Territorial Disparities in the Regional Value Chain of IT&C

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Abstract

Regional development in Romania involves direct action on post-suburbia, compact and complex cities as a system of systems, cluster coordinated at the macro level. When we talk about regions and other macroeconomic analysis we refer to clusters and we study the process that includes each stage of development and communication, activities organized in a certain way in order to properly analyze them. Through this article we want to demonstrate the regional development/evolution in Romania in all four industrial revolutions, with an emphasis on the "national goal" represented by IT (the third industrial revolution), the macroregional imbalances that generate territorial disparities, we'll correlate these IT & C insertions with the unemployment rate and tertiary training of residents and those attracted from the neighborhood to work in this industry, namely the influence of the academic environment and the cluster focused on the production cycle as a value chain at the regional level rather than by SMEs.

Key words: value chain, IT&C industry, regions, unemployment, regression
J.E.L. classification: J64, L63, L86, O14, O47

1. Introduction

Over time, human activities have diversified, appearing some new ones or disappearing those that were no longer needed. Thus, in the literature there are talks about four industrial revolutions which had implications both in economic and social life. If the first revolution used steam to produce through mechanization, in the second one invention of electricity has improved productive capacity, in the third one the emergence of computers has brought changes in all economic branches, the Fourth Industrial Revolution began with the emergence of artificial intelligence. This article focuses on the analysis of IT & C activities in Romania, showing the main economic implications at the territorial level (NUTS2 and NUTS3). The four activities analyzed form a part of the value chain for IT&C: computer manufacturing, optical and electronic products; support activity as the field of telecommunication, programming and computer coding, activities in the information service, also consultancy and related activities.

2. Literature review

The most complete, for our study, survey on IT industry in Europe is found in a research conducted by Rachel Nienaber and Thierry Vermeiren (2018), where they have searched for variables and directions in fast growing technological revolution for some countries from Central-Eastern Europe. Many software companies from all over the world choose in this region, based on talent, excellence, price-quality, countries like: Ukraine (230,000 IT professionals), Poland (140,000) and Romania (95,000), which have an estimated IT market growth of 15-20% year by year. For Romania, the exports of IT services are estimated at 4bn in 2019 (from 2bn Euro in 2015). According the data presented we see a correlation between the location of companies and the degree of cities development. So, the companies choose cities from developed regions. Also,

this study highlights the measures of government who intervene with 16% tax cut and incentives for this type of activities.

Andreea Burciu conducted a study on the Romanian industries, with an emphasis on the 3rd industrial revolution, and a comparison with the other European countries, based on Digital Agenda, 2020 strategy on ICT. Today we have 8 Mil. workers in ICT (3,7%). Beside research, sells and maintenance, today's focus is on industry (tools, business), as EU is trying to compete more and more with the US and China. Also, the importance of ICT in business administration, entrepreneurship, named e-business and e-leadership. In Romanian ICT environment, we have Bucharest with 56% from number of employees, and GDP contribution (60%), Timis county (8,6%), Cluj (6,6%), with ICT companies in Bucharest at 41%, national level.

Nelu Popescu, in his study/article "Entrepreneurship and SMEs Innovation in Romania" (2014), gave us a comparison between innovation, entrepreneurship and SMEs, the role of these business for the economic recovery, with an accent on creative industries and ICT. Innovation, as an important component in SMEs is about creation of new products (37,21%); new management and marketing approaches (19,51%), in 2012. In Romanian SMEs we have 16,45% for new technologies and update in ICT systems (7,60%). In the last decades the ICT Industrial Revolution changed the way business is made today, we have SMEs using computers (81,94%), access & use the Internet (80.83%), electronic mail (3/4), own website (1/4), online selling (4,33%).

3. Methodological considerations

For the international comparison the processed data was extracted from the database on EUROSTAT, for the period 2008-2015.

For the national analyze the processed data, for the last 16 years, was from TEMPO database (on the Romanian National Institute of Statistics website)[1], respectively for the period 2002-2016. Given that in 2008 the "Classification of activities in the national economy" (CANE Rev1) "was revised to ensure a 1:1 ratio with the International Standard Classification of Economic Activities" developed by the United Nations Statistical Commission (NACE Rev2 ISIC Rev4) [13] data processing has been divided into two periods 2002-2008 and 2008-2016.

IT and communications activities have been identified as both IT and communications equipment production and IT services and communications.

We present below a correspondence table at CANE level used for IT and telecommunication activities between the two CANE versions:

Table no 1. Correspondence table for CANE versions

CANE Rev.2		**CANE Rev.1**	
2620	Computers and peripheral equipment manufacturing	3002	Manufacture of computers and other electronic equipment
		3230	Production of radio and television receivers; audio and video recording and reproducing apparatus
2630	Communications equipment manufacturing	3162	Production of other electrical components n.c.a.
		3220	Production of radio and television transmitters, telephone and telegraph equipment and apparatus
6110	Telecommunication services via cable networks	6420	Telecommunications
6120	Wireless telecommunication activities (exclusively by satellite)		
6130	Satellite telecommunications activities		
6190	Other telecommunications activities		

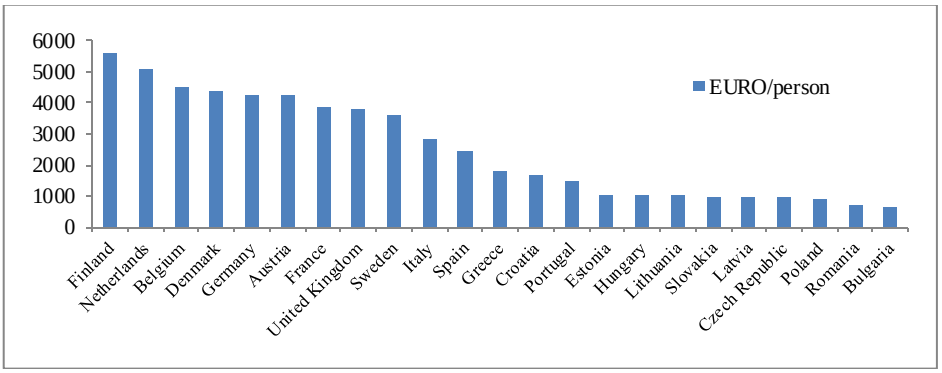
6201	Custom software development activities (customer oriented software)	7221	Program editing
		7240	Database related activities
		7222	Consultancy and supply of other software products
6202	IT&C consultancy activities	7210	Consultancy in the field of computer equipment (hardware)
		7222	Consultancy and supply of other software products
6203	Management activities (management and use) of the data calculation tools	7230	Computer data processing
6209	Other information technology service activities	3002	Manufacture of computers and other electronic equipment
		7260	Other computer related activities
		7222	Consultancy and supply of other software products
6311	Data processing, web page management and related activities	7230	Computer data processing
		7240	Database related activities
6312	Web portals activities	7240	Database related activities

Source: www.insse.ro - methodological notes for "Classification of activities in the national economy" CANE Rev2)

4. Romania within the European Union- territorial level comparison

At European Union level, in 2015, 41,000 [2] of enterprises were active in the field of "Manufacture of computer, electronic and optical products", of which about 2% were in Romania. More than 50% of the number of enterprises with this main activity were located in Czech Republic, Germany, Italy and United Kingdom. Analyzing in terms of value added at factor cost, countries with the highest values per enterprise were: Germany (with over 4 million euro/enterprise), Austria (with 3.70 million euro/enterprise), Denmark (3.56 million euro/enterprise) and France (with 3.51 million euro/enterprise). The added value of just 0.56 million euro/enterprise places Romania on the 18th place in the total countries of the European Union. The highest monthly earnings in this economic activity are earned in Finland, the Netherlands, Belgium, Denmark, Germany and Austria, where they reach average values per employee of over 4,000 euros. With an average monthly earnings / employee of 698 euros, in 2015, Romania is among the last places in the hierarchy of EU countries.

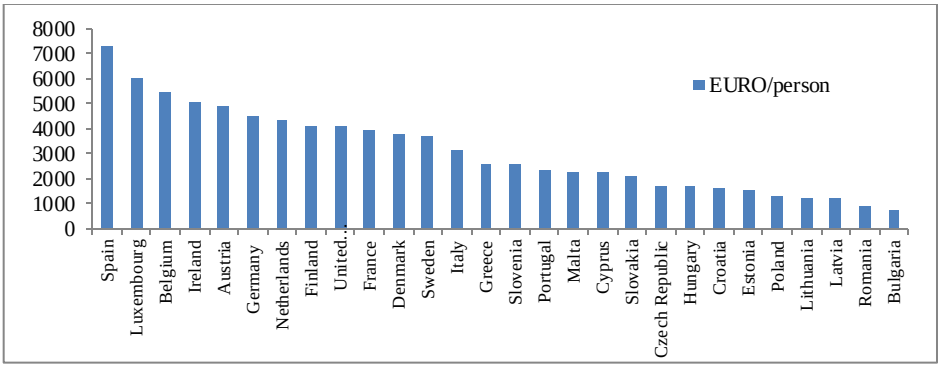
Figure no. 1 Average monthly earning per person from "Manufacture of computer, electronic and optical products activity", in 2015



Source: authors' computation

In 2015, in Romania in telecommunication field were active 2319 enterprises, 30% less than in 2008. The value added at factor cost produced by them is close to the value added by the 80 companies in Luxembourg. Thus, if in EU on average an enterprise achieves EUR 20 million value added, in Romania an enterprise produces on average 0.7 million euros. Also in this field, the average monthly earning obtained by a Romanian person is much lower than in the other EU member states. In 2015, the EU average monthly earning was 3714 euros, and in Romania four times smaller. The countries with the highest earnings are Spain, Luxembourg, Belgium and Ireland where average monthly earnings exceed € 5,000 per person.

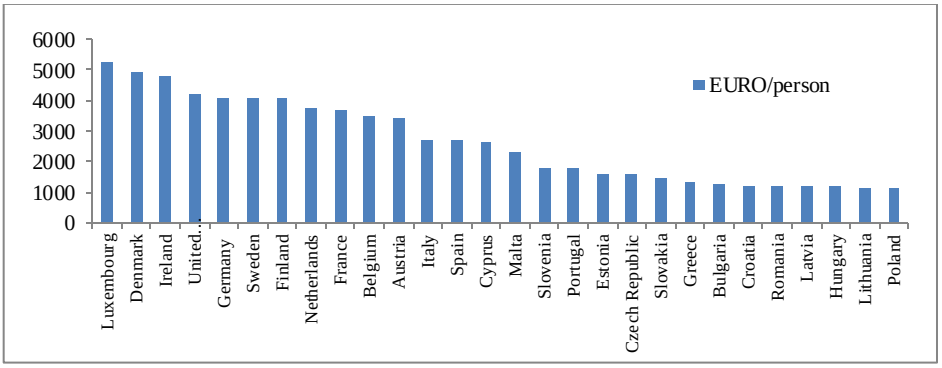
Figure nr. 2 Average monthly earning per person from "Telecommunication" activities, in 2015



Source: authors' computation

In 2015, in EU there were active over 250,000 enterprises with the activity of "Computer programming, consultancy and related activities", of which 9,811 were in Romania [2]. In this economic branch the number of enterprises in Romania has an upward trend, increasing by over 25% compared to 2008. The average value added at factor cost produced by a Romanian company almost doubled in 2015 compared to 2008, reaching EUR 183,070 in 2015 [2]. The average monthly earning gained by one person at EU level was 3365 euro in 2015. Of the 28 countries, 11 countries registered average monthly earning over the european average level. Romania ranks among the countries with the lowest average monthly earning, in 2015 it was 1214 euros.

Figure no. 3 Average monthly earning per person from "Computer programming, consultancy and related activities", in 2015

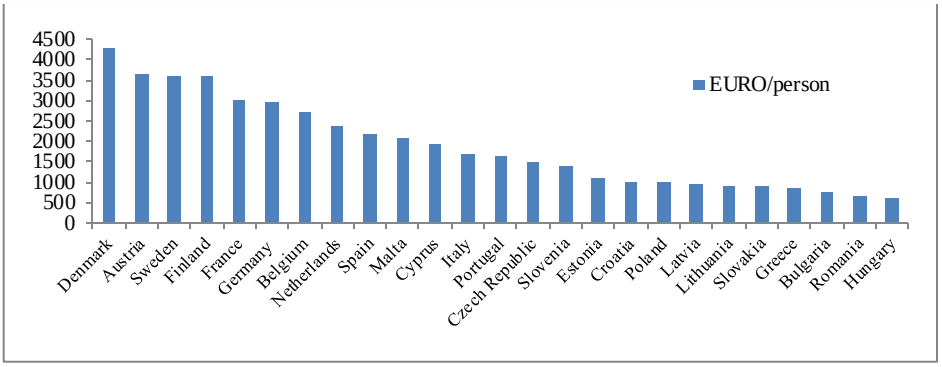


Source: authors' computation

In the field of "Information service activities", in 2015 at the EU level there were registered 130,000 enterprises, the trend being a growing one. Also, gross value added at cost factor has an increasing trend. Over 7,000 enterprises from the United Kingdom provide over 25% of the EU's gross value added in this industry. In 2015, with 656,952 euro/enterprise, Finland was situated on the second place, while on the third place was Germany with 562,359 euro/enterprise. The gross value added of an enterprise, in Romania, was just 68,991 euro, more than four times smaller than the European average. The largest average monthly earning in this area was obtained in 2015, in

Denmark (Ireland, Luxembourg and United Kingdom do not contain figures for this indicator on the Eurostat website), with Romania ranked last but one in the EU countries classification. Thus, a Romanian employed in this field earned in 2015 seven times less than a person in Denmark and over 5 times less than an Austrian.

Figure no. 4 Average monthly earning per person from "Information service activities", in 2015



Source: authors' computation

Analyzing the evolution of Romania's indicators on the four branches of interest, we can highlight the following aspects:

- the enterprises with main activity of "Manufacture of computer, electronic and optical products" and "Telecommunications" bring the almost same value added at cost factor to enterprises with main activity of "Computer programming, consultancy and related activities" and "Information service activities" (in 2015 was 2171.5 million euro versus 2015.7 million euro), although their number is much smaller than the latter (in 2015 the percentage was 1 to 4);
- the activity of "Computer programming, consultancy and related activities" has a growing trend in recent years. The value added obtained by the enterprises with this main activity doubled in 2015 compared to 2008, while the number of enterprises increased with over a quarter in 2015 compared with 2008;
- the highest average monthly earnings are obtained in the field of "Computer programming, consultancy and related activities" (in 2015, the average monthly earning / person was twice as much as that obtained by a person working in one of the branches of "Manufacture of computer, electronic and optical products" or "Information service activities").

5. IT&C activities in Romania - territorial analyse

During 2008-2016 period, the number of local active units from Romania decreased by 4.5%. The number of units with IT activities and communications increases by over 3000 units, their share in the total economy reaching 2.39% in 2008 to 3.13% in 2016. Over 45% of the local IT & C units are in Macroregion Three. Please note that this region includes the capital city, which is a pillar of economically importance. If at the level of three macro-regions: One, Two and Four, the local active IT & C units are around 2%; in Macroregion Three, this weight exceeds 3%, reaching 4.19% in 2016. In the 9 years analyzed, an increase has been made at the level of units with WEB portal activities, the number of them growing more than 10 times; over half of them are found in macro-region Three. Over 95% of the units with this activity are micro-enterprises (SMEs). Many entrepreneurs are also targeting custom software activities, the number of units with this activity increasing by more than 50%.

During 2002-2008 period, the number of units in IT&C (considering CANE Rev1) in total active local units registered values of over 2.30%. These higher values compared to the period 2008-2016 may be slightly deformed by the inclusion in the analysis of CANE 3162 - "Production of other electronic components n.c.a.". Applying a correction coefficient obtained from year 2008 data on both CANE Rev1 and CANE Rev2, these percentages decrease in the range of 1.65% (2002) to 2.41% (2008), the trend being constantly increasing. At the territorial level, the rising

trend is manifested at the level of all four macroregions, the highest pace manifesting in the Macroregion Three, where the share reaches from 2.24% in 2002 to 3.30% in 2008 and 3.84% in 2016. Also, during this period most local units are micro-enterprises (SMEs).

In 2008-2016 period, the average number of employees in IT & C activities has confronted with a growing trend, contrary to the evolution recorded by the average number of employees from total economy. Thus, in IT & C the average number of employees increase from 103,046 people [1] in 2008 to 145,683 persons [1] in 2016 (in "Information service activities" and "Computer service activities" doubling the number of employees). The largest weight of employees attracted in IT & C activities is recorded in Macro-Region Three (in 2016 it reaches 4.35% of employees in this area) and in Macroregion Four (where in 2016 it reaches at 3.08% of total employees). In comparison with the data from the 8 regions of Romania, the regions where IT&C employees are more numerous are the Bucharest-Ilfov Region (where more than 62,000 people worked in 2016) and the West Region (where over 23,000 people worked in 2016).

From the 40 counties of Romania, 7 of them concentrate more than 75% of the average number of IT &C employees nationwide, the only one different is the capital, attracting over 40% of people in this field.

Average monthly nominal net earning from "Service activities in information technology" and "Computer service activities" (div. 62-63, CANE Rev.2)[13] exceeds national average monthly nominal net earning, over the last 7 years being double than this. From all the 40 counties, only 4 are heaving an average monthly nominal net earning higher than the national average, Bucharest - the capital city being one of them.

6. The influence of IT&C activities on unemployment in Romania

Unemployment is a phenomenon due to the lack of suitable workplaces for the population in a given area. Taking into account the number of local active units and the average monthly earnings in the IT&C domains, it was attempted to obtain whether these two indicators influence the registered unemployment rate in the territorial area, regions and counties respectively.

Thus, the model taken into account was:

$$unemployment = a_0 * units + a_1 * salaries + \varepsilon$$

Table no. 2. Variables descriptions

Variable	Definitions
unemployment	registered unemployment rate for each region/county
units_26	number of active local units from 26 division (CANE Rev2)
units_61	number of active local units from 61 division (CANE Rev2)
units_62_63	number of active local units from 62 and 63 divisions (CANE Rev2)
salaries_26	average monthly nominal net earning /person for 26 division (CANE Rev2)
salaries_61	average monthly nominal net earning /person for 61 division (CANE Rev2)
salaries_62_63	average monthly nominal net earning/person for 62 and 63 divisions (CANE Rev2)

Source: authors' computation

Data used was taken from 2016, the software used was EVIEWS and the least squares method. Thus, we present the results obtained for the data at regional level.

$$unemployment = -0.014742\ units - 0.002359\ salaries + 11.32560$$

Table no.3. Regression of the unemploymenton number of units and salaries for26 Div

Variable	Coefficient	Std. Error	t-Statistic	Prob.
UNITS_26	-0.014742	0.005045	-2.922062	0.0329
SALARIES_26	-0.002359	0.000613	-3.851391	0.0120
C	11.32560	1.105315	10.24649	0.0002
R-squared	0.911129	Mean dependent var		4.937500
Adjusted R-squared	0.875580	S.D. dependent var		2.369411
S.E. of regression	0.835768	Akaike info criterion		2.759064
Sum squared resid	3.492538	Schwarz criterion		2.788855
Log likelihood	-8.036256	Hannan-Quinn criter.		2.558139
F-statistic	25.63051	Durbin-Watson stat		3.512420
Prob(F-statistic)	0.002355			

Source: authors' computation

$$unemployment = -0.003269\ units - \ 0.001988\ salaries + 11.53550$$

Table no. 4. Regression of the unemploymenton number of units and salaries for 61 Div

Variable	Coefficient	Std. Error	t-Statistic	Prob.
UNITS_61	-0.003269	0.002478	-1.319066	0.2443
SALARIES_61	-0.001988	0.000687	-2.892089	0.0341
C	11.53550	1.828121	6.310031	0.0015
R-squared	0.758653	Mean dependent var		4.937500
Adjusted R-squared	0.662115	S.D. dependent var		2.369411
S.E. of regression	1.377288	Akaike info criterion		3.758107
Sum squared resid	9.484616	Schwarz criterion		3.787897
Log likelihood	-12.03243	Hannan-Quinn criter.		3.557181
F-statistic	7.858550	Durbin-Watson stat		0.920765
Prob(F-statistic)	0.028616			

Source: authors' computation

$$unemployment = -0.000112\ units - 0.001274\ salaries + 10.33540$$

Table no. 5. Regression of the unemploymenton units and salaries for 62_63 Div

Variable	Coefficient	Std. Error	t-Statistic	Prob.
UNITS_62_63	-0.000112	0.000422	-0.264169	0.8022
SALARIES_62_63	-0.001274	0.000493	-2.584598	0.0492
C	10.33540	1.579162	6.544864	0.0012
R-squared	0.788964	Mean dependent var		4.937500
Adjusted R-squared	0.704549	S.D. dependent var		2.369411
S.E. of regression	1.287902	Akaike info criterion		3.623903
Sum squared resid	8.293458	Schwarz criterion		3.653693
Log likelihood	-11.49561	Hannan-Quinn criter.		3.422977
F-statistic	9.346310	Durbin-Watson stat		2.372419
Prob(F-statistic)	0.020459			

Source: authors' computation

From the three analyzed cases, we can draw the following conclusion: with the increase in the number of local active IT&C units and the increase in the average monthly nominal net earning from IT&C, the unemployment rate will decrease. It seems that the activity of "Manufacture of computer, electronic and optical products" - 26 according to CANE Rev2 has a higher influence on the unemployment than other IT&C activities, the coefficient of determination being 91%.

At county level, the following models were obtained:

$$unemployment = -0.012166\ units - 0.001738\ salaries + 8.530078$$

Table no. 6. Regression of the unemployment on number of units and salaries for 26 Div

Variable	Coefficient	Std. Error	t-Statistic	Prob.
UNITS_26	-0.012166	0.009985	-1.218412	0.2336
SALARIES_26	-0.001738	0.000671	-2.591600	0.0152
C	8.530078	1.232046	6.923507	0.0000
R-squared	0.316691	Mean dependent var		5.003333
Adjusted R-squared	0.266076	S.D. dependent var		2.594355
S.E. of regression	2.222568	Akaike info criterion		4.529843
Sum squared resid	133.3748	Schwarz criterion		4.669963
Log likelihood	-64.94764	Hannan-Quinn criter.		4.574668
F-statistic	6.256808	Durbin-Watson stat		2.298486
Prob(F-statistic)	0.005852			

Source: authors' computation

$$unemployment = -0.0003325\ units - 0.00639\ salaries + 9.716714$$

Table no. 7. Regression of the unemploymenton number of units and salaries for 61 Div

Variable	Coefficient	Std. Error	t-Statistic	Prob.
UNITS_61	-0.003325	0.003554	-0.935508	0.3553
SALARIES_61	-0.001639	0.000598	-2.741342	0.0092
C	9.716714	1.397619	6.952332	0.0000
R-squared	0.248870	Mean dependent var		5.609524
Adjusted R-squared	0.210351	S.D. dependent var		2.686262
S.E. of regression	2.387072	Akaike info criterion		4.646761
Sum squared resid	222.2263	Schwarz criterion		4.770880
Log likelihood	-94.58198	Hannan-Quinn criter.		4.692256
F-statistic	6.460899	Durbin-Watson stat		1.643857
Prob(F-statistic)	0.003771			

Source: authors' computation

$$unemployment = -0.000262\ units - 0.000839\ salaries + 7.833065$$

Table no. 8. Regression of the unemploymenton units and salaries for 62_63 Div

Variable	Coefficient	Std. Error	t-Statistic	Prob.
UNITS_62_63	-0.000262	0.000543	-0.482042	0.6325
SALARIES_62_63	-0.000839	0.000297	-2.826761	0.0074
C	7.833065	0.750148	10.44203	0.0000
R-squared	0.286177	Mean dependent var		5.609524
Adjusted R-squared	0.249571	S.D. dependent var		2.686262
S.E. of regression	2.327036	Akaike info criterion		4.595817

Sum squared resid	211.1888	Schwarz criterion	4.719936
Log likelihood	-93.51216	Hannan-Quinn criter.	4.641312
F-statistic	7.817715	Durbin-Watson stat	1.781410
Prob(F-statistic)	0.001396		

Source: authors' computation

The results obtained at the county level are consistant with the results obtained at the regional level. Both independent variables act in the direction of lowering the unemployment rate, but the extremely low coefficients in the models show little influence. However, the emergence and growing of development poles of IT&C activities, such as the counties of Timis, Cluj, Iasi and Bucharest, contribute to the reduction of unemployment in these areas.

7. Conclusions

In Romania, IT & C activities tend to develop especially in recent years, in line with the European trend. Although most enterprises who carries out these activities are micro-enterprises, they attract more and more workforce from year to year. These tendencies influence the orientation of young people towards school units to prepare them in these areas. Compared with the other countries in the European Union, the conditions regarding salary in Romania for people with IT training discourages the workforce from remaining in the country. Thus, Romania is increasingly confronted with the phenomenon of labor force emigration with IT training, which it does in these activities job offer to be higher than demand. Therefore, decisive factors need to think about policies involving both education measures, as well as economic measures to stop this phenomenon. As seen, increasing the average monthly earnings and the number of units with IT & C activities can reduce the unemployment phenomenon, fact found also at the territorial level: in counties where the average monthly earning in IT & C is higher, the unemployment rate is lower. So, our workpaper focused on a part form the value chain for IT&C activities, remaining in the future to extend the analysis to other activities like marketing and labour force education.

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