Evolutions on the Labour Market in the European Chemical Sector

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Our paper aims to analyse the labour market in the field manufacture of chemicals and chemical products in UE28, over the period 2005-2014. We attempted to identify evolutions throughout the phases of the economic cycle, by isolating a series of determining variables. We noticed that the number of employees in this sector was influenced by macroeconomic frictions induced by the crisis that started at the end of 2008 and continued until 2011. At the same time, relevant factors that influenced the number of employees (turnover, personnel expenses) acted differently during the three phases of the economic cycle.

Keywords: chemical industry, labour, global-financial crisis

How the labour market responds to macroeconomic shocks is an interesting subject to study. Being one of the most important factors of production, labour is very sensitive to fluctuations in business cycles. Classical theories considered output markets to be strictly connected to input markets and therefore, there is a co-movement phenomenon [1]. Consequently, an increase or decrease in output produces immediate effects at the level of workforce occupation. Hamilton [2] and Gordon [3] reach the same conclusion. On the other hand, Deschamps [4] showed that contractions on the labour market are longer than those of business cycles. What is more, according to other authors [5, 6], inflows into unemployment are counter-cyclical. Anyhow, oscillations in business cycles influence industrial production and, implicitly, the relevant labour market. The effects are visible especially in large sectors, where scale yields develop based on massive capital and labour inflows. The chemical industry is one such sector.

The chemical industry is very important for the European economy. Since it is one of the highest productivity sectors, it is expected that its weight would increase in the future. According to an Accenture study [7], total revenue for the European chemical industry will grow at an accelerated pace in the following period and it is possible that in 2030 it would reach approximately 477 billion dollars. Statistics on the chemical industry in Europe show that this field is one of the most important in the industrial area. Its relevance is given both by the size of specific businesses (approx. 7% of the EU industrial production and 17% of the world sales of chemical products in 2013), and by the potential for innovation and technological advancement that it has [8]. The same source shows that the labour force that is directly involved in the European chemical industry comprises more than 1.1 million persons. In the case of Romania, the weight of the chemical industry in industrial production has an evolution that starts from 7.2%in 1997 and, by systematic drops, it went down to 4.8% in 2005, 4.4% in 2008 and even 3% in 2011 (data are taken from the Romanian Statistical Yearbook).

The evolutions of this industry are influenced by many factors: the availability and prices of raw materials, the diversification of demand, global or local/regional political, economic, or military crises, the achievements of specific research, the industrial policy of various states or regions, the availability of the labour force, its qualification and cost.

The evolution of the total number of employees in the European chemical industry during the period 2005-2014 is suggestive as far as the impact of the global economic crisis is concerned. Thus, we noticed a slight increase during the period 2005-2007, while in 2008 the level remained almost the same as in 2007 (approximately 3%) less). The effects of the crisis were manifest in 2009 by a significant drop of almost 7%, which continued in 2010 (-2%), and which was then followed by a period when the level was maintained or it registered a very slight decrease. By comparison, the evolution of production in the chemical industry is similar; the difference consists in that the amplitude of changes was more severe, both in 2009 (-20%), and in the following years (increases of 12%, respectively 9% in 2010 and in 2011). In 2014, neither the value of production in the chemical industry, nor the number of employees, reached the levels before the crisis.

Experimental part

Research hypothesis

H1: The number of employees in the chemical sector was influenced significantly by the economic crisis in 2009-2011.

H2: The number of employees in the chemical sector varied differently under the influence of determining factors throughout the economic cycle over the period 2005-2014.

Our study takes a statistical approach in order to test and validate the proposed research hypotheses.

Sample: the analysed sample covers the 28 states of the European Union, for which annual data were collected, that had been reported by them for the period 2005-2015, concerning companies operating in the field *manufacture* of chemicals and chemical products. In this case, the analysed sample comprises a number of 280 observations (country/year).

Variables: in order to validate the proposed work hypotheses, our study considered the following variables:

- (*TO*): *Manufacture of chemicals and chemical products* - independent variable;

- (*VA*): *Value added at factor cost* – independent variable;

- (GOS): Gross operating surplus independent variable;
- (*PC*): *Personnel costs* independent variable;

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- (*NoP*): *Number of persons employed* – dependent variable.

All variables were scaled with (NoE) - *Number of enterprises*, to ensure better estimates for the parameters of proposed models.

In order to establish the phases of the economic cycle we considered the following periods: BC – before crisis (2005-2008); C – crisis (2009-2011); AC – after crisis (2012-2014).

The data were collected on a yearly basis from EUROSTAT, and missing data were replaced based on the yearly mean values registered for each variable, at the level of each country included in the analysed sample.

Data analysis methods: for data analysis and the estimation of the factors' influence on (NoP): Number of persons employed, the study proposes the use of General linear models – GLM [9]. The model proposed in the analysis also includes time fixed effects, as well as cross fixed effects, by country, as follows:

$$\begin{split} & \text{NoP/NoE} = \beta_{\theta} + \beta_{1}. \text{ TO/NoE} + \beta_{2}. \text{ A/NoE} + \beta_{3}. \text{ GOS/}\\ & \text{NoE} + \beta_{4}. \text{ PC/NoE} + \beta_{5}. \text{ Before_crisis} + \beta_{6}. \text{ Crisis} + \beta_{7}.\\ & \text{Before_crisis}. \text{ TO/NoE} + \beta_{8}. \text{ Before_crisis}. \text{ VA/NoE} + \beta_{9}.\\ & \text{Before_crisis}. \text{ GOS/NoE} + \beta_{1\theta'} \text{ Before_crisis}. \text{ PC/NoE} + \\ & \beta_{11}. \text{ Crisis}. \text{ O/NoE} + \beta_{12}. \text{ Crisis'}. \text{ VA/NoE} + \beta_{13}. \text{ Crisis}.\\ & \text{GOS/NoE} + \beta_{14}. \text{ Crisis}. \text{ PC/NoE} + \text{ Year fixed effects} + \\ & \text{Country fixed effects} + \varepsilon \end{aligned}$$

where β_1 measures the influence of each factor included in the analysis on *NoP/NoE*; *Before crisis* and *Crisis* are dummy variables that take the value 1 for the case in which the analysed period corresponds to the periods *BC* – before crisis (2005-2008) and *C* – crisis (2009-2011), and 0 for *AC* – after crisis (2009q4-2015), the reference period.

In order to test the existence of significant differences between the mean values registered for each variable, at the level of each period of the economic cycle, the study

Variable		N	Mean	Std. Deviation
(TO/NoE)	BC	112	14.77	16.07
	С	84	14.40	14.76
	AC	84	16.60	17.33
	Total	280	15.21	16.06
(VA/NoE)	BC	112	3.22	3.43
	С	84	3.12	3.12
	AC	84	3.24	3.45
	Total	280	3.20	3.33
(GOS/NoE)	BC	112	1.50	1.59
	С	84	1.47	1.50
	AC	84	1.48	1.60
	Total	280	1.48	1.56
(PC/NoE)	BC	112	1.62	1.68
	С	84	1.61	1.64
	AC	84	1.68	1.72
	Total	280	1.64	1.67
Ti-a(NoP/NoE)	BC	112	39.22	18.33
	С	84	36.87	17.63
	AC	84	35.91	18.35
	Total	280	37.52	18.12

 Table 1

 DESCRIPTIVE STATISTICS

(Source: own processing in SPSS 20.0)

used the ANOVA procedure and post hoc tests (LSD) [10]. The data were processed and analysed via SPSS 20.0

Results and discussions

Table 1 features descriptive statistics at the level of the entire analysed sample, in what concerns mean values and standard deviations, and for each phase of the economic cycle. In the table one can notice:

- lower (*TO/NoE*) values registered during the *BC* and *C* periods, compared to the *AC* period;

- lower (*VA/NoE*) values registered during the *C* period, compared to the *BC* and *AC* periods;

- higher (GOS/NoE) values registered during the BC period, compared to the C and AC periods;

- lower (*PC/NoE*) values registered during the *BC* and *C* periods, compared to the *AC* period;

- higher (*NoP/NoE*) values registered during the *BC* period, compared to the *C* and *AC* periods.

In order to test and validate the proposed research hypothesis/ hypotheses, table 2 features the estimations of the three analysed regression models, starting from the regression equation (1).

The data presented in table 2 show that:

- *Model 1*: irrespective of the phases of the economic cycle, at the *manufacture of chemicals and chemical products* level, *PC/NoE* has a significant influence on *Nop/NoE*. An increase of personnel expenses determine, on average, an increase of the turnover and the other way round. Therefore, there is a direct and significant connection between the labour market and the turnover

 Table 2

 ESTIMATIONS OF REGRESSION MODELS PARAMETERS

 CONCERNING THE IFLUENCE OF FACTORS ON NoP / NoE

Variable	Model (1)		Model (2)**		Model (3)**	
	βι	Sig	βι	Sig	βι	Sig
Intercept	9.94	0.00	13.91	0.00	13.23	0.00
TO/NoE	0.01	0.91	-0.27	0.02	-0.20	0.06
VA/NoE	-1.93	0.36	-1.35	0.56	-	-
GOS/NoE	3.29	0.15	3.49	0.20	-	-
PC/NoE	16.39	0.00	16.22	0.00	16.45	0.00
BC	-	-	0.00	0.00	0.00	0.00
С	-	-	0.00	0.00	0.00	0.00
BC· TO/NoE	-	-	0.56	0.00	0.34	0.00
BC· VA/NoE	-	-	-1.26	0.56	-	-
BC∙ GOS/NoE	-		-1.20	0.65	-	-
BC· PC/NoE	-		-2.43	0.28	-3.93	0.00
C∙ TO/NoE	-		0.53	0.00	0.35	0.00
C∙ VA/NoE	-		0.30	0.93	-	-
C∙ GOS/NoE	-		-3.31	0.39	-	-
C· PC/NoE	-	-	-3.12	0.43	-3.64	0.00
Year fixed effects	Yes		Yes		Yes	
Country fixed effects	Yes		Yes		Yes	
Obs.(N)	280		280		280	
Adjusted R²	0.9	6	0.96		0.96	

* Dependent variable: *NoP/NoE*

***AC* is the reference category

*** Significant values for Sig ≤ 0.10

(Source: own processing in SPSS 20.0)

variation registered by companies operating in the chemical sector.

- Model 2: there are significant differences in what concerns the influence of the factors (TO/NoE and PC/ *NoE*) on *NoP/NoE* during the three phases of the economic cycle. During the post-crisis period, *TO/NoE* had a negative influence on Nop/NoE. The evolution is natural, if we give it an economic interpretation. The expansion phases of the economic cycle suppose both the increase of yields (productivity) and of the revenues of production factors, and implicitly of the labour factor. Towards the end of the expansion phase, the increase of costs becomes stronger than that of productivity, which primes the crisis. Yet, the labour market does not have a pro-cyclic character; it evolves with a certain delay from the general economic evolution. Therefore, the crisis does not bring about an immediate restructuring of the labour market under the perspective of the number of employees. At least during the first recession phase, the first costs to be adjusted are capital costs. Thus, personnel restructuring comes to overlap the recovery period. This is why, our analysis revealed a counter relation between turnover increase and the number of employees in the recovery phase. During the period before the crisis and during the crisis, TO/NoE had a positive influence on Nop/NoE (at the level of companies with a high number of employees, there are high turnover levels and the other way round, which means that adjustments of labour productivity did not occur). As for *PC/NoE*, personnel expenses have a significant and positive influence on *NoP/NoE* only during the post-crisis phase; during the other phases, its influence is insignificant in the case of the model that takes into account all proposed variables (1). The other factors do not have a significant influence on the average number of employees in companies operating in the field manufacture of chemicals and chemical products, irrespective of the phases of the economic cycle.

- *Model 3*: compared to model 2, model 3 includes in the analysis only factors of a significant influence on NoP/ *NoE*. In this case too we can notice that during the postcrisis period, the turnover (TO/NoE) had a counter evolution relative to the number of employees (Nop/NoE), that is at the level of companies, turnover increase occurred in parallel with the reduction of the number of employees. This phenomenon can be explained by the increase of productivity of the labour factor. During the period before the crisis and during the crisis as such, the turnover (TO/ *NoE*) had a positive influence on *Nop/NoE* (at the level of companies, the turnover's positive evolution occurred in parallel with the increase in the number of employees). As for the *PC/*NOE variable, we can argue that personnel expenses had a significant and positive influence on NoP/ *NoE* during the post-crisis phase (personnel changes were closely connected to associated costs, and they were both on a decreasing trend). Before the crisis and during the crisis, personnel expenses had a significant and negative influence on NoP/NoE (this shows that during the stagnation or even the decrease of the number of employees, there was a faster increase of personnel costs).

At the same time, for all three models, there are significant differences in what concerns the *NoP/NoE* level registered in the 28 EU countries, as well as during the analysed period (2005-2015).

Conclusions

Our analysis of the labour market in the European chemical sector during the period 2005-2014 has led us to a series of interesting conclusions. On the one hand, we noticed that the number of employees in this sector was influenced by macroeconomic frictions induced by the crisis that started at the end of 2008 and continued up to 2011. At the same time, relevant factors that had an influence on the number of employees (turnover, personnel expenses) acted differently during the three phases of the economic cycle. We found that there is a direct connection between the number of employees and personnel expenses in the chemical sector during the recovery phase and a negative connection during the other two phases. On the other hand, there is a counter-dependence between turnover and the number of employees. Thus, during the recovery period (after crisis), turnover evolves in a negative connection with the number of employees while during the expansion phase (before crisis) and during recession (crisis) there is a direct connection. For the future, we aim to analyse how these evolutions can be accounted for by changes in labour productivity.

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