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Interconnections between Social and Economic Indicators in the Context of EU Resilience

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Abstract: The COVID 19 pandemic has once again exposed a number of important risks and problems for the world's economies. Although the present analyzes of the literature are more and more often aggregated between fields, emphasizing the capacity of digitalization and international relations to improve the transition to the circular economy, resilience speaks not only of positive aspects but also of vulnerabilities. Thus, the article deals with the link between vulnerabilities and capacities of the socio-economic domain at EU27 level. The study uses Eurostat data for the period 2011-2020, systematized in the panel form. The results once again demonstrate the need to strengthen public support for health and education, for research and development, in order to reduce socio-economic vulnerabilities at EU27 level, demonstrating the need to correlate policy efforts with results.

Keywords: Resilience; social and economic dimension, econometric model, interrelations

JEL Classification: A14; B23; H50

1. Introduction

Recent international and European policy guidelines are increasingly talking about an ecologically sustainable world, in which technology plays an important role and society aims to become more equitable. The European Union aims to become the first climate-neutral continent by 2050. Even if it is the first or last continent to succeed in this endeavor, the entire planet must understand the need for a coordinated, common effort. At the same time, the effort must be proportional with economic, political, social and technological power of each continent of the world.

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Beyond the human losses and the medical and economic sequels left by the COVID-19 pandemic, socially and educationally, children, women, people with disabilities, people at risk of poverty or with serious illness were the social categories most affected by the pandemic.

According to Eurostat, the EU27 unemployment rate rose from 6.7% in 2019 to 7.1% in 2020, and the real gross disposable income of households per capita fell from 107.69 million units of national currency (index = 2008) to 107.32. Thus, although affected, the economic and social resilience versus to the challenges of EU countries has been relatively good, compared to other parts of the world (e.g. Africa, some part of Asia, South America etc.).

In this context, seen as "the ability not only to stand and cope with challenges but also to undergo transitions in a sustainable, fair, and democratic manner" (European Commission, 2020 Strategic Foresight Report Charting the course towards a more resilient Europe), resilience can contribute to the achievement of EU sustainable development goals, through the multiple facets or dimensions it addresses (e.g. the social and economic dimension, the geopolitical dimension, the green dimension and the digital dimension). Therefore, this article does not seek to pursue the multidimensionality of the concept of resilience, but focuses on a number of indicators that capture the social and economic dimension of the EU27. Thus, the article starts from the attempt to understand the extent to which some of the economic and social indicators describing socio-economic vulnerabilities can be explained by the evolution of economic and social indicators describing capabilities.

2. Description of the Problem in the Context of the Literature Review

The socio-economic framework of the population of the world's countries had been more carefully analyzed in recent decades (Hsing, 2005; Goldthorpe, 2007; Rose & Harrison, 2010 etc.), although valuable research in this regard has been started before in the past, regarding the sustainability and the well-being, prosperity or wealth of a nation (Ayres, 1978; Pearce et al., 1990, Pezzey, 1992; Max-Neef, 1995, etc.). The need to incorporate more socio-ecological meaning than a classic GDP, however, was manifested by highlighting and measuring another type of GDP (Daly & Cobb, 1989; Asheim, 2000; Hanley, 2000, Talberth, Cobb & Slattery, 2006; Krueger et al. 2008; Stiglitz et al., 2009 etc.).

For example, Stiglitz, Sen, Fitoussi 2009 Report mentioned there is a great need for measurement system to shift emphasis from measuring economic production to measuring people's well-being in the context of sustainability.

More exactly, the Report accentuate that well-being is important because there appears to be an increasing gap between the information contained in aggregate GDP

data and what counts for common people's well-being, mentioning that there are several dimensions to well-being and the measurement should be started with material well-being or living standards. The dimensions analyzed in the above report were: Material living standards (income, consumption and wealth); Education; Health; Personal activities including work; Social connections and relationships; Political voice and governance; Environment; Insecurity, of an economic as well as a physical nature.

Also, in order to measuring people's wellbeing beyond GDP, as a multidisciplinary picture on several dimensions (green, digital, geopolitical, socio-economic) the EU Resilience Dashboards tries to give a general holistic image, been conceived on a selection of quantitative indicators.

The indicators were structured in vulnerabilities and capacities of all four dimensions, in order to better cope with the challenges of COVID-19 crisis. Thus, in the European Commission 2021 Resilience Dashboards, considering the vulnerabilities and capacities of the social and economic dimension there were treated the following aspects: - inequalities and social impact of transitions, - health, education and work and - economic and financial stability and sustainability. But the Resilience Dashboards concentrates on across-dimension linkages and correlations between domains and streamlined in terms of their overall balance across areas, and between vulnerabilities and capacities.

At the same time, there are calculated the synthetic indices, which aggregate the relative situation of the Members States and the EU across all considered indicators. A higher capacity index indicates higher (relative) capacities, while a higher vulnerability index shows higher (relative) vulnerabilities. However, the explaining of the causal link and homogeneity at the field level seems to be quite precarious. Therefore, although it is the starting point for this article, the article focuses exclusively on better understanding and explanation of the conduct of some socio-economic domain indicators.

3. Methodology

Therefore, given the importance of the connection between resilience indicators, this study aims to demonstrate the connection between a series of indicators of the socio-economic domain, seen as vulnerabilities and capacities indicators such as: At-risk-of-poverty rate by sex (Arpr), Income quintile share ratio (S80/S20) by sex (IqsrS80/S20), Gender employment gap (Geg), Old-age-dependency ratio (Oadr), General government gross debt (Gggd), General government expenditure by function - Education (COFOG) (Ggee), General government expenditure by function - Health (COFOG) (Ggeh), Tertiary educational attainment by sex, age group 30-34 (Tea), Life expectancy at birth by sex (Leb), Employment rate by sex, age group 20-

64 (Emplr), Gross domestic expenditure on R&D (GERD) (GdeR&D), General government gross fixed capital formation (Gggfcf). In summary, the result of the analyzed indicators is presented below:

Table 1. Indicators and the Period of Analysis for the Social and Economic Domain

Area of action	Indicator	Measurement unit	Period
Vulnerabilities	At-risk-of-poverty rate by sex	%	2011-2020
	Income quintile share ratio (S80/S20) by sex	ratio	2011-2020
	Gender employment gap	% of total population	2011-2020
	Old-age-dependency ratio	ratio	2011-2020
	General government gross debt	% of GDP	2011-2020
Capacities	General government expenditure by function - education	% of GDP	2011-2020
	General government expenditure by function -health	% of GDP	2011-2020
	Tertiary educational attainment by sex, age group 30-34	%	2011-2020
	Life expectancy at birth by sex	Year	2011-2020
	Employment rate by sex, age group 20-64	% of total population	2011-2020
	Gross domestic expenditure on R&D (GERD)	% of GDP	2011-2020
	General government gross fixed capital formation	% of GDP	2011-2020

Source: author's selection. Eurostat data base

The starting hypotheses are those in which the indicators that describe the socio-economic vulnerabilities are conditioned by the indicators that describe the capabilities of the same domain.

In order to validate these hypotheses described above, it will be used a panel data regression models showed below. The least square (LS) method was performed to test the statistical hypotheses. Eurostat database it has been used for the period 2011-2020.

Thus, in this article the descriptive statistics of the model is analyzed, a Pearson correlation matrix is made, a ADF test is performed, a series of regression equations are performed that connects each vulnerability socio-economic indicator with the capacities socio-economic indicators selected, in order to confirm or to reject the hypotheses. A Johansen Cointegration test and a Granger causality test for the relationship between vulnerabilities and capacities of socio-economic domain of EU27.

First, we proceed with a statistical description of the indicators used in regression model (e.g. mean, median, maximum, minimum, and standard deviation— see Table no. 2). The values of the mean and the median of the variables of the model reveal how close the data is to normal distribution. It can be concluded, that the mean and median values are close to one other, thus we could say that the data follows a normal distribution.

Table 2. Descriptive Statistics of the Model

	ARPR	IQSRS80 S20	GEG	OADR	GGGD	GGEE	GGEH	EMPLR	GDER D	LEB	GGGFCF	TEA
Mean	16.64259	4.888370	10.53704	27.62667	69.02593	4.994074	6.198066	70.73963	1.620481	79.77481	3.595556	40.23444
Median	16.10000	4.520000	9.350000	28.10000	62.00000	5.000000	6.300000	71.35000	1.325000	81.10000	3.600000	42.00000
Maximum	25.40000	8.320000	35.20000	36.40000	206.3000	7.100000	9.200000	82.40000	3.620000	84.00000	6.600000	62.20000
Minimum	8.600000	3.030000	0.600000	17.20000	6.200000	2.800000	2.500000	52.90000	0.380000	73.60000	1.500000	20.30000
Std. Dev.	3.808560	1.174552	5.716288	4.218726	38.57889	0.938277	1.441038	6.176098	0.886432	2.845193	1.063932	9.681018
Skewness	0.220901	0.732104	1.026562	-0.475770	0.968878	0.025828	-0.330026	-0.450513	0.573024	-0.688954	0.429563	-0.075187
Kurtosis	2.146950	2.629887	4.470811	2.692312	3.889580	2.452662	2.337428	2.648175	2.068787	2.065925	2.773208	2.150392
Jarque-Bera	10.38244	25.65998	71.75926	11.25114	51.14534	3.400286	9.840054	10.52583	24.53159	31.17516	8.882237	8.375016
Probability	0.005565	0.000003	0.000000	0.003605	0.000000	0.182657	0.007299	0.005180	0.000005	0.000000	0.011783	0.015184
Sum	4493.500	1319.860	2845.000	7459.200	18637.00	1348.400	1673.478	19099.70	437.5300	21539.20	970.8000	10863.30
Sum Sq. Dev.	3901.880	371.1053	8789.830	4787.568	400360.9	236.8179	558.6028	10260.79	211.3700	2177.589	304.4947	25211.25
Observations	270	270	270	270	270	270	270	270	270	270	270	270

Source: Author's processing in EViews 11; Eurostat data

4. Results Obtained

Pearson correlation matrix is usually used for identifying the strength and the direction of a relation, evaluating whether there is a linear relationship among the pairs of variables in the population.

If we look at the correlation matrix (see Table 3), almost all indicators that describe vulnerabilities are positively correlated with each other, and almost all indicators that describe capabilities are also positively correlated with each other. At the same time, the indicators that describe the vulnerabilities are negatively correlated with those that describe the capacities, with small exceptions regarding Oadr and Gggd, obesity rates among children being practically stimulated by the good evolution of the indicators of socio-economic capabilities. Of the indicators that describe socio-economic vulnerabilities, only Arpr and IqsrS80/S20 are positively and strongly correlated (over 70%), therefore the risk of poverty and income inequality are mutually reinforcing at the level of EU27 countries. Regarding the indicators that describe the capacities, among them, the most significant links have the government expenditures for education (Ggee) and health (Ggeh) with those for research and development (GdeR&D). Also, the Employment rate (Emplr) has a significant positive correlation with GdeR&D.

Looking at the indicators that describe the vulnerabilities in relation to those that describe capacities, only the: Arpr with Ggeh, Arpr with GdeR&D, IqsrS80/S20 with GdeR&D, Gggd with Emplr and Gggd with Gggfcf have a correlation value of over 50%.

Table 3. Correlation Matrix between Selected Vulnerabilities and Capacities Indicators of Socio-Economic Area for the Period 2011-2020

	Arpr	*IqsrS80/S20*	*Geg*	*Oadr*	*Gggd*	*Ggee*	*Ggeh*	*Tea*	*Leb*	*Emplr*	*GdeR&D*	*Gggfcf*
Arpr	1											
IqsrS80/S20	0,918	1										
Geg	0,050	-0,009	1									
Oadr	0,242	0,250	-0,172	1								
Gggd	0,061	0,054	0,277	0,262	1							
Ggee	-0,368	-0,437	-0,433	0,047	-0,139	1						
Ggeh	-0,528	-0,497	-0,140	0,254	0,132	0,250	1					
Tea	-0,182	-0,184	-0,490	-0,145	-0,127	0,400	-0,041	1				
Leb	-0,346	-0,396	0,150	0,105	0,469	0,203	0,405	0,301	1			
Emplr	-0,418	-0,380	-0,428	0,144	-0,547	0,352	0,226	0,418	0,065	1		
GdeR&D	-0,531	-0,536	-0,402	0,319	-0,009	0,507	0,739	0,230	0,458	0,510	1	
Gggfcf	-0,038	-0,053	-0,170	-0,047	-0,509	0,286	-0,215	0,019	-0,471	0,205	-0,040	1

Source: Author's calculations; Eurostat data

But the correlation matrix does not show any causality, so in Table 4,5,6,7 and 8 are shown the results of the regression equation formulated as follows:

$$Arpr = \alpha_0+\alpha_1 Ggee+\alpha_2 Ggeh+\alpha_3 Tea+\alpha_4 Leb+\alpha_5 Emplr+\alpha_6 GdeR\&D+\alpha_7 Gggfcf + \varepsilon \quad (1)$$

$$IqsrS80/S20= \beta_0+\beta_1 Ggee+\beta_2 Ggeh+\beta_3 Tea+\beta_4 Leb+\beta_5 Emplr+\beta_6 GdeR\&D+\beta_7 Gggfcf+\varepsilon \quad (2)$$

$$Geg= \delta_0+\delta_1 Ggee+\delta_2 Ggeh+\delta_3 Tea+\delta_4 Leb+\delta_5 Emplr+\delta_6 GdeR\&D+\delta_7 Gggfcf+\varepsilon \quad (3)$$

$$Oadr= \gamma_0+\gamma_1 Ggee+\gamma_2 Ggeh+\gamma_3 Tea+\gamma_4 Leb+\gamma_5 Emplr+\gamma_6 GdeR\&D+\gamma_7 Gggfcf+\varepsilon \quad (4)$$

$$Gggd= \chi_0+\chi_1 Ggee+\chi_2 Ggeh+\chi_3 Tea+\chi_4 Leb+\chi_5 Emplr+\chi_6 GdeR\&D+\chi_7 Gggfcf+\varepsilon \quad (5)$$

Where: $\alpha_i,\beta_i,\delta_i,\gamma_i$ and χ_i i=0-7 – are coefficients of the equations, Arpr is At-risk-of-poverty rate by sex, IqsrS80/S20 is Income quintile share ratio (S80/S20) by sex, Geg is Gender employment gap, Oadr is Old-age-dependency ratio, Gggd is General government gross debt, Ggee is General government expenditure by function - Education, Ggeh is General government expenditure by function - Health, Tea is Tertiary educational attainment by sex, age group 30-34, Leb is Life expectancy at birth by sex, Emplr is Employment rate by sex, age group 20-64, GdeR&D is Gross domestic expenditure on R&D (GERD), Gggfcf is General government gross fixed capital formation, ε – error term.

For the first equation (see table 4), analyzing the value of the determination coefficient or R2, which is used to measure the intensity of the correlation between the endogenous variable and its determinants, it is observed that the value of 0.431727 is relatively small. At the same time, with respect to the adjusted R2, equal to 0.416544 at the sample level, it can be suggested that there is a relatively weak correlation between the variables in the model. The coefficients of independent variables are not significantly different from zero, only Ggeh shows a satisfactory result. The Ggee, Ggeh, Leb, Emplr and Gggfcf have an associated probability or a

p-value below 0.05, which confirms that for those indicators, the null hypothesis H0 can be rejected, which proposes those indicators for the model. Looking at the Durbin-Watson statistics, which tests the null hypothesis that the residuals from an ordinary least-squares regression are not autocorrelated against the alternative that they are, we are noticing that the value DW is over R2, which indicates that the regression performed is not spurious.

Table 4. Results for the Regression Equation for Arpr Depending on the Variables Selected for Capacities for Social-Economic Domain

Dependent Variable: ARPR
Method: Least Squares
Date: 01/14/22 Time: 17:31
Sample: 1 270
Included observations: 270

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	67.28369	7.826880	8.596490	0.0000
GGEE	-0.524098	0.252493	-2.075693	0.0389
GGEH	-1.171635	0.202244	-5.793179	0.0000
TEA	0.010920	0.023535	0.463972	0.6431
LEB	-0.340215	0.087536	-3.886559	0.0001
EMPLR	-0.182920	0.038488	-4.752631	0.0000
GDER_D	0.504833	0.400726	1.259795	0.2089
GGGFCF	-0.539274	0.216338	-2.492743	0.0133

R-squared	0.431727	Mean dependent var	16.64259
Adjusted R-squared	0.416544	S.D. dependent var	3.808560
S.E. of regression	2.909142	Akaike info criterion	5.002775
Sum squared resid	2217.335	Schwarz criterion	5.109395
Log likelihood	-667.3747	Hannan-Quinn criter.	5.045589
F-statistic	28.43510	Durbin-Watson stat	2.032922
Prob(F-statistic)	0.000000		

Source: Author's calculations, using Eurostat, annual data and Eviews11 soft

Table 5. Results for the Regression Equation for IqsrS80/S20 Depending on the Variables Selected for Capacities for Social-Economic Domain

Dependent Variable: IQSRS80_S20
Method: Least Squares
Date: 01/14/22 Time: 17:35
Sample: 1 270
Included observations: 270

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	22.53280	2.386823	9.440500	0.0000
GGEE	-0.279475	0.076998	-3.629626	0.0003
GGEH	-0.284049	0.061675	-4.605599	0.0000
TEA	0.009316	0.007177	1.297988	0.1954
LEB	-0.139191	0.026694	-5.214236	0.0000
EMPLR	-0.046253	0.011737	-3.940755	0.0001
GDER_D	0.116953	0.122202	0.957048	0.3394
GGGFCF	-0.188198	0.065973	-2.852666	0.0047

R-squared	0.444355	Mean dependent var	4.888370
Adjusted R-squared	0.429510	S.D. dependent var	1.174552
S.E. of regression	0.887149	Akaike info criterion	2.627574
Sum squared resid	206.2027	Schwarz criterion	2.734194
Log likelihood	-346.7225	Hannan-Quinn criter.	2.670388
F-statistic	29.93206	Durbin-Watson stat	2.028120
Prob(F-statistic)	0.000000		

Source: Author's calculations, using Eurostat, annual data and Eviews11 soft

For the second equation (see table 5), analyzing the value of the determination coefficient or R2, it is observed that the value of 0.444355 is relatively small, but has a better value compared to the result of the previous equation, suggesting that there isn't a very strong correlation between the variables in the model. The coefficients of independent variables are not significantly different from zero, only Ggee and Ggeh shows better results. The Ggee, Ggeh, Leb, Emplr and Gggfcf have an associated probability or a p-value below 0.05, which confirms that for those indicators, the null hypothesis H0 can be rejected, which proposes those indicators for the model. Looking at the Durbin-Watson statistics, we are noticing that the value DW is over R2, which indicates that the regression performed is not spurious.

Table 6. Results for the Regression Equation for Geg Depending on the Variables Selected for Capacities for Social-Economic Domain

Dependent Variable: GEG
Method: Least Squares
Date: 01/14/22 Time: 17:37
Sample: 1 270
Included observations: 270

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-76.43308	10.06105	-7.596928	0.0000
GGEE	-0.936474	0.324567	-2.885306	0.0042
GGEH	0.204447	0.259974	0.786414	0.4323
TEA	-0.300323	0.030253	-9.926882	0.0000
LEB	1.290085	0.112523	11.46503	0.0000
EMPLR	0.028369	0.049474	0.573408	0.5669
GDER_D	-3.534615	0.515113	-6.861828	0.0000
GGGFCF	0.908826	0.278091	3.268091	0.0012

R-squared	0.583169	Mean dependent var	10.53704
Adjusted R-squared	0.572032	S.D. dependent var	5.716288
S.E. of regression	3.739553	Akaike info criterion	5.504991
Sum squared resid	3663.875	Schwarz criterion	5.611611
Log likelihood	-735.1738	Hannan-Quinn criter.	5.547805
F-statistic	52.36454	Durbin-Watson stat	2.335029
Prob(F-statistic)	0.000000		

Source: Author's calculations, using Eurostat, annual data and Eviews11 soft

For the third equation (see table 6), analyzing the value of the determination coefficient or R2, it is observed that the value of 0.583169 is relatively good, and the adjusted R2 is 0.572032, a lot better compared to the result of the previous equations, showing a considerably good correlation between the variables in the model.

The coefficients of independent variables are not significantly different from zero, except Leb and GdeR&D. The Ggee, Tea, Leb, GdeR&D and Gggfcf have an associated probability or a p-value below 0.05, which confirms that for those indicators, the null hypothesis H0 can be rejected, which proposes those indicators for the model. Looking at the Durbin-Watson statistics, we are noticing that the value DW is over R2, which indicates that the regression performed is not spurious.

For the fourth equation (see table 7), analyzing the value of the determination coefficient or R2, it is observed that the value of 0.163979 it's pretty precarious, showing the weakest correlation between the variables from the model. The

coefficients of independent variables are not significantly different from zero, except GdeR&D.

Table 7. Results for the Regression Equation for Oadr Depending on the Variables Selected for Capacities for Social-Economic Domain

Dependent Variable: OADR
Method: Least Squares
Date: 01/14/22 Time: 17:39
Sample: 1 270
Included observations: 270

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	26.74653	10.51572	2.543481	0.0116
GGEE	-0.294237	0.339234	-0.867356	0.3865
GGEH	-0.261484	0.271723	-0.962318	0.3368
TEA	-0.113461	0.031621	-3.588200	0.0004
LEB	0.020907	0.117608	0.177771	0.8590
EMPLR	0.057805	0.051710	1.117855	0.2647
GDER_D	2.033882	0.538391	3.777704	0.0002
GGGFCF	-0.143930	0.290658	-0.495187	0.6209

R-squared	0.163979	Mean dependent var	27.62667
Adjusted R-squared	0.141643	S.D. dependent var	4.218726
S.E. of regression	3.908547	Akaike info criterion	5.593390
Sum squared resid	4002.505	Schwarz criterion	5.700010
Log likelihood	-747.1077	Hannan-Quinn criter.	5.636204
F-statistic	7.341349	Durbin-Watson stat	1.884393
Prob(F-statistic)	0.000000		

Source: Author's calculations, using Eurostat, annual data and Eviews11 soft

The Tea and GdeR&D have an associated probability or a p-value below 0.05, which confirms that for those indicators, the null hypothesis H0 can be rejected, which proposes those indicators for the model. Looking at the Durbin-Watson statistics, we are noticing that the value DW is over R2, which indicates that the regression performed is not spurious. It is interesting that tertiary education can reduce the rate of obesity in children but does not have a very strong statistical effect, while gross domestic expenditure on research and development has a significant impact but not positive, rather negative, evolving in the same direction with the rate of young children obesity.

For the fifth equation (see table 8), analyzing the value of the determination coefficient or R2, it is observed that the value of 0.595809 is relatively good, and the adjusted R2 is 0.585010, is the best result of adjusted R2 compared to the results of the previous equations, showing a considerably important correlation between the variables in the model.

The coefficients of independent variables are not significantly different from zero, except Ggeh, Leb, Emplr, GdeR&D and Gggfcf. The Leb, Emplr and Gggfcf have an associated probability or a p-value below 0.05, which confirms that for those indicators, the null hypothesis H0 can be rejected, which proposes those indicators for the model. Looking at the Durbin-Watson statistics, we are noticing that the value DW is over R2, which indicates that the regression performed is not spurious.

Table 8. Results for the Regression Equation for Gggd Depending on the Variables Selected for Capacities for Social-Economic Domain

Dependent Variable: GGGD
Method: Least Squares
Date: 01/14/22 Time: 17:42
Sample: 1 270
Included observations: 270

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-26.18454	66.86401	-0.391609	0.6957
GGEE	0.061499	2.157013	0.028511	0.9773
GGEH	-1.090198	1.727744	-0.630995	0.5286
TEA	-0.085931	0.201059	-0.427390	0.6694
LEB	4.787263	0.747811	6.401698	0.0000
EMPLR	-3.647941	0.328799	-11.09475	0.0000
GDER_D	6.623372	3.423350	1.934763	0.0541
GGGFCF	-8.194624	1.848143	-4.433976	0.0000

R-squared	0.595809	Mean dependent var	69.02593
Adjusted R-squared	0.585010	S.D. dependent var	38.57889
S.E. of regression	24.85242	Akaike info criterion	9.292969
Sum squared resid	161822.4	Schwarz criterion	9.399589
Log likelihood	-1246.551	Hannan-Quinn criter.	9.335783
F-statistic	55.17254	Durbin-Watson stat	2.428687
Prob(F-statistic)	0.000000		

Source: Author's calculations, using Eurostat, annual data and Eviews11 soft

In addition to correlation and regression, it has been performed a unit root test (see table 9) a Johansen Cointegration Test (Table 10) and a Granger causality test (table 11).

In order to adjust the model and make correct specification, it has been perform a unit root test in levels and first differences in order to determine univariate properties of the used data series.

As presented in Table no. 9, the results show that it could reject the null hypothesis of unit roots for all the variables in level forms for trend with intercept, because t critical value was in module under t-statistic. Although it was no longer necessary, at first differences things are even more obvious, the null hypothesis being easily rejected. It means that the calculated ADF statistics are more than their critical values in level form, suggesting that the variables are level stationary, indicating that these variables are order zero integrated I(0), which is normal for panel data.

Establishing that all variables are integrated in the same order, it has been proceed with the Johansen Cointegration test and Granger Causality Test. As it shows in the table 10, the results of the Johansen's cointegration test show that there are multiple cointegrating equations at 5% level of significance.

In table no.11 (presented below only for indicators of vulnerabilities against the capacities ones), the Granger causality test reflects that the probability under 0.05 is accomplished only for: - Arpr, which is Granger cause by Ggee, Tea, Leb, Emplr, Gggfcf; - IqsrS80/S20, which is Granger cause by Ggee, Tea, Leb, Emplr, Gggfcf; -

Oadr, which is Granger cause Ggeh, Tea, Leb, Emplr, GdeR&D; and – Gggd, which is Granger cause by Ggee, Ggeh, Tea, Leb, Emplr, GdeR&D.

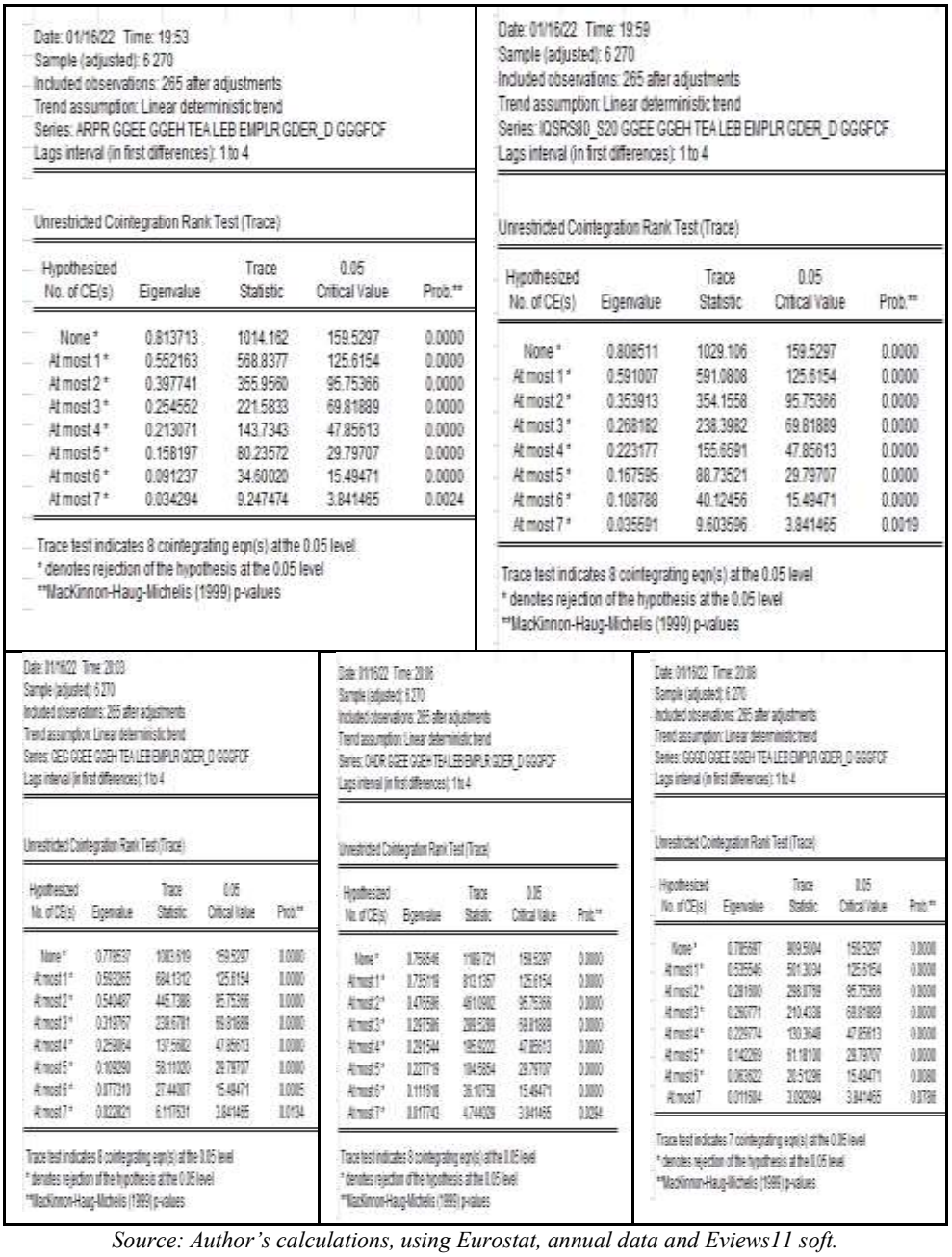
Table 9. Augmented Dickey - Fuller Unit Root Test and Stationary Results for Selected Socio-Economic Indicators

Series Label	Level t-Statistic	Critical Value		First Difference t-Statistic	Critical Value	
	Constant & Trend	5%	1%	Constant	5%	1%
Arpr	-6.692	-3.428	-3.995	-6.752	-2.873	-3.456
	0.000*			0.000*		
IqsrS80/S20	-8.415	-3.428	-3.995	-14.131	-2.872	-3.455
	0.000*			0.000*		
Geg	-9.681	-3.427	-3.993	-9.359	-2.873	-3.456
	0.000*			0.000*		
Oadr	-12.208	-3.428	-3.995	-6.328	-2.873	-3.456
	0.000*			0.000*		
Gggd	-9.679	-3.427	-3.993	-11.828	-2.872	-3.455
	0.000*			0.000*		
Ggee	-4.079	-3.427	-3.994	-12.715	-2.873	-3.456
	0.008*			0.000*		
Ggeh	-9.048	-3.428	-3.995	-5.879	-2.873	-3.456
	0.000*			0.000*		
Tea	-13.688	-3.427	-3.993	-14.638	-2.872	-3.455
	0.000*			0.000*		
Leb	-6.660	-3.428	-3.995	-5.624	-2.873	-3.456
	0.000*			0.000*		
Emplr	-9.753	-3.427	-3.993	-10.476	-2.873	-3.456
	0.000*			0.000*		
GdeR&D	-10.423	-3.427	-3.994	-6.715	-2.873	-3.456
	0.000*			0.000*		
Gggfcf	-7.372	-3.427	-3.993	-11.112	-2.872	-3.455
	0.000*			0.000*		

*Source: Author's calculations, using Eurostat, annual data and Eviews11 soft. The ADF tests examine the null hypothesis of a unit root against the stationary alternative; the * is the p-value.*

Also, the capacities indicators are determined by vulnerabilities indicators, such as: -Arpr is a Granger cause for all capacities indicators; - IqsrS80/S20 is Granger cause for all capacities indicators except Ggeh; - Geg is Granger cause for Ggeh, Tea, Emplr, GdeR&D, Gggfcf; - only Tea, Leb and Emplr is Granger cause by Oadr, and Gggd is a Granger cause for all capacities indicators, except Leb and Gggfcf.

Table 10. Johansen Cointegration Test for Unrestricted Cointegration Rank Test (Trace) for Selected Socio-Economic Indicators and for all Proposed Equations



Date: 01/16/22 Time: 19:53
Sample (adjusted): 6 270
Included observations: 265 after adjustments
Trend assumption: Linear deterministic trend
Series: ARPR GGEE GGEH TEA LEB EMPLR GDER_D GGGFCF
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.813713	1014.162	159.5297	0.0000
At most 1 *	0.552163	568.8377	125.6154	0.0000
At most 2 *	0.397741	355.9560	95.75366	0.0000
At most 3 *	0.254552	221.5833	69.81889	0.0000
At most 4 *	0.213071	143.7343	47.85613	0.0000
At most 5 *	0.158197	80.23572	29.79707	0.0000
At most 6 *	0.091237	34.60020	15.49471	0.0000
At most 7 *	0.034294	9.247474	3.841465	0.0024

Trace test indicates 8 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Date: 01/16/22 Time: 19:59
Sample (adjusted): 6 270
Included observations: 265 after adjustments
Trend assumption: Linear deterministic trend
Series: IQSRS80_S20 GGEE GGEH TEA LEB EMPLR GDER_D GGGFCF
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.808511	1029.106	159.5297	0.0000
At most 1 *	0.591007	591.0808	125.6154	0.0000
At most 2 *	0.353913	354.1558	95.75366	0.0000
At most 3 *	0.268182	238.3982	69.81889	0.0000
At most 4 *	0.223177	155.6591	47.85613	0.0000
At most 5 *	0.167595	88.73521	29.79707	0.0000
At most 6 *	0.108788	40.12456	15.49471	0.0000
At most 7 *	0.035591	9.603596	3.841465	0.0019

Trace test indicates 8 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Date: 01/16/22 Time: 20:03
Sample (adjusted): 6 270
Included observations: 265 after adjustments
Trend assumption: Linear deterministic trend
Series: GEG GGEE GGEH TEA LEB EMPLR GDER_D GGGFCF
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.778537	1083.919	159.5297	0.0000
At most 1 *	0.592265	684.1312	125.6154	0.0000
At most 2 *	0.543487	445.7386	95.75366	0.0000
At most 3 *	0.319757	238.6781	69.81889	0.0000
At most 4 *	0.259864	137.5982	47.85613	0.0000
At most 5 *	0.169259	69.11020	29.79707	0.0000
At most 6 *	0.077310	27.44307	15.49471	0.0005
At most 7 *	0.022821	6.117531	3.841465	0.0134

Trace test indicates 8 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Date: 01/16/22 Time: 20:06
Sample (adjusted): 6 270
Included observations: 265 after adjustments
Trend assumption: Linear deterministic trend
Series: GADR GGEE GGEH TEA LEB EMPLR GDER_D GGGFCF
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.758546	1189.721	159.5297	0.0000
At most 1 *	0.735116	813.1357	125.6154	0.0000
At most 2 *	0.476596	481.0902	95.75366	0.0000
At most 3 *	0.357536	295.5289	69.81889	0.0000
At most 4 *	0.291544	195.9222	47.85613	0.0000
At most 5 *	0.227718	104.5654	29.79707	0.0000
At most 6 *	0.111918	35.10758	15.49471	0.0000
At most 7 *	0.017743	4.744029	3.841465	0.0294

Trace test indicates 8 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Date: 01/16/22 Time: 20:06
Sample (adjusted): 6 270
Included observations: 265 after adjustments
Trend assumption: Linear deterministic trend
Series: GGGI GGEE GGEH TEA LEB EMPLR GDER_D GGGFCF
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.785987	969.5094	159.5297	0.0000
At most 1 *	0.535546	591.3034	125.6154	0.0000
At most 2 *	0.381560	358.8759	95.75366	0.0000
At most 3 *	0.290771	240.4338	69.81889	0.0000
At most 4 *	0.229774	150.3648	47.85613	0.0000
At most 5 *	0.142269	91.18108	29.79707	0.0000
At most 6 *	0.083522	39.51296	15.49471	0.0000
At most 7	0.011504	3.035994	3.841465	0.0786

Trace test indicates 7 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Source: Author's calculations, using Eurostat, annual data and Eviews11 soft.

Table 11. Granger Causality Test Results for Selected Socio-Economic Indicators and the Synthesis of the Causal Direction

Pairwise Granger Causality Tests			
Date: 01/15/22 Time: 15:08			
Sample: 1 270			
Lags: 2			
Null Hypothesis:	Obs	F-Statistic	Prob.
GGEE does not Granger Cause ARPR	268	100.781	6.E-05
ARPR does not Granger Cause GGEE		199.861	8.E-09
GGEH does not Granger Cause ARPR	268	0.69602	0.4995
ARPR does not Granger Cause GGEH		472.023	0.0097
TEA does not Granger Cause ARPR	268	294.110	1.E-06
ARPR does not Granger Cause TEA		878.187	0.0002
LEB does not Granger Cause ARPR	268	239.240	3.E-10
ARPR does not Granger Cause LEB		440.148	0.0132
EMPLR does not Granger Cause ARPR	268	637.787	0.0020
ARPR does not Granger Cause EMPLR		124.915	7.E-06
GDER_D does not Granger Cause ARPR	268	177.833	0.1709
ARPR does not Granger Cause GDER_D		253.197	9.E-11
GGGFCF does not Granger Cause ARPR	268	124.081	7.E-06
ARPR does not Granger Cause GGGFCF		435.293	0.0138
GGEE does not Granger Cause IQSRS80_S20	268	117.042	1.E-05
IQSRS80_S20 does not Granger Cause GGEE		111.329	2.E-05
GGEH does not Granger Cause IQSRS80_S20	268	130.318	0.2794
IQSRS80_S20 does not Granger Cause GGEH		258.099	0.0776
TEA does not Granger Cause IQSRS80_S20	268	157.274	4.E-07
IQSRS80_S20 does not Granger Cause TEA		878.129	0.0013
LEB does not Granger Cause IQSRS80_S20	268	193.910	1.E-08
IQSRS80_S20 does not Granger Cause LEB		467.217	0.0101
EMPLR does not Granger Cause IQSRS80_S20	268	156.886	4.E-07
IQSRS80_S20 does not Granger Cause EMPLR		134.129	3.E-06
GDER_D does not Granger Cause IQSRS80_S20	268	227.503	0.1048
IQSRS80_S20 does not Granger Cause GDER_D		154.239	5.E-07
GGGFCF does not Granger Cause IQSRS80_S20	268	153.084	5.E-07
IQSRS80_S20 does not Granger Cause GGGFCF		461.264	0.0107
GGEE does not Granger Cause OADR	268	119.272	0.3050
OADR does not Granger Cause GGEE		289.617	0.0570
GGEH does not Granger Cause OADR	268	831.301	0.0003
OADR does not Granger Cause GGEH		112.378	0.3286
TEA does not Granger Cause OADR	268	148.405	8.E-07
OADR does not Granger Cause TEA		184.399	3.E-08
LEB does not Granger Cause OADR	268	204.705	5.E-09
OADR does not Granger Cause LEB		432.730	0.0142
EMPLR does not Granger Cause OADR	268	470.042	0.0089
OADR does not Granger Cause EMPLR		717.627	0.0009
GDER_D does not Granger Cause OADR	268	610.676	0.0026
OADR does not Granger Cause GDER_D		279.380	0.0630
GGGFCF does not Granger Cause OADR	268	116.036	0.3150
OADR does not Granger Cause GGGFCF		284.832	0.0542
GGEE does not Granger Cause GGGD	268	151.743	0.0309
GGGD does not Granger Cause GGEE		102.844	5.E-05
GGEH does not Granger Cause GGGD	268	366.301	0.0286
GGGD does not Granger Cause GGEH		564.553	4.E-21
TEA does not Granger Cause GGGD	268	339.621	0.0350
GGGD does not Granger Cause TEA		520.422	0.0061
LEB does not Granger Cause GGGD	268	484.253	0.0086
GGGD does not Granger Cause LEB		0.36252	0.6963
EMPLR does not Granger Cause GGGD	268	155.705	4.E-07
GGGD does not Granger Cause EMPLR		836.351	0.0003
GDER_D does not Granger Cause GGGD	268	721.467	0.0009
GGGD does not Granger Cause GDER_D		448.788	2.E-17
GGGFCF does not Granger Cause GGGD	268	147.425	0.2308
GGGD does not Granger Cause GGGFCF		236.596	0.1017
GEG does not Granger Cause GGEE	268	171.527	0.1819
GGEE does not Granger Cause GEG		517.835	0.0062
GEG does not Granger Cause GGEH	268	481.003	0.0108
GGEH does not Granger Cause GEG		0.54289	0.5817
GEG does not Granger Cause TEA	268	807.921	0.0004
TEA does not Granger Cause GEG		157.867	3.E-07
GEG does not Granger Cause EMPLR	268	121.001	9.E-06
EMPLR does not Granger Cause GEG		161.578	2.E-07
GDER_D does not Granger Cause GEG	268	0.75777	0.4697
GEG does not Granger Cause GDER_D		534.991	0.0064
GGGFCF does not Granger Cause GEG	268	608.744	0.0026
GEG does not Granger Cause GGGFCF		391.657	0.0211

Determinant =>	Determined
GGEE	ARPR
TEA	
LEB	
EMPLR	
GGGFCF	
GGEE	IQSRS80/S20
TEA	
LEB	
EMPLR	
GGGFCF	
GGEE	GEG
TEA	
EMPLR	
GGGFCF	
GGEH	OADR
TEA	
LEB	
EMPLR	
GDER&D	
GGEE	GGGD
GGEH	
TEA	
LEB	
EMPLR	
GDER&D	
ARPR	GGEE
	GGEH
	TEA
	LEB
	EMPLR
	GDER&D
	GGGFCF
IQSRS80/S20	GGEE
	TEA
	LEB
	EMPLR
	GDER&D
	GGGFCF
GEG	GGEH
	TEA
	EMPLR
	GDER&D
	GGGFCF
OADR	TEA
	LEB
	EMPLR
GGGD	GGEE
	GGEH
	TEA
	EMPLR
	GDER&D

Source: Author's calculations, using Eurostat, annual data and Eviews11 soft.

5. Conclusion

The socio-economic field seems, more than ever, extremely important in order to limit the dramatic effects of the COVID-19 pandemic. Thus, starting from the 2021 Resilience Dashboards report, the article tries to highlight the internal links in this field between the indicators that describe the vulnerabilities and those that describe the capabilities of the selected socio-economic indicators. The basic assumption is that indicators that describe capabilities can reduce the values of indicators that describe vulnerabilities, of the socio-economic domain.

For the present study, the selected indicators for vulnerabilities are: At-risk-of-poverty rate by sex (Arpr), Income quintile share ratio (S80/S20) by sex (IqsrS80/S20), Gender employment gap (Geg), Old-age-dependency ratio (Oadr), General government gross debt (Gggd), and the selected indicators for capabilities are: General government expenditure by function - Education (COFOG) (Ggee), General government expenditure by function - Health (COFOG) (Ggeh), Tertiary educational attainment by sex, age group 30-34 (Tea), Life expectancy at birth by sex (Leb), Employment rate by sex, age group 20-64 (Emplr), Gross domestic expenditure on R&D (GERD) (GdeR&D), General government gross fixed capital formation (Gggfcf). There has been used Eurostat database, the data arrangement is panel type and the period analyzed is 2011-2020.

Starting the analysis with correlation matrix we can notice that almost all indicators that describe vulnerabilities are positively correlated with each other, and almost all indicators that describe capabilities are also positively correlated with each other. At the same time, the indicators that describe the vulnerabilities are negatively correlated with those that describe the capacities, with small exceptions regarding Oadr and Gggd, obesity rates among children being practically stimulated by the good evolution of the indicators of socio-economic capabilities.

Of the indicators that describe socio-economic vulnerabilities, only At-risk-of-poverty rate by sex and Income quintile share ratio (S80/S20) are positively and strongly correlated, so the poverty has his say on income inequality and vice-versa at EU27 level countries. Regarding the indicators that describe the capacities, among them, the most significant links have the government expenditures for education (Ggee) and health (Ggeh) with those for research and development (GdeR&D). At the same time, the Employment rate (Emplr) has a significant positive correlation with GdeR&D. Looking at the indicators that describe the vulnerabilities in relation to those that describe capacities the correlation of over 50%, have only: Arpr with GdeR&D, Arpr with Ggeh, IqsrS80/S20 with GdeR&D, Gggd with Emplr and Gggd with Gggfcf.

Thus, research and development expenditures play an important role not only for capacity-describing indicators, but also for the power to limit vulnerabilities, both

directly and indirectly, through their influence on other capacity-describing indicators.

If we formulate equations of determination between each indicator that describes the field of vulnerabilities and all the indicators that describe the capacities we can find:

- All regression equations have an R2 between 0.40 and almost 0.60, except for the one that defines the obesity rate of young children (Oadr), facts that it can propose the model formulation as appropriate;

-Independent variables that can properly explain the dependent variables (e.g. a p-value below 0.05) are: - for Arpr the Ggee, Ggeh, Leb, Emplr and Gggfcf; - for IqsrS80 /S20 the Ggee, Ggeh, Leb, Emplr and Gggfcf; - for Geg the Ggee, Tea, Leb, GdeR&D and Gggfcf; - for Oadr the Tea and GdeR&D, and - for Ggged the Leb, Emplr and Gggfcf;

- The minus sign dominates the values of the coefficients of the independent variables, which suggests, as it is natural, that the capacities diminish the vulnerabilities (the dependent variables), being important that the Gender employment gap (Geg) is dominated by the negative correlation with GdeR&D, and the gross public debt (Gggd) of the relationship with employment rate (Emplr) and with General government gross fixed capital formation (Gggfcf).

In order to better adjust the model, there is performed a unit root test, a Johansen Cointegration Test and a Granger causality test. As is natural, in the case of panel data, the ADF test shows stationary values at the level and because the indicators are of the same domain, the Johansen Cointegration Test shows numerous cointegration relations. Also, the Granger causality test reveals that: Ggee, Tea, Leb, Emplr, Gggfcf are the Granger cause for Arpr; - Ggee, Tea, Leb, Emplr, Gggfcf are the Granger cause for IqsrS80/S20; - Ggeh, Tea, Leb, Emplr, GdeR&D are Granger cause for Oadr; and - Ggee, Ggeh, Tea, Leb, Emplr, GdeR&D are Granger cause for Gggd.

The results indicate, as was natural, the need for permanent private and especially public efforts in the field of education and health, employment, prolonging healthy life, investing in the fixed capital of the state (and not only), in order to make a substantial decline in socio-economic risks and vulnerabilities.

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