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Investigate the impact of spending on education and research& development on unemployment rates in high-income countries[1] Compared to low- and middle-income countries[2] during the period 1990-2021[3] as a means of achieving United Nations sustainable development goals

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Abstract:
The study aimed to find out the extent of achieving one of the most important sustainable development goals of the United Nations, which is the goal of caring for people, by investigating the impact of spending on education and research and development(R&D) as one of the tools for caring for people and its impact on decreasing unemployment rates. It was applied to high-income countries compared to low and middle-income countries according to the World Bank classification. The study used the econometrics approach by formulating two multiple regression models, applying Vector Autoregressive (VAR) Model to investigate the short-run relationship between variables, and Autoregressive Distributed Lag (ARDL) model to investigate the long-run relationship, given that public spending on education and scientific research are independent variables and the unemployment rate is the dependent variable, it was applied once to the group of high-income countries, and again to the group of low- and middle-income countries. using the E-views12 package, the study found that for high-income countries there is a positive short-run relationship between unemployment and the public expenditure on education and a negative relationship between the public expenditure on R&D and the unemployment rate, while in the long run also a positive relationship between spending on

1 High-income countries include 1. N. Caledonia, 2. Greece, 3. Spain, 4. Bahamas, 5. Panama, 6. Uruguay, 7. Barbados, 8. Italy, 9. Chile, 10. Croatia, 11. Sweden, 12. Puerto Rico, 13. France, 14. Lithuania, 15. Brunei, 16. Latvia, 17. Finland, 18. Canada, 19. Mauritius, 20. Saudi Arabia, 21. Slovakia, 22. Portugal, 23. Ireland, 24. Belgium, 25. Estonia, 26. Austria, 27. Cyprus, 28. USA, 29. Iceland, 30. Hong Kong, 31. Switzerland, 32. Luxembourg, 33. Romania, 34. Australia, 35. Israel, 36. Norway, 37. Denmark, 38. Tr.&Tobago, 39. UK, 40. Slovenia, 41. Hungary, 42. New Zealand, 43. Netherlands, 44. Kuwait, 45. Singapore, 46. Germany, 47. South Korea, 48. Malta, 49. Poland, 50. UA Emirates, 51. Oman, 52. Macao, 53. Czechia, 54. Japan, 55. Bahrain, 56. Qatar.

2 According to the World Bank classification

3 Low-income countries include 1. Somalia, 2. Sudan,3. Haiti, 4. Yemen, 5. Afghanistan, 6. Gambia, 7. Syria, 8. Eritrea, 9. Tajikistan, 10. Mali, 11. Malawi, 12. G.-Bissau, 13. C.A. Republic, 14. Guinea, 15. DR Congo, 16. Sierra Leone, 17. Burkina Faso, 18. Liberia, 19. Togo, 20. Mozambique, 21. Ethiopia, 22. Uganda, 23. Madagascar, 24. North Korea, 25. Chad, 26. Burundi, 27. Rwanda, 28. Niger.

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education and unemployment rates was confirmed. For low- and middle-income countries, the results show that in the short run there is a negative relationship between spending on education and unemployment rates and a positive relationship between spending on research and development and unemployment rates, while in the long run spending on education has a positive relationship with unemployment rates and negative relationship between spending on research and development and unemployment rates. Some of these results are consistent with economic theory and others are inconsistent with economic theory. So the study recommends for all countries of the world make more efforts towards developing education and scientific research so that the economic relations between these variables go on the right track for raising the standards of human life and achieving the goals of sustainable development.

Keywords:
Education- Research & Development- Unemployment- Sustainable Development Goals- High Income Countries- Low- & Middle-Income Countries

Introduction:

The education and scientific research sectors are considered among the most important sectors that support sustainable development in any society, as this came within the first goal of the United Nations Sustainable Development Goals (the goal of focusing on people[5], This is achieved through the preparation and formation of the human capital necessary to operate in all other economic sectors, in addition to supporting scientific research because of its positive impact on the development of all sectors at the community level and overcoming many problems and obstacles that may encounter. Thus, it is possible to improve people's quality of life, eradicate poverty and achieve well-being, which is called for by the first goal of the United Nations Sustainable Development Goals.

As all countries of the world have recently gone through many economic challenges that may have cast a shadow on many different economic indicators, the importance of the study stems from researching how these challenges affect the public expenditure allocations for both education and scientific research and their impact on the labor market represented in unemployment rates, and that applies to the high-income countries segment compared to the low-& middle-income countries segment, according to the classification of the World Bank.

The study aims to analyze the impact of public spending on education and scientific research in high-income countries compared to and low & middle-income countries, Analyzing of the development of unemployment rates in both segments, Analyze the relationship between spending on education and scientific research and unemployment rates in the areas under study during the period 1990-2021, and then evaluating the economic policies pursued to achieve the first goal of sustainable development which is focusing on people.

5 https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf

The basic hypothesis is: that all countries of the world, regardless of income groups, are fully aware of the importance of the education and scientific research sectors as two of the most important requirements for sustainable development and that public spending on education and scientific research has an inverse relationship with unemployment rates, according to economic theory.

The countries of the world are striving to make achievements on the level of sustainable development, the most important of which is related to human development and focus on people, as spending on education, research, and science is supposed to rise and at the same time reduce unemployment rates to achieve the first goal of the United Nations sustainable development goals, and then the research problem of the study It is an attempt to investigate the relationship between spending on education, research and development and unemployment rates during the period 1990-2021 to determine the extent to which the first goal of sustainable development has been achieved and what is challenges it faces.

The study raises a major question, which is: Did the economic policies succeed in achieving the first goal of the United Nations' sustainable development goals in the group of high-income countries compared to the group of low- and middle-income countries regarding education, scientific research, and the elimination of unemployment?

The study follows the descriptive analytical approach by analyzing the impact of public spending rates on education and scientific research and the development (R&D) on the unemployment rate applying to the group of high-income countries compared to low and middle-income countries during the period 1990-2021, then it follows the econometrics approach by building a multiple linear regression model to investigate the impact of public spending on education and scientific research as independent variables and unemployment rates as a dependent variable and applying Vector Autoregressive (VAR) Model to investigate the short run relationship between variables, and Autoregressive Distributed Lag (ARDL) model to investigate the long run through the use of a time series data for the period 1990-2021 using statistical program E-Views12.

1. Literature Review

UNESCO is entrusted to lead the Education 2030 Agenda, which is part of a global movement to eradicate poverty through 17 Sustainable Development Goals by 2030. Education is essential to achieve all of these goals. (UNESCO 2020), The theory of human capital provided the theoretical underpinning of the connection between education level and unemployment.

Concerning the relationship between R&D, unemployment, and labor market policies, (Hiroaki Miyamoto 2010) tried to study the effects of labor market policies on R & D and unemployment, by building an econometric model, the study found that more intensive labor market policies that protect workers reduce the levels of R&D activities, the study also offers a theoretical framework to understand the relationship between R&D activities, labor market policies, and unemployment which is discussed in empirical studies.

(Serhan ÇIFTÇIOĞLU & Amin SOKHANVAR: 2020), Can Increase the R&D Intensity Lower the Unemployment Rate? Case of Five Selected European Countries" empirically investigates the short- and long-term effects of changes in R&D intensity on, in particular, the rate of unemployment as well as economic growth for a sample of five European countries, using data sample period of 1991–2017. They come to the conclusion that there is a long-run relationship

between R&D, unemployment rate, and economic growth. It may have negative consequences on unemployment in the short term.
(Tommaso Ciarli and Others: 2018) The Impact of R&D on Employment and Self-Employment Composition in Local Labor Markets study discovered that, on average, R&D growth has no multiplier effect on local employment but alters its composition. The study also discovered that results vary significantly depending on the initial level of routineness.
Teslime YILDIRIM(2020) It has been verified that in Turkey, a statistically significant one-way causation link exists between R&D spending and unemployment at the significance level of 5%. At a significance level of 5%, a statistically significant one-way causation association between unemployment and R&D spending is found in Azerbaijan.
(Mariacristina Piva & Marco Vivarelli: 2017) Is R&D Beneficial for Employment? This study, "Micro econometric Evidence from the EU," finds that there is a significant labor-friendly impact of R&D expenditures, but this positive employment effect appears limited in magnitude and entirely due to the middle- and high-tech sectors, with no effect found in the low-tech industries. The study uses a unique firm-level database comprising the top European R&D investors over the period 2002–2013 and runs LSDVC estimates.
On the other hand concerning the influence of education on the unemployment rate and incomes of residents, (Ilga Lavrinovicha*a , Olga Lavrinenkob , Janis Teivans-Treinovskis, 2014) analyzes differences in income and employment that are influenced by education level using methods of frequency, correlation, and regression analysis. The correlation between education and status in the labor market is confirmed empirically, and the correlation between education and in employment is also examined. The study looks at the impact of education on the unemployment rate and the amount of income of Latvian residents between the years of 2002 and 2013.
Then (Grabe Mpendulo & Eric E. Mang'unyi: 2018) Utilizing a systematic random sample approach, this study examines the relationships between education level and unemployment among young people in four towns in South Africa. The design of a cross-sectional survey was used. 120 self-completed survey questionnaires from the young adults who could find work were used to collect the data. The results also show a negative correlation between economic status and education qualification, while it was positively correlated to unemployment. Relationships were established such that educational level was found to positively relate to unemployment and was also found to have the highest effect on unemployment.
At the same level (Sinan ALÇIN, Begüm ERDİL ŞAHİN, and Merve Hamzaoglu: 2021) Using fragments of data from Turkey and Spain and Johansen Cointegration tests to evaluate the relationship between education and youth unemployment, the study finds no unidirectional causal relationship between higher education enrolment and the youth unemployment rate in Turkey and Spain. And the rise in higher education enrollment does not result in a reduction in youth unemployment. The study thus confirmed the need of considering the relationship between young unemployment and education when formulating measures to enhance youth job markets.
(Yoonyoung Cho, David Margolis, David Newhouse, and David Robalino: 2012) attempts to research the labor markets in low-income countries, The study outlines a three-pronged approach based on providing incentives and working conditions, enhancing the effectiveness of job creation, and managing risks/facilitating labor market transitions

For understanding Country Differences: Predicting the Effect of Financial and Labor Market Conditions on International Doctoral Recipients' First Labor Market Destination, (Osasohan Agbonlahor: 2021) The study found that wealth disparities and economic opportunities in the home country have an impact on the outcomes of international doctoral students. The study used the Survey of Earned Doctorates and hierarchical linear modeling analysis to examine the effects of financial factors and home-country macroeconomic indicators on international doctoral students' labor market destinations. While greater home country unemployment rates considerably boosted the likelihood of staying in the United States, higher gross national income per capita was linked to a decreased likelihood of doing so.

Sifatul Mostafi(2018), in the study of "Unemployment with Educational Attainments in Lower Middle-Income Countries: 1994-2017", The study, which empirically examined how labor forces with different levels of educational attainment affect the overall unemployment rate in lower-middle-income countries and found that 53 low middle income countries over the period of 1994–2017, increased labor forces with advanced educational attainment tend to be more unemployed, increasing the overall unemployment rate in developing countries with lower-middle-income levels.

2. Data and Methodology

2.1 Data

Table 1 below defines the selected variables to investigate the impact of spending on education and research& development on unemployment rates in high-income countries Compared to - and low-income countries during 2000-2021. The definition of the variables that are included in the econometric model is listed in Table 1. The data applied in the model were collected from the world bank tables and are all annual and cover the period of 2000-2021. The analysis of the data was conducted using E-Views 12.

3. Table 1: Economic variables included in the model.

Name	Code	Definition
Expenditure on Research & Development	R&D (X1)	Research and development expenditure is the money invested in the creative effort done on a regular basis to build knowledge and use that information to create new applications 6
Expenditure on Education	EDU (X2)	expenditure on Education comprises all spending on educational activities made on the national territory by all economic agents, including the federal, state, and municipal governments, businesses, and people. The organization of the educational system (general administration, educational guidance, and education research), activities intended to promote school attendance (catering and boarding facilities, school medical services, school transportation), and costs incurred by schools (supplies, books, clothing) are among these activities).7

[6] https://stats.oecd.org/glossary/detail.asp?ID=2315

[7] Domestic expenditure on Education, https://www.insee.fr/en/metadonnees/definition/c2093

Unemployment Rate	Unemployment (Y)	The unemployment rate is the proportion of the workforce that is unemployed. It is a lagging indicator, which means that rather than foretelling changes in economic conditions, it often rises or decreases in response to them8

2.2: Methodology

This paper is an attempt to investigate the impact of spending on education and research& development on unemployment rates in high-income countries compared to middle-and low-income countries during 1990-2021. The study applies the Multiple Linear Regression Model while starting by applying descriptive and tests for model variables, then applying Vector Autoregressive (VAR) Model to investigate the short-run relationship between the model variables, then applying Autoregressive Distributed Lag (ARDL) Model to investigate the long run relationship, the main model will take the following formula:

$$\boldsymbol{Y_{it} = \alpha + \beta 1 X 1_{it} + \beta 2 X 2_{it} + \varepsilon_{it}} \qquad \textbf{(1)}$$

Where $\boldsymbol{Y_{it}}$ is the endogenous variable, refers to the unemployment rate

$\boldsymbol{\alpha}$ is the intercept,

B1 represents the partial coefficients for the exogenous variables $\boldsymbol{X1_{it}}$ **(**which refers to expenditure on research & development).

B2 represents the partial coefficients for the exogenous variables $\boldsymbol{X2_{it}}$ **(**which refers to expenditure on education).

The study will apply this model twice, the 1st model to investigate the impact of expenditure on research & development, expenditure on education on the unemployment rate in high-income countries, and the 2nd model will be applied to middle and low-income countries.

3. Empirical Results

3.1. Descriptive and tests for model variables:

Table (1) Descriptive Statistics for high-income countries

	UNEMPLOY	EDUX1	RDX2
Mean	6.842606	12.21457	2.352370
Median	7.012601	12.25204	2.297669
Maximum	8.260613	12.99238	2.967474
Minimum	4.797537	11.29195	2.148122
Std. Dev.	0.912262	0.445095	0.219260
Skewness	-0.396053	-0.161102	1.438925
Kurtosis	2.347432	2.333392	4.673736
Jarque-Bera	1.404370	0.730909	14.77788
Probability	0.495502	0.693881	0.000618
Sum	218.9634	390.8664	75.27583
Sum Sq. Dev.	25.79890	6.141383	1.490324
Observations	32	32	32

The descriptive statistics for high-income countries data provide quantitative insights into the

8 What Is the Unemployment Rate? https://www.investopedia.com/terms/u/unemploymentrate.asp

selected data series. Table (1) above presents the central measures and the standard deviation. The results show a positive mean of all the selected variables over the study period. Yet, a high standard deviation presents in the unemployment and expenditure on education compared to expenditure on R&D in the model. These findings may be a little different in low- and middle-income countries as shown in table (2) below where there is a positive mean for all selected variables, while there is a high standard deviation in unemployment only compared to expenditure on education and expenditure on R & D variables.

Table (2) Descriptive Statistics for low- and middle-income countries

	UNEMPLOY	EDUX1	RDX2
Mean	4.867319	15.21029	0.969721
Median	4.952404	15.22857	0.861978
Maximum	5.832926	15.97959	1.863377
Minimum	3.799079	14.21379	0.575390
Std. Dev.	0.580936	0.393807	0.388024
Skewness	-0.511210	-0.569752	0.775115
Kurtosis	2.728553	3.837184	2.587476
Jarque-Bera	1.492033	2.665796	3.431183
Probability	0.474252	0.263712	0.179857
Sum	155.7542	486.7294	31.03107
Sum Sq. Dev.	10.46210	4.807605	4.667438
Observations	32	32	32

3.2. Vector Autoregressive (VAR) Model (Short Run Relationship):

There may be a reciprocal effect between the model variables, as education can affect unemployment by reducing the unemployment rate as expected in the economic theory, but in fact, a high unemployment rate can give a negative impression about the importance of education, as well as the relationship between scientific research and unemployment, so the study chooses to apply The vector autoregressive (VAR) model which differs from univariate autoregressive models because they allow feedback to occur between the variables in the model.

For High-Income countries:
Vector Autoregression Estimates
Date: 08/27/22 Time: 22:23
Sample (adjusted): 1992 2021
Included observations: 30 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	UNEMPLOY
UNEMPLOY (-1)	0.894971
	(0.19621)
	[4.56124]

For low and middle-income countries:
Vector Autoregression Estimates
Date: 08/27/22 Time: 22:34
Sample (adjusted): 1992 2021
Included observations: 30 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	UNEMPLOY
UNEMPLOY (-1)	0.729742
	(0.20181)
	[3.61604]
UNEMPLOY (-2)	-0.008368

UNEMPLOY (-2)	-0.370199		
	(0.19859)		
	[-1.86413]		
C	4.135259		
	(3.96968)		
	[1.04171]		
EDUX1	0.105778		
	(0.27102)		
	[0.39030]		
RDX2	-0.921563		
	(0.64446)		
	[-1.42999]		
R-squared	0.598028		
Adj. R-squared	0.533713		
Sum sq. resids	9.872619		
S.E. equation	0.628414		
F-statistic	9.298364		
Log likelihood	-25.89667		
Akaike AIC	2.059778		
Schwarz SC	2.293311		
Mean dependent	6.887870		
S.D. dependent	0.920279		

	(0.19053)		
	[-0.04392]		
C	3.579943		
	(2.31832)		
	[1.54419]		
EDUX1	-0.152914		
	(0.14191)		
	[-1.07751]		
RDX2	0.170766		
	(0.17489)		
	[0.97643]		
R-squared	0.754426		
Adj. R-squared	0.715134		
Sum sq. resids	1.971388		
S.E. equation	0.280812		
F-statistic	19.20058		
Log likelihood	-1.731261		
Akaike AIC	0.448751		
Schwarz SC	0.682284		
Mean dependent	4.938535		
S.D. dependent	0.526133		

The result for high-income countries shows that there is a short-run positive relationship between unemployment and the public expenditure on education This may reflect the insufficiency of the labor market in absorbing labor in the short term, but for this group of countries the result shows a negative relationship between the public expenditure on R & D and the unemployment rate, This result is consistent with the economic theory as well as with achieving the goal of sustainable development, where the state is supposed to seek, through spending on education and scientific research, to improve employment rates, and then improve income and improve the quality of human life.

On the other hand, concerning low- and middle-income countries the results in the short run shows that there is an inverse relationship between spending on education and unemployment rates, which means that the labor market is still thirsty for graduates and can absorb many despite the internal distortions of the labor market, where jobs may not match qualifications. While the results showed a positive relationship between spending on research and development and unemployment rates, which contradicts the economic theory, perhaps this is due to labor market distortions and weak rates of spending on research and development in these countries, and then the model may not be characterized by quality in judging the relationship in this case.

3.3. Autoregressive Distributed Lag (ARDL) model (Long Run relationship):

3.3.1. For Low- Middle-income countries:

When working with variables that are integrated in a different order—I(0), I(1), or a combination of both—the ARDL cointegration technique is preferred. It is also reliable when there is just one long-term link between the underlying variables in a small sample size. The F-statistic is used to determine whether the underlying variables have a long-term relationship; a long-term relationship of a series is said to have been established when the F-statistic surpasses the critical value band. Although pre-testing for unit roots is not necessary for the ARDL cointegration technique, in our opinion it should be done to determine the number of unit roots in the series under consideration in order to prevent ARDL model crash in the presence of integrated stochastic. This is presented in the next section:

Unit Root Test:

3.3.1.1. For High-income countries data:

The next results according to Augmented Dickey-Fuller (ADF) test show that the time series for all variables are normal distribution:

For testing the stationarity of (Y) variable time series, it appeared that be a station at the 2nd difference with intercept as R square greater than Durbin Watson state, while for x1 variable time series it appeared that be a station at the 2nd difference with intercept, and For x2 variable time series its appeared that be a station at the 2nd difference with intercept, as Prob T greater than T – Statistic.

.Null Hypothesis: D(UNEMPLOY,2) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=2)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.652566	0.0000
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(UNEMPLOY,3)
Method: Least Squares
Date: 08/28/22 Time: 12:15
Sample (adjusted): 1993 2021
Included observations: 29 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D (UNEMPLOY (-1),2)	-1.458900	0.219299	-6.652566	0.0000
C	-0.042196	0.158030	-0.267012	0.7915

R-squared	0.621088	Mean dependent var	-0.099727
Adjusted R-squared	0.607054	S.D. dependent var	1.355566
S.E. of regression	0.849742	Akaike info criterion	2.578704
Sum squared resid	19.49565	Schwarz criterion	2.673000

Null Hypothesis: D(EDUX1,2) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=2)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.675781	0.0000
Test critical values:	1% level	-3.689194	
	5% level	-2.971853	
	10% level	-2.625121	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EDUX1,3)
Method: Least Squares
Date: 08/28/22 Time: 12:18
Sample (adjusted): 1994 2021
Included observations: 28 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EDUX1(-1),2)	-2.456056	0.319975	-7.675781	0.0000
D(EDUX1(-1),3)	0.478922	0.175572	2.727786	0.0115
C	-2.62E-16	0.098882	-2.65E-15	1.0000

R-squared	0.869265	Mean dependent var	-4.44E-16
Adjusted R-squared	0.858806	S.D. dependent var	1.392474
S.E. of regression	0.523233	Akaike info criterion	1.643379

Log likelihood	-35.39120	Hannan-Quinn criter.	2.608236
F-statistic	44.25663	Durbin-Watson stat	2.053462
Prob(F-statistic)	0.000000		

Sum squared resid	6.844329	Schwarz criterion	1.786115
Log likelihood	-20.00730	Hannan-Quinn criter.	1.687015
F-statistic	83.11308	Durbin-Watson stat	2.157982
Prob(F-statistic)	0.000000		

Null Hypothesis: D(RDX2,2) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=2)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.096884	0.0000
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RDX2,3)
Method: Least Squares
Date: 08/28/22 Time: 12:19
Sample (adjusted): 1993 2021
Included observations: 29 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(RDX2(-1),2)	-1.797065	0.221945	-8.096884	0.0000
C	0.007316	0.011539	0.634083	0.5314

R-squared	0.708296	Mean dependent var	-0.009179
Adjusted R-squared	0.697492	S.D. dependent var	0.111201
S.E. of regression	0.061161	Akaike info criterion	-2.684135
Sum squared resid	0.100999	Schwarz criterion	-2.589838
Log likelihood	40.91995	Hannan-Quinn criter.	-2.654602
F-statistic	65.55953	Durbin-Watson stat	1.998451
Prob(F-statistic)	0.000000		

3.3.1.2. For low- and middle-income countries:

The next results according to Augmented Dickey-Fuller (ADF) test show that the time series for all variables are normal distribution:

For testing the stationarity of (Y) variable time series, it appeared that be a station at the 2nd difference with intercept as R square greater than Durbin Watson state, while for x1 variable time series it appeared that be a station at the 1st difference with intercept, and for x2 variable, it appeared that be a station at the 2nd difference with intercept as, as Prob T greater than T – Statistic.

Null Hypothesis: D(UNEMPLOY,2) has a unit root	Null Hypothesis: D(EDUX1) has a unit root
Exogenous: Constant	Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=2)	Lag Length: 0 (Automatic - based on SIC, maxlag=2)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.074993	0.0000
Test critical values:	1% level	-3.689194	
	5% level	-2.971853	
	10% level	-2.625121	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(UNEMPLOY,3)
Method: Least Squares
Date: 08/28/22 Time: 12:55
Sample (adjusted): 1994 2021
Included observations: 28 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(UNEMPLOY(-1),2)	-2.056372	0.338498	-6.074993	0.0000
D(UNEMPLOY(-1),3)	0.368287	0.197764	1.862258	0.0744
C	0.008078	0.069500	0.116224	0.9084

R-squared	0.781720	Mean dependent var	2.82E-16
Adjusted R-squared	0.764258	S.D. dependent var	0.755956
S.E. of regression	0.367041	Akaike info criterion	0.934273
Sum squared resid	3.367984	Schwarz criterion	1.077009
Log likelihood	-10.07982	Hannan-Quinn criter.	0.977908
F-statistic	44.76593	Durbin-Watson stat	2.163935
Prob(F-statistic)	0.000000		

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.525306	0.0000
Test critical values:	1% level	-3.670170	
	5% level	-2.963972	
	10% level	-2.621007	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EDUX1,2)
Method: Least Squares
Date: 08/28/22 Time: 12:56
Sample (adjusted): 1992 2021
Included observations: 30 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EDUX1(-1))	-1.443787	0.169353	-8.525306	0.0000
C	-0.039946	0.081463	-0.490359	0.6277

R-squared	0.721893	Mean dependent var	5.74E-17
Adjusted R-squared	0.711961	S.D. dependent var	0.829994
S.E. of regression	0.445452	Akaike info criterion	1.284885
Sum squared resid	5.555965	Schwarz criterion	1.378298
Log likelihood	-17.27328	Hannan-Quinn criter.	1.314769
F-statistic	72.68085	Durbin-Watson stat	2.135694
Prob(F-statistic)	0.000000		

Null Hypothesis: D(RDX2,2) has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=2)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.197680	0.0000
Test critical values:	1% level	-3.699871	
	5% level	-2.976263	
	10% level	-2.627420	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(RDX2,3)
Method: Least Squares
Date: 08/28/22 Time: 12:57
Sample (adjusted): 1995 2021
Included observations: 27 after adjustments

Investigate the impact of spending on education and research& development on unemployment rates in high-income countries1 Compared to low- and middle-income countries1 during the period 1990-20211 as a means of achieving United Nations sustainable development goals

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(RDX2(-1),2)	-3.023033	0.487768	-6.197680	0.0000
D(RDX2(-1),3)	1.510800	0.464821	3.250284	0.0035
D(RDX2(-2),3)	1.010573	0.279277	3.618530	0.0014
C	0.010721	0.012380	0.865983	0.3954

R-squared	0.830307	Mean dependent var	-0.011570
Adjusted R-squared	0.808173	S.D. dependent var	0.142402
S.E. of regression	0.062369	Akaike info criterion	-2.575535
Sum squared resid	0.089468	Schwarz criterion	-2.383560
Log likelihood	38.76973	Hannan-Quinn criter.	-2.518451
F-statistic	37.51301	Durbin-Watson stat	2.452993
Prob(F-statistic)	0.000000		

3.4. ARDL model results:

3.4.1. For Low- and middle-income countries:

Dependent Variable: LOG(UNEMPLOY)				
Method: ARDL				
Date: 08/29/22 Time: 13:50				
Sample (adjusted): 1997 2021				
Included observations: 25 after adjustments				
Maximum dependent lags: 10 (Automatic selection)				
Model selection method: Akaike info criterion (AIC)				
Dynamic regressors (4 lags, automatic): LOG(EDUX1) LOG(RDX2)				
Fixed regressors: C				
Number of models evaluated: 250				
Selected Model: ARDL(7, 4, 4)				
Note: final equation sample is larger than the selection sample				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LOG(UNEMPLOY(-1))	0.838579	0.268543	3.122698	0.0168
LOG(UNEMPLOY(-2))	-0.011792	0.330050	-0.035727	0.9725
LOG(UNEMPLOY(-3))	0.027550	0.172870	0.159368	0.8779
LOG(UNEMPLOY(-4))	0.057403	0.169994	0.337676	0.7455
LOG(UNEMPLOY(-5))	-0.121664	0.179488	-0.677841	0.5196
LOG(UNEMPLOY(-6))	0.277320	0.176301	1.572987	0.1597
LOG(UNEMPLOY(-7))	-0.046574	0.215511	-0.216107	0.8351
LOG(EDUX1)	0.293566	0.560709	0.523563	0.6167
LOG(EDUX1(-1))	0.099339	0.480492	0.206743	0.8421
LOG(EDUX1(-2))	0.656561	0.437619	1.500301	0.1772
LOG(EDUX1(-3))	1.207863	0.528849	2.283946	0.0563
LOG(EDUX1(-4))	1.776043	0.767061	2.315388	0.0538
LOG(RDX2)	-0.723794	0.562014	-1.287858	0.2387
LOG(RDX2(-1))	0.558957	0.429257	1.302150	0.2341
LOG(RDX2(-2))	-0.665289	0.377766	-1.761113	0.1216
LOG(RDX2(-3))	-0.225803	0.432571	-0.522003	0.6178
LOG(RDX2(-4))	1.109572	0.547792	2.025536	0.0825
C	-10.89581	5.157161	-2.112753	0.0725
R-squared	0.938383	Mean dependent var		1.621343

Adjusted R-squared	0.788743	S.D. dependent var		0.076415
S.E. of regression	0.035122	Akaike info criterion		-3.692921
Sum squared resid	0.008635	Schwarz criterion		-2.815330
Log likelihood	64.16151	Hannan-Quinn criter.		-3.449514
F-statistic	6.270924	Durbin-Watson stat		2.164323
Prob(F-statistic)	0.009856			
*Note: p-values and any subsequent tests do not account for model selection.				

The results showed that in the long term, spending on education has a positive relationship with unemployment rates, and this may reflect the labor market's failure to absorb graduates, especially with the increase in their numbers over time, which requires taking appropriate economic and social policies to match education outputs with the requirements of the labor market on the one hand, as well as Create an appropriate investment environment for more projects to absorb labor.

As for the relationship between spending on research and development and unemployment rates, the results showed that there is a negative relationship in the long term and that this relationship becomes clear after at least two years of spending until it becomes clear its impact on reducing unemployment rates through research on labor market problems and the investment environment. And put forward and implement solutions to it, which is a logical result that is consistent with the economic theory

3.4.2. ARDL model result for high-income countries:

Dependent Variable: LOG(UNEMPLOY)				
Method: ARDL				
Date: 08/29/22 Time: 13:44				
Sample (adjusted): 1992 2021				
Included observations: 30 after adjustments				
Maximum dependent lags: 4 (Automatic selection)				
Model selection method: Akaike info criterion (AIC)				
Dynamic regressors (4 lags, automatic): LOG(EDUX1) LOG(RDX2)				
Fixed regressors: C				
Number of models evaluated: 100				
Selected Model: ARDL (2, 0, 1)				
Note: final equation sample is larger than the selection sample				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LOG(UNEMPLOY(-1))	1.199044	0.211454	5.670468	0.0000
LOG(UNEMPLOY(-2))	-0.554132	0.190456	-2.909504	0.0077
LOG(EDUX1)	0.602472	0.466359	1.291863	0.2087
LOG(RDX2)	2.659708	1.017155	2.614849	0.0152
LOG(RDX2(-1))	-3.362237	1.096963	-3.065041	0.0053
C	-0.265641	1.192587	-0.222743	0.8256
R-squared	0.691291	Mean dependent var		1.920532
Adjusted R-squared	0.626977	S.D. dependent var		0.140718
S.E. of regression	0.085945	Akaike info criterion		-1.893370
Sum squared resid	0.177276	Schwarz criterion		-1.613130
Log likelihood	34.40055	Hannan-Quinn criter.		-1.803719
F-statistic	10.74863	Durbin-Watson stat		1.926456
Prob(F-statistic)	0.000016			

*Note: p-values and any subsequent tests do not account for model selection.		

Surprisingly, the results of the model for high-income countries are quite similar to the same results for low- and middle-income countries, which confirms that in the long term it is necessary to formulate and improve economic policies that aim to harmonize labor market requirements with education outputs, as well as improving the investment environment to create more jobs from, On the one hand, spending on research and development has a good effect on reducing unemployment rates in the long term.

4. Conclusion & policy recommendations:

The result shows that for high-income countries there is a positive short-run relationship between unemployment and the public expenditure on education which is matching with the result of (Ilga Lavrinovicha*a , Olga Lavrinenkob , Janis Teivans-Treinovskis, 2014), and negative relationship between the public expenditure on R & D and the unemployment rate which is may consist with (Serhan ÇIFTÇIOĞLU & Amin SOKHANVAR: 2020) results, and the last result matching with economic theory while the first one not matching. In the long run, also a positive relationship between spending on education and unemployment rates was confirmed, as long as a negative relationship between spending on research and development and unemployment rates. Therefore, the results did not differ, whether in the short or long run for high-income countries.

Thus, the results are in agreement with the economic theory only about the relationship between spending on research and development and unemployment rates, while the results were the opposite of economic theory in other relationships, which may reflect the existence of distortions in the labor market and in its relationship with education outputs, which requires policy modification. economic followed and so on.

For low- and middle-income countries, the results show that in the short run there is a negative relationship between spending on education and unemployment rates and this is consistent with economic theory. And a positive relationship between spending on research and development and unemployment rates, which is inconsistent with economic theory. While in the long run spending on education has a positive relationship with unemployment rates and a negative relationship between spending on research and development and unemployment rates. this result matches with (Sinan ALÇIN, Begüm ERDİL ŞAHİN, and Merve Hamzaoglu: 2021). Hence, these results show that low and middle-income countries suffer from distortions in the relationship between spending on education and scientific research and their impact on reducing unemployment rates, which reflects the need for more efforts and policies to improve the business environment in a way that aims to improve the lives of citizens in general and In a way that makes the economic variables move in the right directions, whether in the short or long term and in accordance with economic theory in general. Therefore, the last group of countries needs to direct more quantitative and qualitative efforts towards developing and supporting education and scientific research so that they can have a positive impact on the labor market and the sustainable development goals with regard to focusing on people.

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