econometric estimation process is to test the integration order of the intended time series. In this regard, this study employs the Dickey-Fuller (DF) unit root test. This test is the most well-known approach used to determine the stationarity of time series. This test is used to determine whether or not there is a unit root in time series variables. The assumption of randomness and homogeneity in the distribution of error terms is the foundation of the conventional DF test [67]. First, to determine whether or not the data would provide statistically significant findings, a stationarity test was carried out using the DF (Dickey-Fuller) unit root test. The outcomes are provided in Table 4. The estimated outcomes report that UN, GDPC, GOVEXP, and TAXR are not stationary at level I (0). Moreover, URB, INF, and TRADE are stationary at the first difference I (1). This shows that none of the single variables are stationary at the second difference I (2). This recommends that the ARDL modeling framework is more suitable for these variables.

To ensure the non-linearity of the variables, the Brock, Dechert and Scheinkman (BDS) test was used in this study. The null hypothesis of the BDS test is that the data are independently and identically (i.i.d) distributed. The rejection of the null hypothesis shows the existence of non-linear dependence between the data. In Table 5, the values of the BDS statistic indicate the non-linearity of the dependent variable trend. Therefore, the NARDL approach can be used.

Table 6 presents the findings of lag order selection criteria of the studied model. According to the findings of AIC, SC, and HQ lag selection criteria, the optimal lag selection is one.

Table 7 explores the findings of the Johansen cointegration test. The estimated results of the Johansen cointegration approach reveal that all six hypothesized numbers of cointegrated equations are significant at a 5 % level in both unrestricted cointegration rank test (Trace) and unrestricted cointegration rank test (Max-eigenvalue) except the last cointegrated equation, respectively. This revealed the rejection of the null hypothesis of no cointegration. Hence, the long run relationship between the intended variables has been identified.

The long-run and short-run coefficients are estimated through the NARDL model. In this regard, Table 8 presents the results of NARDL estimations and reveals that the coefficient of urbanization exhibits a positive relationship and significance with unemployment in the long run at a 1 % significant level. This implies that a 1 % increase in the value of the urbanization process will determine a 26.999 % increase in the unemployment rate. These results align with previous studies' findings [68,69]. Furthermore, Sati et al. [20] revealed that urbanization increases unemployment in rural areas and areas near the urban region. From NARDL estimations, we can notice that urbanization is the most important factor impacting Romanian unemployment during the investigated period. The main reason behind this coefficient is that urbanization from rapid and uncontrolled rural-urban migration causes the labor market to face severe problems with the movement of the population from villages to cities. This is the specific case of Romania also because during the communist era, there was a large industrialization process, and people were forced to move from the rural areas to big cities and work in the industry sectors. Another reason for this high coefficient is that once the economic restructuring began, some large industries started to collapse, which aggravated unemployment problems after 1989.

From the perspective of trade openness and unemployment nexus, it is observed that there is a negative relationship between trade openness and unemployment in the case of Romania. Particularly, a 1 % increase in trade openness will reduce the unemployment level by 2.5911 % in the long run. The major reason behind this phenomenon is that opening up trade can lead to increased

Table 4
Dickey-Fuller unit root test.

Variables	I (0)		I (1)	
	Level		First difference	
	t-stats.	Prob.	t-stats.	Prob.
UN	−2.286869	0.4283	−4.857210	0.0026
URB	−4.731516	0.0036	–	–
GDPC	−2.331967	0.4052	−4.557697	0.0053
INF	−5.415421	0.0007	–	–
GOVEXP	−3.038871	0.1384	−6.015501	0.0001
TAXR	−2.747236	0.2263	−4.497934	0.0065
TRADE	−4.557754	0.0052	–	–

Table 5
BDS test.

	Dimension	BDS Statistic	Std. Error	z-Statistic	Prob.
UN	2	0.178814	0.010136	17.64118	0.0000
	3	0.287087	0.016474	17.42703	0.0000
	4	0.351975	0.020064	17.54277	0.0000
	5	0.383543	0.021398	17.92456	0.0000
	6	0.386168	0.021126	18.27938	0.0000
GDP_{PC}	2	0.173412	0.007301	23.75230	0.0000
	3	0.284938	0.011716	24.31984	0.0000
	4	0.357541	0.014086	25.38183	0.0000
	5	0.406098	0.014828	27.38685	0.0000
	6	0.436698	0.014449	30.22417	0.0000
URB	2	0.152272	0.009678	15.73336	0.0000
	3	0.247118	0.015680	15.75971	0.0000
	4	0.296459	0.019037	15.57296	0.0000
	5	0.317364	0.020237	15.68270	0.0000
	6	0.317360	0.019914	15.93671	0.0000
INF	2	0.154057	0.026955	5.715393	0.0000
	3	0.248615	0.044318	5.609753	0.0000
	4	0.346163	0.054685	6.330110	0.0000
	5	0.410641	0.059126	6.945183	0.0000
	6	0.447902	0.059209	7.564763	0.0000
GOVEXP	2	0.077470	0.011937	6.490193	0.0000
	3	0.109377	0.019363	5.648795	0.0000
	4	0.127674	0.023541	5.423414	0.0000
	5	0.135438	0.025063	5.403949	0.0000
	6	0.144346	0.024702	5.843594	0.0000
TAXR	2	0.136790	0.018422	7.425384	0.0000
	3	0.191879	0.030073	6.380506	0.0000
	4	0.210769	0.036815	5.725102	0.0000
	5	0.183655	0.039477	4.652212	0.0000
	6	0.234784	0.039197	5.989855	0.0000
TRADE	2	0.106787	0.009406	11.35355	0.0000
	3	0.194135	0.015278	12.70701	0.0000
	4	0.272747	0.018595	14.66749	0.0000
	5	0.312658	0.019817	15.77688	0.0000
	6	0.320381	0.019551	16.38718	0.0000

Table 6
Lag order selection criteria.

Lag	Log L	LR	FPE	AIC	SC	HQ
0	30.63530	NA	4.87e-05	−1.41719	−1.28922	−1.37128
1	172.0125	253.7539*	5.49e-08*	−8.20576*	−7.69390*	−8.02211*
2	180.1729	13.39136	5.79e-08	−8.16271	−7.26694	−7.84131

competition from foreign firms, which may result in job displacement in certain industries. This is particularly true for industries that face strong international competition. For example, if a country opens up its markets to cheaper imports, domestic producers may struggle to compete, leading to layoffs and increased unemployment in those industries. On the other hand, trade openness can also lead to job creation in certain industries. When a country engages in international trade, it can access larger markets and export its products abroad. This increased demand for domestic goods and services can stimulate production and create employment opportunities [70]. Additionally, increased international trade can support export-oriented industries, leading to new job opportunities in those sectors. Furthermore, the effects of trade openness on unemployment can also be influenced by the skill requirements of a country's workforce. When trade barriers are lowered, certain industries may benefit more than others, depending on their comparative advantage. Industries that require highly skilled workers and rely on innovation and technology may benefit from increased trade openness, leading to job creation in those sectors. However, industries that rely on lower-skilled labor and face intense foreign competition may experience job losses.

The relationship between tax revenue and unemployment can be complex and multifactorial, influenced by a range of economic and policy factors. From the perspective of tax revenue and unemployment nexus, it is observed that there is a positive relationship between tax revenue and unemployment in the case of Romania. Particularly, a 1 % increase in positive shock in tax revenue will increase the unemployment level by 3.7779 % in the long run. Moreover, a 1 % increase in negative shock in tax revenue will also increase the unemployment level by 1.2821 % in the long run. The main reason behind this relationship is that tax policies can also have an impact on job creation and thus affect unemployment rates. For example, if taxes on businesses and corporate profits are reduced, this can encourage businesses to invest, expand, and create new jobs, contributing to lower unemployment rates. However, if

Table 7
Johansen cointegration test findings.

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob. Critical Value
None *	0.995218	448.7848	159.5297	0.0000
At most 1 *	0.958182	293.8402	125.6154	0.0000
At most 2 *	0.907402	201.7821	95.75366	0.0000
At most 3 *	0.884549	132.7769	69.81889	0.0000
At most 4 *	0.620346	70.16848	47.85613	0.0001
At most 5 *	0.576971	42.08212	29.79707	0.0012
At most 6 *	0.391666	17.13298	15.49471	0.0281
At most 7	0.089501	2.719097	3.841465	0.0992
Unrestricted Cointegration Rank Test (Max-eigenvalue)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob. Critical Value
None *	0.995218	154.9447	52.36261	0.0000
At most 1 *	0.958182	92.05809	46.23142	0.0000
At most 2 *	0.907402	69.00518	40.07757	0.0000
At most 3 *	0.884549	62.60841	33.87687	0.0000
At most 4 *	0.620346	28.08636	27.58434	0.0431
At most 5 *	0.576971	24.94914	21.13162	0.0138
At most 6 *	0.391666	14.41388	14.26460	0.0474
At most 7	0.089501	2.719097	3.841465	0.0992

Table 8
Results of long-term coefficients of NARDL model.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Long-run outcomes				
URB	26.99932	8.793496	3.070374	0.0066
TRADE	−2.591172	0.644795	−4.018601	0.0008
TAXR_POS	3.777916	0.837703	4.509852	0.0003
TAXR_NEG	1.282062	0.378428	3.387865	0.0033
INF	−0.001986	0.001009	−1.967191	0.0648
GOVEXP	−0.579848	0.318219	−1.822168	0.0851
GDPPC	−0.645057	0.402961	−1.600792	0.1268
C	−87.70836	30.82412	−2.845446	0.0107
Short-run outcomes				
D (TRADE)	−1.080960	0.179592	−6.018967	0.0000
D (TAXR_POS)	1.006045	0.434833	2.313634	0.0327
D (INF)	−0.000198	0.000305	−0.649852	0.5240
CointEq (-1)*	−0.801236	0.107567	−7.448740	0.0000
R-squared	0.882723		F-Bounds Test	4.267979
F-statistic	12.31661		5 % I (0)	2.17
Prob. (F-statistic)	0.000005		5 % I (1)	3.21

taxes are increased on businesses and individuals, this could potentially discourage business investment and hiring, leading to increased unemployment rates [71]. Moreover, during periods of economic expansion and low unemployment rates, tax revenue tends to increase. This is because more people are employed, earning more money, and therefore paying more in taxes. Additionally, businesses tend to have higher profits and pay more in corporate taxes. This can contribute to increased government revenue and surplus budgets. On the other hand, the provision of unemployment benefits can also have an impact on tax revenue. When individuals receive unemployment benefits, they pay less in income taxes and may also be eligible for additional social welfare support during periods of joblessness. This can result in lower tax revenue for the government, but it can also contribute to increased economic stability by providing a safety net for those who have lost their jobs.

In addition, the coefficient of inflation also negatively and significantly contributes to the unemployment decrease. It indicates that a 1 % increase in the inflation rate would decrease the rate of unemployment by 0.0019 % in the long run. In this regard, Bokhari [26] argued that there is a long-term negative causal link between inflation and unemployment in Saudi Arabia. Fratianni et al. [31] proved the inverse and persistent association between wage inflation and unemployment in the UK. Recently, Aliu et al. [24] investigated the relationship between inflation and unemployment in former Yugoslav countries and validated an inverse association for Slovenia, Croatia, and Montenegro. These findings are also consistent with Ciurilă and Murarașu [28], and Jula and Jula [29] for Romania. They have found a strong and long-run negative association between inflation and unemployment in Romania. Romania allowed high inflation rates and lower unemployment in the first decade of transition, which impeded the economic growth's rapid recovery [72]. Economic growth recovered during the 2000s′ when inflation started to reach one single-digit value, while unemployment stayed low

also.

The relationship between government size and unemployment is challenging [33]. The increase in the government's expenditure by 1 % will reduce the employment rate in Romania by 0.5798 % in the long run. In this regard, Afonso et al. [35] proved the direct association between Government size (expenditure) and unemployment in emerging countries. Furthermore, Ahmet and Dökmen [34] showed a positive effect of Government expenditure on unemployment in OECD countries. This positive association is explained by increasing public expenses for social purposes, decreasing the unemployment cost, and the motivation to reintegrate into the labor market. This was also the case in Romania as a transition economy, in the first stages when the restructuring process led to large compensatory wages for people who lost their jobs. This situation lasted until regulations limited the duration of unemployment allowance and until the conditions for getting it became stricter in proving that unemployed people are actively looking for jobs. The error correction model (ECM) coefficient represents the proportion of yearly convergence that occurs from short-run equilibrium to long-run equilibrium.

Summarizing the results of the NARDL analysis we can highlight the most important factors impacting on unemployment rate in Romania:

- The most significant effect displayed by urbanization determined an increase in the unemployment level in Romania because it was a forced urbanization process that made people move from the rural areas to big cities and their work skills needed time training and reconversion to adapt to the industrial or services sectors demand for labor force
- Revenue tax also positively impacted on unemployment rate in Romania. Increasing taxation negatively impacts business and that deters the new job creation process.
- Trade is negatively associated with the unemployment rate in Romania because exports represent the engine of Romanian economic growth. The economic sectors that are export-oriented employ many people.
- A much weaker impact is displayed by GDP per capita and by governmental expenditure, both being in a negative relation with the unemployment rate. Economic boom and increased public expenditure support creating jobs or the reintegration of unemployed people into the labor market.
- The weakest impact is displayed by the inflation rate, a negative impact, but the inflation rate was very low for a long period in Romania after 2000.

Unplanned urbanization can harm the life quality in rural and even urban areas increasing agricultural sector unemployment (Gossop, 2011). Sati et al. [20] revealed that urbanization increases unemployment in rural areas and areas near the urban region. Also moving to urban areas required qualified work skills to adapt to the new industrial or services sectors. This takes time and also implication and support from the public authorities that have to organize reconversion and training courses for people in this situation. Also, it requires large funding allocated for the education sector. Everaert (2010) proved a positive association between taxation and unemployment for EU countries, and Zuo et al. [51] found similar results for China. Hence, the impact of taxation is the same matter for developed or developing economies. That is explained by the fact that increasing taxation creates a burden for business and that affects creating new jobs. The negative association between trade openness and unemployment was demonstrated by many studies for developed, but also for developing countries. Exports support economic growth and can create many new jobs in export-oriented sectors. That was proved by Gozgor [73] for G-7 developed economies. Alkhateeb et al. [42] showed a positive impact of trade openness and economic growth on employment in the long run. Kılıç and Kutlu [43] exhibited a diminishing effect of trade openness on unemployment in transition economies. The impact of government expenditure on unemployment can be positive but also negative. It can be positive because a rise in social expenses can diminish the motivation to work. But this is true only for developed economies with a well-developed social system. In developing economies, such as Romania, the relation of government expenses with unemployment is negative because if the public expenses for social purposes decrease, the living standard is very negatively impacted and the risk of social exclusion becomes high. The unemployed people need support to get reinserted into the labor market. And that means higher public spending on education, training, or for social purposes. Similarly, Almula-Dhanoon et al. [33] demonstrated the reverse link between government size and unemployment in MENA countries. Anjande et al. (2020) found the same negative relation for African countries. Likewise, Şahin et al. [8] proved that for the US, but studying only the COVID-period, which was a specific period for unemployment trend. All our hypotheses (except Q2 on relation between urbanization and unemployment) were validated for Romania. Forced urbanization in Romania created umbalance on the labor market because of a labor force without proper skills and knowledge for new sectors and jobs.

The findings of diagnostic tests are provided in Table 9. According to the results of the diagnostic tests, there was no evidence of heteroscedasticity and serial correlation. The diagnostic procedures and the normality and model structure stability also established the presence of cointegration. This implies that the NARDL model's findings are reliable, robust, and consistent.

Table 9
Diagnostic tests.

Classical hypothesis testing	Statistic	Prob.
Jarque-Bera Test	4.672651	0.0966
Serial Correlation LM Test	2.099716	0.1550
Heteroskedasticity Test	2.312167	0.1553
Ramsey RESET Test	1.134845	0.3016

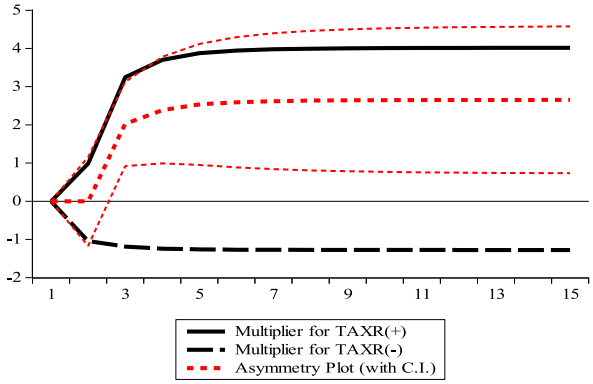

Fig. 2. Dynamic multiplier graph for TAXR.

Table 10
Asymmetry test.

TAXR	**F-statistic**	5.71755	0.01261
	Chi-square	11.43510	0.00328

Likewise, the dynamic multiplier graphs are employed to check the linearity due to negative and positive shocks or changes/components in the unemployment rate. As presented in Fig. 2, the multiplier curves portray the validation of asymmetric alteration of unemployment to its negative and positive shocks in the long run. This time series indicator is portrayed in a graphical form that also determines that the beneficial shocks of tax revenue have more influence on the level of unemployment than negative shocks in the long run during the intended period and specified unemployment function.

To test the short- and long-run asymmetries (nonlinearity), the present study accomplished the WALD asymmetric method. Table 10 presents the findings of the asymmetry test to check the nonlinearity. The empirical evidences of this approach expose that the long run and short run asymmetric/nonlinear connection exists between tax revenue in the case of the Romanian economy.

6. Conclusion and recommendations

The unemployment rate is a significant element affecting the whole economy. It has a tremendous financial and psychological influence on the persons who do not participate in the labor force and on the homes that those individuals support. At the level of the national economy, a high unemployment rate has a negative impact not just on society but also on the economy. A higher unemployment rate results in a decrease in tax revenue (caused by the loss of income by jobless people) and an increase in government spending in the form of unemployment benefits and the related program for retraining and placement. Decreasing tax bases and increasing governmental expenses is a difficult burden for the government and the entire economy. Time series data was used from 1991 to 2021.

The cointegration test demonstrated that there is a long-run relationship between those variables. The findings of the NARDL approach show a strong and positive relationship between urbanization and unemployment and a negative relationship between government size and the unemployment rate in Romania. Economic growth is not the most important factor for reducing unemployment, while inflation has a negative but weak impact on unemployment. The Romanian authorities must adopt appropriate measures to increase government expenses. Urbanization in Romania was a forced process during the communist era. This process can explain its positive relation with unemployment because of the lack of people specialization in specific industries or service domains. Trade openness displays a negative impact on the unemployment rate. All EU countries display high trade openness because of EU intra-trade flows that are very robust. Increased trade supported economic sectors export-oriented and that has created more jobs. Income tax is positively associated with the unemployment rate which is explained by the great tax burden supported by economic organizations that makes them diminish job offers, diminish their activity, or even try tax evasion to maintain their profitability.

Monetarists are economists who subscribe to the theory that the amount of money currently in circulation directly affects the inflation rate. The governmental expenditure will be reduced over the long run due to policies that increase the competitiveness and efficiency of the economy. To mitigate spending and the demand and inflationary pressures, governments may need to raise income tax rates, in a progressive way, according to the income, and adopt appropriate measures to fight against the grey economy where people work without a legal contract or with reduced time contracts. To contest the issue of unemployment, government authorities should encourage self-employment and entrepreneurial endeavors to reduce the bureaucratic measures for starting a business and barriers to entering a market. Governments should alleviate all legal procedures for starting a business and support the private sector to develop to create new jobs. Otherwise, the fiscal evasion will be even more extensive, and the grey economy will expand, in the context of a positive relation between tax on income and the unemployment rate in Romania. More people will be employed on minimum salary and with reduced work time contracts for not paying hefty taxes to the public budget. In Romania, public expenditure broadly supports

mainly the public sector, which lacks efficiency. Proactive public policies should be implemented in the labor market in this regard, not only passive policies that can't solve the unemployment issue. Moreover, a more significant share of this public expenditure should be invested in the education sector to train future generations according to the demands of the labor market. In the long run, labor productivity can increase, and more products will be generated at a lower cost per unit, supporting sustained economic growth. People living in rural areas should be provided with the necessary social and economic infrastructure by the government to combat the adverse effects of forced and rapid urbanization and speed up the production of agricultural goods. The urbanization process was instead forced in the communist era, and with few exceptions, many large urban areas were not very economically developed to mitigate unemployment in Romania. Moreover, the people lack some appropriate skills to adapt to the labor market in this forced shift from rural areas to urban zones.

Based on our findings, Romanian authorities must focus on increasing public spending for education and training to reduce unemployment, since Romania has one of the lowest shares of education funding of GDP among EU countries. Also, given the high poverty rate in Romania, the public spending on social purposes must increase, because poverty and social exclusion diminish the chances of people for reinserting on the labor market. Also, economic growth supports the creation of new jobs. Export-oriented sectors are drivers of the Romanian economic growth so the public authorities should adopt measures to stimulate their expansion by granting fiscal facilities or subsidies, and easy banking financing with public guarantees.

The limitation of this study is that it has examined the impact of inflation, trade openness, GDP, urbanization, tax on income and government expenditure on unemployment. Future studies may use other macroeconomic variables like labor productivity, literacy rate, corruption, and political stability on unemployment. Institutional quality factors are very important factors especially for a developing country such as Romania. In addition, different empirical approaches may be used to achieve and validate the results. Similarly, the impact of macroeconomic variables on unemployment for specific groups like males or females can be studied further.

CRediT authorship contribution statement

Ali Moridian: Software, Formal analysis. **Magdalena Radulescu:** Validation, Supervision, Data curation, Conceptualization. **Muhammad Usman:** Writing – original draft, Methodology, Conceptualization. **Seyed Mohammadreza Mahdavian:** Writing – original draft, Investigation. **Alina Hagiu:** Writing – original draft, Visualization, Conceptualization. **Luminita Serbanescu:** Writing – review & editing, Conceptualization.

Data availability

Data will be available on request from the corresponding author.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:Magdalena Radulescu reports a relationship with Heliyon that includes: board membership. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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