Considerations Regarding the Influence of Experts Mobility on R&D Activity
Evidence from Romania

Florentina Ivanov

Our society can progress on the long term only by encouraging research on the limits and problems that we are facing and the development of new solutions to our needs.

Introduction

The European Union has identified seven new modalities to raise growth and employment, presented by the Commission in 2010 and included in the EU Strategy 2020. Among these initiatives, creating an innovation-friendly environment was one way of bringing growth and employment in the economy. Yet, the demand for knowledge remains weak in Romania, as the innovation culture is still underdeveloped. The 2014 country profile for research and innovation in Romania (EC 2014) illustrates a weak position of Romania compared with the EU average. Together with Bulgaria, Romania is the only country in the EU that did not pass the threshold from an efficiency-driven economy to an innovation-driven one. It has one of the lowest values in the EU for both R&D intensity (-4.2 % for

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2007–2012) and business R&D investments, at a -6.8% annual average growth for 2007–2012.

The report of the European Commission recognizes the efforts made by policy-makers to reform the research system in the country. Nevertheless, these efforts were not supported by a long-term political vision and a consistent implementation of the strategies to encourage innovation. The fact that Romania ranks no. 27 among 27 countries on the average public expenditure on R&D as percentage of GDP in 2007–2012 proves the lack of real support for research and development. According to the same report, the Romanian population is also unaware of the value that the R&D sector has for enhancing competitiveness and securing high-quality jobs. This article aims at rising the interest in R&D activities by underlining some of the factors influencing it.

Factors Influencing R&D

"An open economy spurs innovation with fresh ideas from abroad," argued the *Business Week Magazine* one and a half decades ago (Bernstein 2000), a statement also explained by Andrew DuBrin, Professor Emeritus in Management at the Rochester Institute of Technology (2011). In an open economy, foreign companies bring new products and strategies to the local economy. By adapting them to the domestic circumstances, they create new outputs, and engage in the innovation process. Ultimately, they test their limits, but also put pressure on the limits of the market. This is not a one-way transfer of knowledge and inspiration, but rather a mutual benefit. By entering a new market, the globalized company adapts itself to the new economy and brings innovative ideas back home or elsewhere. A study conducted on the interaction of expatriates in multinational corporations with host country nationals shows that there is an active transfer of knowledge both ways, from the expatriates to the companies abroad and vice-versa (Hsu 2012).

The business sector is not the only means of innovation by pooling together diverse knowledge. International research projects, the inflow and outflow of students engaged in mobility programs and teachers' professional visits abroad are conductors of innovative ideas in the education and public research system. At the same time, the distribution of international publications and global access to data are all pathways for knowledge and ideas transfer, and thus enablers of innovation in the private sector, with potential for entrepreneurship.

In this article, we will analyze if the internalization of the Romanian macroeconomic NUTS 2 regions relates in a significant way to R&D activities in the country. We expect that a more significant presence of international companies, a higher number of students and teachers engaged in mobility programs, and broader access to international data will have a positive impact on R&D activities in the regions.

Estimators

OUR ANALYSIS focuses on the eight macroeconomic regions of Romania. In order to ensure the relevance of the results for policymaking, we considered only data starting one year after the accession to the European Union. Delayed effects of membership are thus accounted for by leaving one year for adaptation. The R&D activity of the regions is estimated by the percentage of the total population engaged in R&D activities (y). The knowledge and innovation channels linking the domestic business sector to the external sector are estimated by the level of foreign direct investments (x1). The foreign knowledge inflow in the education system is estimated by the number of students and teachers engaged in mobility programs. These figures were computed by summing up the reported data from all universities located in each of the regions and include both teachers and students engaged in study, research or practice stages on a temporary basis, in relation to the regional population (x2).

Finally, the access to international information is estimated by the proportion of the population who used the internet at least once a week, including every day (x3). However, this last variable has a mixed content, referring not only to the population using the internet for research or for obtaining ideas with the potential of becoming innovative products or strategies. We expect that a significant part of the population with internet access uses it for other purposes, like socialization, entertainment, networking, shopping etc. Indeed, the Eurostat regional information society statistics show that 66% of the individuals who used the internet in one week's time also used it for networking purposes, like creating user profiles or using social media, in 2011. A similar study performed in 2014 shows an average of 74%. This proves that most individuals use the internet for other purposes than research and this trend is getting stronger. Of course, we expect that individuals using the internet as a source of innovation will also use it for networking purposes and the data does not allow us to differentiate according to the exact purpose. Anyhow, this discussion is beyond the aims of this article. In this article, we do not delimitate what kind of knowledge transfer is useful for the innovative process or what kind of specific interactions with the external sector are influencing the R&D process. There are sufficient grounds to consider that some of the networking activities might actually support R&D

employment. Therefore, we will include this variable in our model under the caveat that it might not be very significant for our analysis.

To summarize the discussion above, we can write our estimated model in the following way:

$$y_{it} = \beta_0 + \beta_1 * x_{1it} + \beta_2 * x_{2it} + \beta_3 * x_{3it} + u_{it} \quad (1)$$

where i=1,...8 is the individual dimension representing the number assigned to each macroeconomic region, t =2008,...2012 is the time dimension and u is the error term.

Data Collection

THE DATA included in our model is calculated as an average for each of the eight NUTS 2 macroeconomic regions of Romania. The period taken into consideration is 2008–2012, starting one year after the accession of Romania to the European Union in order to take into consideration lagged effects.

The data was collected and computed using databases from the Romanian National Institute of Statistics, Eurostat, the Romanian National Bank, the Romanian Ministry of Finance, UNCTAD, and the National Patent Office.

TABLE 1. SUMMARY OF DATA

Variable	Obs	Mean	Std. Dev.	Min	Max
A	40	4.5	2.320477	1	8
B	40	2010	1.43223	2008	2012
C	40	34.975	9.360275	22	61
D	40	5250.6	5897.65	1515	22234
F	40	6640.8	10151.59	975	35859
G	40	775.1	484.2062	171	1807
H	40	2649981	544222.2	1828087	3722553
J	40	.2152427	.2669596	.0540583	.9805863
L	40	.030256	.0192275	.0052138	.06953
O	40	.0028129	.0045388	.0002623	.0157335

SOURCE: Stata

Where:

- A identifies the regions and takes the values 1 to 8 as follows: 1—North-West, 2—Center, 3—North-East, 4—South-East, 5—South, 6—Bucharest and Ilfov, 7—South-West, 8—West;

- B identifies the year, and runs from 2008 through 2012;
- C is the variable describing the percentage of the population using the internet in the last week, based on data from Eurostat;
- D is the total number of employees in R&D activities by NUTS 2 regions at the end of the year, retrieved from the National Institute of Statistics;
- F represents the foreign direct investments in each region, in mil. euros, calculated after the methodology recommended by the International Monetary Fund (IMF 2009) and computed after the yearly reports published by the National Bank;
- G represents the number of students and teachers who completed mobilities, computed for each region by adding the data reported by each university in the NUTS 2 regions, based on statistics published by The Lifelong Learning Programme and UNCTAD;
- H represents the number of resident population in each region at the beginning of each year, based on data from the Eurostat database. All the variables in our model are compared to the corresponding regional population in order to account for regional differences and to make the values comparable;
- J is the dependent variable of our model and represents the percentage of the regional population working as employees in the R&D sector, computed after the formula $J = D/H * 100$;
- L is the rate of students and teachers engaged in mobility programs as a percentage of the total population, computed after the formula $L=G/H * 100$;
- O represents millions euros of foreign direct investments per capita, computed with the formula $O=F/H$.

The steps followed in estimating our model were the ones described by Stănilă et al. 2013. After declaring the variables as panel dataset, with the identification variable A and the time variable B, the econometrics program recognized a strongly balanced panel (the same number of years for each region) with complete observations for each panel from 2008 through 2012, meaning 40 observations. Taking into consideration our assumptions, we expected a positive sign for all the three explanatory variables included.

Linear Panal Data Regression Model

Taking into consideration the relatively small number of observations and the possibility that additional unobserved variables affect the R&D activity, we conducted a Hausman test in order to choose between fixed or random effects (Stata 2013). The fixed effects model assumes that the error term u_{it} in the model (1) includes individual-specific, time-invariant effects, like the geographical resources, climate, historical developments for each region, etc. that we assume are fixed during the period studied, not included in the model otherwise and affecting the R&D activity. If we assume fixed effects, we impose time independent effects for each variable possibly correlated with the predictor variable. This means that we can control for unobserved heterogeneity of the regions, when this heterogeneity is constant over time and correlated with the R&D activity. The random effects model is a special case of the fixed effects model. It assumes in addition that the regional specific effects are uncorrelated with the independent variables. If the random effects assumption holds, the random effects model is more efficient than the fixed effects model (Wooldridge 2010).

The Hausman test evaluates the null hypothesis that the coefficients estimated by the efficient random effects estimator are the same as the ones estimated by the consistent fixed effects estimator (Stata 2013). A statistically significant P-value of the test is an argument for using fixed effects instead of random ones. The Hausman test on our data gave the following result:

TABLE 2. HAUSMAN TEST

	--------Coefficients--------			
	(b) fixed	(B) random	(b–B) Difference	sqrt(diag(V_b-V_B)) S.E.
L	.0124632	1.426246	–1.413783	1.554075
O	45.8991	58.69103	–12.79193	25.06748
C	–.0013923	–.002777	.0013847	.0015045

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg
Test: Ho: difference in coefficients not systematic
chi2(2) = (b–B)'[(V_b–V_B)^(–1)](b–B) = 1.02
Prob>chi2 = 0.6016

SOURCE: Stata

Our Hausman test revealed that a P-value is statistically insignificant. Therefore, random effects would be more appropriate in our case. Some of the differences between the regions are anyway accounted for in our model by adjusting all variables by population size.

Additional, we considered robust standard errors for taking in consideration heteroskedasticity problems, as suggested by Prof. Andreica Madalina A. Monterey (personal communication, 26 and 27 September 2012). Heteroskedasticity appears if the error term u_{it} in the model (1) does not have a constant variance, something that is often the case with cross-sectional and time series measurements. Even if this does not cause our coefficient estimates to be biased, it invalidates the hypothesis tests and we might consider them significant coefficients that should actually be rejected. Conducting a serial correlation test and a test for group heteroskedasticity indicated that a robust estimation was more appropriate. Accordingly, the random-effects linear regression with robust standard errors gave the following results:

Table 3. Panal data regression

Number of obs = 40
Number of groups = 8
R–sq:
within = 0.0916
between = 0.9945
overall = 0.9792

Obs per group:
min = 5
avg = 5.0
max = 5
(Std. Err. adjusted for 8 clusters in A)

J	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
L	1.426246	.3530637	4.04	0.000	.734254	2.118238
O	58.69103	1.459233	40.22	0.000	55.83098	61.55107
C	-.002777	.0007213	-3.85	0.000	-.0041908	-.0013632
_cons						

Source: Stata

Interpretation

The regression analysis shows that all the three explanatory variables considered are statistically significant at 1%. They are also jointly significant.

The overall fit of the model is very good, showing that the foreign direct investments (FDI), the mobility of students and teachers and the access to internet explain 97% of the R&D activities per capita in the Romanian macroeconomic regions after the accession to the European Union, when controlling for the number of population in each region. This means that only 3% of the R&D employment variations are left unexplained. Even if this high goodness-of-fit shows that our model explains most of the R&D activity in Romania, we still have to treat with caution the practical significance of the exact percentage. Mainly, we can give special attention to the fact that the number of individuals residing in each region in included in all the variables in our test. The size of the population in each region implicitly includes many other factors, like the general regional economic conditions, climate, socio-economic development possibilities, ethnic situation, political stability, etc.

Of the three factors explaining the R&D activity, the FDI per capita has an important influence on the number of jobs in the R&D sector (variable O). The results of our test show that a 10,000 euros increase in FDI per capita will lead to an additional 0.59% of the population working in R&D activities, other factors remaining unchanged.

The rate of students and teachers engaged in mobility programs (variable L) has, as expected, a positive impact on R&D employees: for the same level of FDI, doubling the number of students and teachers going abroad for short term professional visits will increase R&D employment in the region by 1.4%.

Using the internet at least weekly has however a negative, but practically insignificant impact on the number of R&D jobs, given by the low coefficient of –.002777. This is related to our discussion in chapter 2.1, in which we explained that given the fact that the internet seems to be used for other activities than information purposes, this variable might not have a significant economic impact on the R&D sector.

Finally, the intercept of 0.104 shows that there would be on average 0.104 % of the population working in the R&D sectors if the FDI well zero and if there were no mobility at the university level.

Accounting for the Economic Crisis

The Hausmann test conducted above showed random effects as a better choice than fixed effects, but we still assume that there are no time-dependent effects. However, this assumption might not hold. The period we analyzed included not only the beginning, but also the unfolding and the end of the economic crisis. Therefore, we wanted to analyze the case when an unobserved variable like the economic contexts affects all the regions in a similar way, but differently in time. On the grounds on this assumption, we also conducted a regression analysis with time fixed effects. This analysis aims at taking in consideration mainly the effects of the economic crisis during the different years of the studied period, but controls as well for other time-dependent variations, like the economic cycle. The results are reported below, with the absorbing indicator set to "year" (variable B):

Table 4. Time fixed effects regression

Number of obs	= 40
F (3, 32)	= 529.14
Prob > F	= 0.0000
R–squared	= 0.9803
Adj R–squared	= 0.9759

J|	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
C|	-.0019214	.0026672	-0.72	0.477	-.0073543	.0035116
L|	1.539934	.4630871	3.33	0.002	.5966566	2.483212
C|	57.16481	4.175887	13.69	0.000	48.6588	65.67081
_cons|	.0750489	.0799808	0.94 0.355	-.0878666	.2379645	.0750489

Source: Stata

The results show that, taking into account time-dependent circumstances, internet use fails to be a statistical significant variable. All other coefficients, except for the constant term, are statistically significant. The goodness-of-fit remains high, with the variables included explaining most of the variance in R&D employment. Otherwise, the coefficients of foreign investment and mobility are only slightly different from the random effects model, which is a good support for our initial model. The interpretation of the coefficients shows that, while leaving the economic context to affect our data in an unobserved way, an increase by 1% in the FDI will create jobs in the R&D sector for an additional 0.57% of the population of the region. Holding the FDI constant, a 10% increase in the enrolment to mobility programs will have a positive impact on R&D employment by 0.15%.

Concluding Remarks

It is often stated that opening the economy to the external sector has adverse effects, something that specialists like to compare to the immigration of the skilled labor force, instability of production, drain of resources, macroeconomic imbalances and others. In our opinion, these are all risks that need to be handled by firmly coordinated strategies and not avoided by retreating from the globalization process. It is very hard and expensive to swim against the tide and try stopping the natural exchange of information and workforce movement across country borders, especially in the technological era. Instead, we can concentrate on the positive aspects of globalization and make the most of them. The flow of knowledge across countries is such a positive aspect, because it stimulates creativity and innovation in the confluence space where different perspectives and ideas meet. Students and teachers travelling abroad, foreign companies coming with new products and strategies on the domestic market, and people accessing information from all around the world are the kind of factors that create diffusion of knowledge and transfer of competencies around the globe. The regions which manage to attract and stimulate this transfer of knowledge are the ones more likely to become the frontier where new competencies are combining, creating unexpected products and solutions.

In selecting the estimators for the level of globalization, we concentrated on foreign direct investments (FDI) for the business sector, the number of students and teachers enrolled in exchange programs for the government sector, and the rate of the population using internet for the private sector. The estimator for the level of R&D activity is the total number of employees involved in regional R&D activities. The model used for analyzing the relationship between the variables is regression with panel data and time fixed effect, with R&D employees as the dependent variable. The results of both simple linear regression with robust estimation and time fixed effects suggest a significant positive relationship between the estimators used and the number of people employed in the R&D sector.

Our society can progress on the long term only by encouraging research on the limits and problems that we are facing and the development of new solutions to our needs. As this article shows, research and development are positively correlated to the greater openness of the economy. An active presence of foreign companies and the mobility of personnel at the tertiary education level is likely to bring an infusion of knowledge from abroad and has a positive impact on R&D jobs creation. Opening to external influences in the business and education sectors has therefore the potential to develop the country and create high-quality jobs, without relying on governmental R&D investments.

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Abstract

Considerations Regarding the Influence of Experts Mobility on R&D Activity: Evidence from Romania

Theoretical models analyzing the effects of globalization suggest that knowledge transfer is fostered by the combination between foreign expertise and domestic knowledge. One possible outcome is that regional development can be stimulated in an indirect way by policies that encourage the transfer of knowledge between countries and regions. This article will test this hypothesis on data from Romania. More precisely, we will test if the level of globalization of the Romanian macroeconomic regions has a significant impact over the R&D activity of the regions. The results of the test would be a guiding factor in regional development policies.

Keywords

knowledge transfer, transfer of competencies, R&D, mobility, globalization