

## **Net earnings trends in the EU countries**

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**Abstract.** *The purpose of this paper consists in analysing the ante- and post-crisis economic trends of the real net earnings in the EU countries by building several econometric models. A Hierarchical cluster analysis was applied in order to classify the 27 EU countries in two distinct groups, based on a set of labour market indicators. The econometric results were consistent with the economic theory and indicated that GDP growth rate, foreign direct investment, trade openness and remittances have a positive effect on earnings, while unemployment rate's impact is negative. Several particularities were also noticed when studying the two EU country clusters. Then numerical simulation was used for a short-term prediction of earnings.*

**Keywords:** net earnings, GDP growth rate, panel data model, European Union, simulation.

**JEL Classification:** E24, J31, C10.

## 1. Introduction

The aim of this paper consists in quantifying the impact of several macroeconomic variables upon earnings, such as the GDP growth rate, the unemployment rate, the foreign direct investment, trade openness, remittances and number of persons with tertiary education. The analysis was conducted over the period 2000-2012, using data for the EU-27 countries.

The economic literature suggested that earnings are a permanent concern for both economists and policymakers and that real wage flexibility is a crucial adjustment channel to asymmetric shocks, especially if cross-border labour mobility and fiscal flexibility is limited. For instance, Frigyes and Desislava (2011) measured the degree of real wage flexibility in 19 EU countries by conducting panel data estimation, where the real wage flexibility was measured in a broad manner, both in terms of the response of real wages to cyclical unemployment as well as to productivity growth. The results indicated that real wage flexibility appears to be somewhat higher in the CEE countries than in the euro area, both with respect to the response to unemployment and to productivity. This difference is likely related to differences in labour market institutions in general and in wage bargaining institutions in particular.

Among the international literature some also quantified the determinants of wages upon European developing countries (Andreica et al., 2010; Aparaschivei et al., 2011; Militaru et al., 2011; Vasilescu et al., 2010; Chubrik and Giucci 2006).

Between unemployment and earnings the classic theory states that there is a negative correlation. For instance, Blanchflower and Oswald (1995) found an empirical regularity of a robust negative correlation between wages and log unemployment for a wide range of different countries and datasets. For the case of Great Britain, Cameron and Muellbauer (2001) also observed a negative long-run effect for log unemployment on log earnings for full-time men.

The GDP growth rate is often considered an indicator of economic well-being, so we expect that its impact on earnings to be a positive and significant one. Trade openness is another important element for the developing countries to get out of poverty and while in the long run the effect of trade on earnings should be positive, in the short run it may be experienced adverse effects.

Foreign direct investment is mostly seen as a driver for economic development as it may bring capital, technology, management know how, jobs and access to new markets. Therefore, policymakers have tended to emphasize the benefits that foreign direct investment can bring to host economies, particularly in developing countries. Moreover, Driffield and Girma (2003) found that foreign direct investment has a large positive effect on wages in domestic firms in U.K. electronics industry through its impact on labour demand and a small positive effect through its impact on labour supply.

However, the empirical evidence in support of positive wage spillovers as a result of foreign direct investment is relatively limited (Arnal and Hijzen, 2008). For instance, Zhao (1998) found that when labour-management bargaining is industry-wide, foreign

direct investment reduces the negotiated wage as well as the union employment and the competitive wage. But, if labour-management bargaining is firm-specific and unionization is industry-wide, then the above effects of foreign direct investment are substantially reduced.

This paper is organized as follows: Section 2 describes the data and presents the econometric framework used for this study, whereas Section 3 presents the econometric results. In section 4 a short-term forecast is presented based on numerical simulation, while the last section concludes.

## 2. Data description and methodologies

Annual data for the period 2000-2012 for the 27 EU countries were used in the study by considering the following variables: the real net earnings (*earnings*) as dependent variable and the gross domestic product growth rate (*GDP growth*), the unemployment rate (*ur*), the trade openness as percentage of GDP (*Trade*), the persons with tertiary education (*isced56*), the remittances (*Remittance*) and the foreign direct investment as percentage of GDP (*FDI*) as explanatory variables.

The real net earnings are expressed in Euros, considering a single person without children and were deflated by the Consumer Price Index of each of the 27 EU countries. Then the natural logarithm was applied. The unemployment rate is calculated as annual average percentage, while the variable representing the persons with tertiary education was considered for the 25-64 age-group and is expressed in percentage points. The data source for these variables was the Eurostat Database.

Further on, the trade openness is expressed as the sum of exports and imports as percentage of GDP and the remittances are considered the sums received by each country as percentage of GDP. The foreign direct investment represents the inward FDI flows as percentage of GDP. We also considered the real GDP annual growth rates and the source for these latter variables was the UNCTAD database.

The econometric analysis was based on panel data estimation, using the STATA software, where several fixed-effects models (FE) were estimated, by assuming that the individual effects are correlated with the explanatory variables (Baum, 2001; Baltagi, 2008). We also tested whether a FE model is more appropriate than a random-effects model (RE), where the individual effects are assumed to be uncorrelated with the explanatory variables, using the Hausman test.

For the FE model the most used estimator is the “within estimator”. Moreover, the models are estimated assuming that the default standard errors is independent and identically distributed (Cameron and Trivedi, 2009) and homoskedastic. When heteroskedasticity is present the standard errors of the estimates will be biased and one need to compute robust standard errors. Another problem is the serial correlation of the idiosyncratic error term for which Wooldridge (2002) proposed a very simple test for checking the autocorrelation of the residuals.

In order to overcome these problems, we should estimate the regression model using robust standard errors (Hoechle, 2007). Some authors have provided a number of tests in order to identify the problems encountered (Drukker, 2003; Baum, 2001). Also, for the Stata program, there are some procedures that correct the error structure, assuming for example that the errors are heteroskedastic, auto-correlated up to some lag and possibly correlated between the groups.

### 3. Results of the analysis

The following general net earnings equation was considered in the analysis:

$$Earnings_{it} = a_1 + a_2 * GDP\_growth_{it} + a_3 * ur_{it} + a_4 * FDI_{it} + a_5 * Trade_{it} + a_6 * isced56_{it}$$

The Hausman test statistics indicated that we are dealing with fixed-effects instead of random effects, since the probability was less than 5%. We then estimated the model using the within estimator. Moreover, as both the modified Wald test for heteroskedasticity and the serial correlation test indicated that the errors are autocorrelated and heteroskedastic, we re-estimated the model using a robust fixed-effects regression with Driscoll and Kraay standard errors.

It resulted the following general net earning model for the 27 EU countries:

$$\Delta earnings = 0,0326 + 0,0037 * GDP\_growth - 0,0067 * ur + 0,0002 * FDI + 0,0042 * Trade + 0,0155 * Remittance$$

[3,34]\*                      [8,62]\*                      [-6,27]\*                      [1,69]\*\*\*                      [2,66]\*                      [1,93]\*\*\*

where between brackets are t-Statistics values and \* significant at 1%; \*\* significant at 5%; \*\*\* significant at 10%.

According to the neoclassical theory, the results of the estimation confirms the negative impact of unemployment rate upon the real net earnings, indicating that a 1% increase in the unemployment rate generates a reduction of about 0,667% of the net earnings index, keeping all other variables constant.

Moreover, the GDP growth rate influence is quite normal, although lower than expected. An increase in GDP growth of only 1% supports a 0,372% increase in the net earnings index, which is quite low. Normally, GDP growth leads to an increase in the labour demand (especially highly qualified workers) which therefore generates higher wages.

When considering the FDI and the trade openness shocks upon net earnings, the econometric results indicate positive but very low impacts as well. An inflow of FDI has the slightest influence on earnings, meaning that the technological investments hardly generates changes in the structure of labour demand and when it does it brings changes mostly in favour of better paid jobs. That is why a 1% increase of the foreign direct investments in the EU countries leads to a slight growth of only 0.02% of the total net earnings index, keeping all other variables constant. Similarly, an increase in the trade openness to export brings an increase of labour demand and hence an increase of earnings.

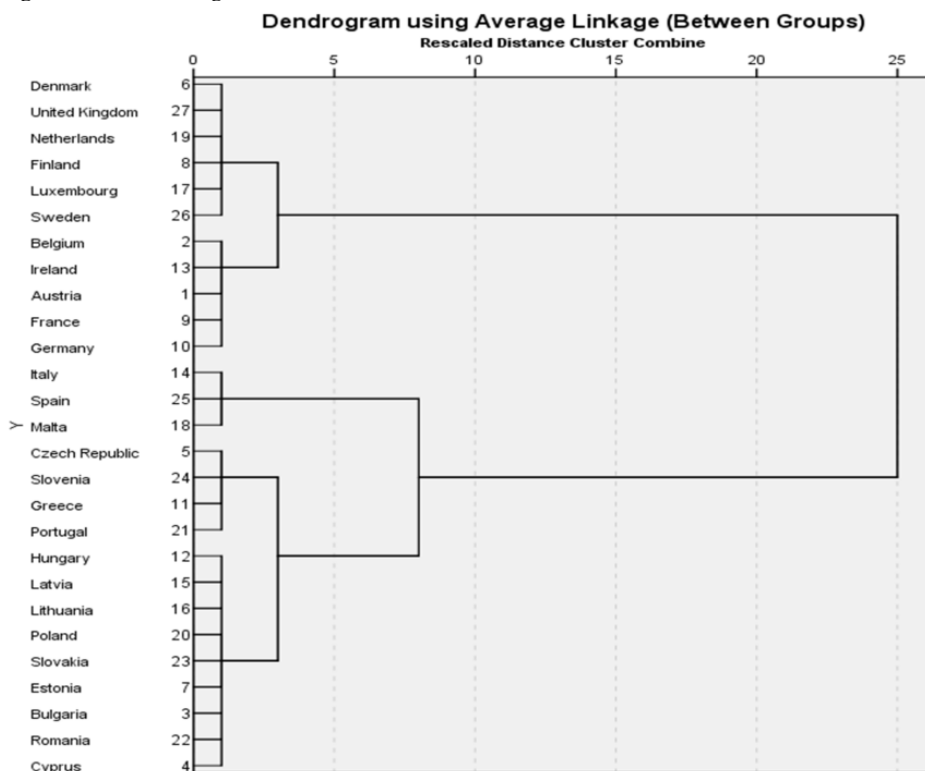
The impact of the remittances rate is however the highest upon net earnings in the EU countries, showing that the remittances flow support net earnings and the national productive system by increasing the domestic consumption.

The study further on continued with a more particular discussion based on the distinctive patterns of the labour market status of each of the 27 EU members. In order to check for the differences and the similarities between the EU countries, a Hierarchical cluster analysis was applied, using an unsupervised learning method that assigns a set of observations into subsets (called *clusters*) based on their similarities. The cluster technique was built on the between groups linkage cluster method, whereas the intervals were calculated using the squared Euclidean distance. Based on it we were able to classify the EU members into two distinct groups using the values of the year 2012 of the variables net earnings and unemployment rate.

As concluded from the dendrogram (Figure 1), we notice that the 27 European Union members can be easily assigned into the following two main clusters:

- **Cluster 1:** Denmark, U.K., Netherlands, Finland, Luxemburg, Sweden, Belgium, Ireland, Austria, France and Germany.
- **Cluster 2:** Italy, Spain, Malta, Czech Republic, Slovenia, Greece, Portugal, Hungary, Latvia, Lithuania, Poland, Slovakia, Estonia, Bulgaria, Romania and Cyprus;

Figure 1. The Dendrogram



We then continued the analysis by studying the particularities of the two clusters using econometric estimation.

For the **first cluster** we obtained the following equation:

$$\Delta \text{learnings} = 0,0003 + 0,0027 * \text{GDP\_growth} - 0,0018 * \text{Trade} + 0,0019 * \text{Trade} (-1)$$

[0,02]
[5,17]\*
[-4,64]\*
[2,92]\*\*

where between brackets are t-Statistics values and \* significant at 1%; \*\* significant at 5%.

The economic significance of the econometric model resulted for this group of EU countries is quite interesting since only GDP growth rate and trade openness were statistically significant in order to explain net earnings variation for the most developed EU countries. It resulted that the GDP growth rate has the highest impact upon the net average earnings. More precisely a 1% increase in the GDP growth rate leads to an increase of 0.27% of the average earnings variation, keeping all other variables constant.

Secondly, the influence of the trade openness it seems to be negative in the present, but positive with a one year delay, corresponding to the economic theory that while in the long run the effect of trade on earnings should be positive, in the short run it may be experienced adverse effects. The contemporary negative effect of trade openness upon earnings shows that an increase of 1% of the trade openness leads to a decrease of 0.18% of the net earnings, keeping all other variables constant, while the presence of a one year delay impact of trade openness indicates that the positive effect takes longer time to manifest.

When considering **the second cluster**, the net earnings equation is:

$$\Delta \text{learnings} = 0,022 + 0,0042 * \text{GDP\_growth} - 0,0067 * \text{ur} + 0,0025 * \text{FDI}(-1) + 0,0008 * \text{Trade}(-1) + 0,016 * \text{Remittance}$$

[1,21]
[9,85]\*
[-4,77]\*
[3,61]\*
[2,43]\*
[2,04]\*\*\*

where between brackets are t-Statistics values and \* significant at 1%; \*\* significant at 5%; \*\*\* significant at 10%.

Similarly to the results of the previous cluster, the GDP growth rate has once again the highest impact upon net average earnings variation. The influence of the unemployment rate is negative, but quite small, while the positive impact of remittances on earnings could be explained primarily by analysing their distribution in supporting the consumption financing. Based on the econometric results of the second cluster of EU countries it turns out that the remittances flows mostly support the national production, leading to an increase in earnings.

Meanwhile, the presence of both FDI and trade openness with a one year delay shows that for the second group of EU countries it takes more time for their effects to manifest on the labour market. An inflow of FDI needs at least a year for the equipment to be installed and to start producing efficiently. Similarly, an increase in the trade openness through exports means an increase of labour demand and hence an increase of earnings.

#### 4. Numerical simulation

Based on the panel data models highlighted in the previous section concerning the net earnings evolution in the two distinctive EU country groups, the study continued with a stochastic simulation in order to short term predict the net earnings level for the horizon 2013-2014 for the EU countries.

After considering the main particularities of the two clusters, we formulated several statistical hypothesis regarding the random variation of the explanatory variables of the two panel data models in order to build the stochastic simulation. We assumed that the explanatory variables will follow a uniform distribution between the following intervals, as presented below:

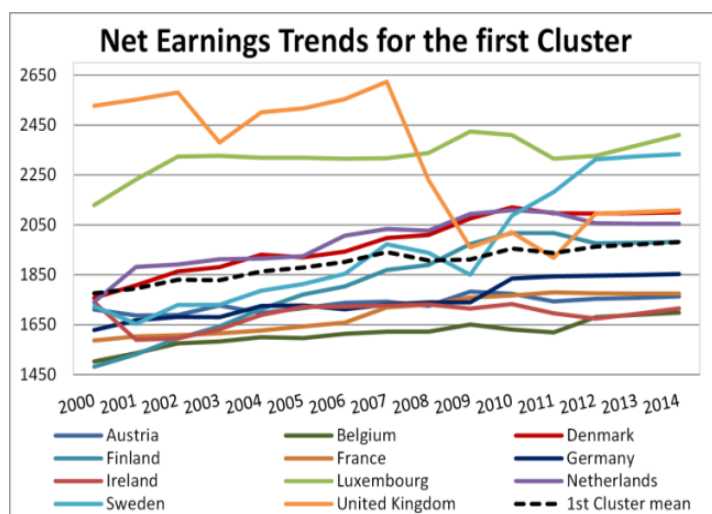
**Table 1.** Statistical hypothesis for the stochastic simulation

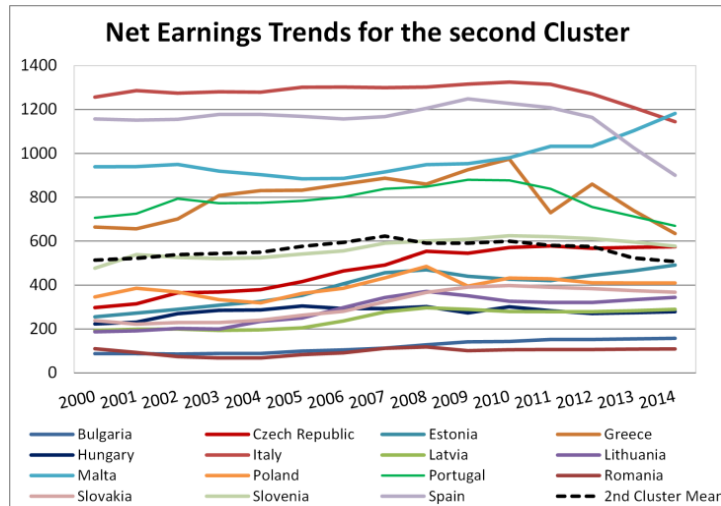
		GDP growth (percentage points)	FDI (percentage points)	TRADE (percentage points)	UR (percentage points)	REM (percentage points)
2013	Cluster 1	[-1; 1]		[-0,4; 0,6]		
	Cluster 2	[-2,5; 1]	[-1; 2,5]	[-0,5; 1,7]	[-2; 2]	[-0,2; 0,15]
2014	Cluster 1	[-0,5; 0,5]		[-0,3; 0,6]		
	Cluster 2	[-1,5; 0,5]	[-0,5; 2]	[-0,3; 1,5]	[-1,5; 1,5]	[-0,1; 0,3]

The results of the numerical simulation computed after 1000 iterations suggests that the net earnings in the EU members is more likely to encounter slight increases on the simulation horizon mostly for the countries assigned to the first cluster (Figure 2).

When considering the second EU country cluster, however, there is a general average decreasing trend of the real net earnings expected for the period 2013-2014. Estonia and Malta are the only countries of the second cluster expecting slight increases, while the steepest reductions of net earnings were predicted for the following EU countries: Greece, Italy, Spain and Portugal. All the other variations for the other countries from the second cluster are assumed to keep between the limits of the previous years.

**Figure 2.** Net earnings trends for the two EU member cluster





Regarding the first EU country cluster, the most shocking evolution of the real net earnings can be observed for the United Kingdom, who suffered a deep reduction in wages starting with 2008, which later on turned into a smoother fluctuation until 2014. Starting with 2009 the highest increase in the net earnings is registered by Sweden, while the rest of the EU members of the first cluster suffered only slight variations in net earnings trend during the simulation horizon 2013-2014.

## 5. Conclusions

In this study we analysed the impact of the main relevant macroeconomic indicators for the European Union upon net earnings. Annual data for the period 2000-2012 for the 27 EU countries were used by considering the following variables: the real net earnings (earnings) as dependent variable and the gross domestic product growth rate, the unemployment rate, the trade openness as percentage of GDP, the remittances, the number of persons with tertiary education and the foreign direct investment as percentage of GDP as explanatory variables.

The analysis continued with a cluster analysis, based on the level of the net earnings and employment rate for each of the 27 EU countries of the year 2012. After applying the Hierarchical cluster analysis we obtained two distinctive clusters, for which we then estimated two panel data models. For both panels we used the fixed effects estimator and a robust estimation was required in order to solve the autocorrelation and heteroskedasticity problems.

At EU country level the econometric results were consistent to the economic theory and indicated that GDP growth rate, foreign direct investment, trade openness and remittances have a positive effect on earnings, while unemployment rate's impact is negative. Several particularities were also noticed when studying the two EU country clusters. For the first cluster only GDP growth rate and trade openness turned out to explain net earnings variation, while the influence of the trade openness was negative in the present, but



positive with a one year delay. For the case of the second cluster, GDP growth rate has positive effects on earnings as compared to the unemployment rate. The remittances are injections to the macroeconomic circuit and also a support for national companies, while FDI and trade openness have a one year delay in inducing their effects. The variable representing the number of persons with tertiary education turned out to be statistically insignificant in all panel data estimations.

Based on the panel data models concerning the net earnings evolution in the two distinctive EU country groups, we built a stochastic simulation in order to short-term predict the net earnings level for the horizon 2013-2014 for the EU countries. The results of the numerical simulation suggest that the net earnings in the EU members is more likely to encounter slight increases on the simulation horizon only for the countries assigned to the first cluster. When considering the second EU country cluster, however, there is a general average decreasing trend of the real net earnings expected for the forecasted period.

Our research can further on be extended and the numerical simulation improved by considering additional macroeconomic indicators of the EU countries in order to assure more accurate predictions.

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