Abstract. In the view of the economic recovery, the European Union encourages member states to rapidly implement a policy convergence at competitive levels, coherent with the internal single market. In this context, economic competitiveness should have a leading place within the structural policies designed to unleash the industrial potential of the European economies. Wage is a key factor of economic competitiveness as it also reflects the level of labour productivity. In this study we conducted a panel data analysis of the economic activities in Romania to identify the factors that determine the wage level.

Keywords: wages, labour productivity, panel data, economic activities.

JEL Classification: J24, J30.
REL Classification: 9B, 12F.
1. Introduction

Labour productivity affects living standards through real wages, that is, wages adjusted to reflect the cost of living. Economic theory holds that “at the aggregate level the growth of real wages is determined by labour productivity growth” (Sharpe, Arsenault and Harrison, 2008). If wages rise in line with labour productivity they are both sustainable and create a stimulus for further economic growth through individuals’ purchasing power increase. Between 1999 and 2011 average labour productivity in developed economies increased more than twice as much as average wages (ILO, 2013).

For a decade or more before the crisis, the link between these indicators was broken in many countries and this contributed to the creation of global economic imbalances. Considering this recent economic crisis and the imbalances between Eurozone countries, the relationship between wages and productivity (or between the growths of them) has become one of particular policy relevance in recent years (Meager and Speckesser, 2011).

Factors that may explain a weak connection between the growths of the two indicators might be price and wage rigidities, labour adjustment costs, employment protection, entry restrictions and market regulations. Also, bargaining power of workers versus firms can play an important role in weakening the link between labour productivity and real wage (Klein, 2012).

In general it is expected that exporting firms are more productive than the others. Some possible explanations for this may be the fact that firms engaging in export activities must be able to compete in international markets and by entering these international markets they probably gain knowledge and expertise allowing them to improve their efficiency (De Loecker, 2007). Thus, is expected that exporting firms to also pay higher wages, at least as a consequence of a higher productivity.

For example, Bernard and Jensen (1995) found that exporter wage premia are statistically significant for all categories of wages and benefits for the case of US Manufacturing. Their paper started a new literature body research, and Schank, Schnabel and Wagner (2007) surveyed a large part of this literature concluding that the results of these latter studies are broadly consistent with the results of Bernard and Jensen in 1995. Also, Ricker (2010) argues that exporting has a significant positive impact on earnings, more precisely adds an additional 18% to workers’ earnings on average in the US manufacturing sector. He also claims that the export earnings premium varies by industry, being highest in industries with high export shares (like machinery, computers, electrical equipment, and transportation equipment).

In a paper from 2003, Goolsbee found that a 10% investment tax credit raises the relative wages of workers, on average, by 2.5%-3.0% relative to comparable workers in other sectors.
2. Data analysis

In this study we used annual data for the period 2008-2011, regarding 16 economic activities in Romania. The variables employed in this paper are: the average gross monthly earnings (earn), the labour productivity (prod), the net investment (invn) and the exports (exp). The data was collected from National Institute of Statistics database. The labour productivity was calculated as the ratio between the production and the average number of employees. The choice of the period was imposed by the changes made in 2008 to the NACE (the European standard classification of economic activities).

Growth in labour productivity and real wages are real inflation-adjusted concepts and therefore a significant aspect is how nominal estimates are converted into real values. The growth of consumption wages (deflated by the CPI) is more directly relevant to living standards than the growth of product wages (deflated by the GDP deflator), but is less directly linked to labour productivity growth because of the differences between the prices for the goods that workers produce (overall GDP) and the goods that they consume (the basket used to construct the CPI). In the light of these aspects, we decided to deflate earnings by the CPI, and the labour productivity by the GDP deflator. The net investments and the exports were also deflated by the CPI.

There are significant differences between the economic activities in Romania regarding the real gross average monthly wages (Figure 1). It is interesting to note that in the post crisis period, 2008-2011, the wages based on the national economy activities registered an increasing trend in most economic activities (in 13 of the 16 activities analysed). This moderate increase in wages could support the hypothesis that during the crisis unemployment has affected mostly the low-qualified employees.

The most significant increases in the real gross average wages in the post crisis period occurred in sectors such as Information and communication, Electricity, gas, steam, and air conditioning production, Mining and quarrying, Professional, scientific and technical activities. The highest level of decreases in wages occurred especially in the public sector – Human health, Education, Arts, entertainment and recreation. For Education there was an average decrease of 13%, 3% for Human Health, and 3.5% for Arts, entertainment and recreation. These decreases occur mainly because of the government decision to reduce expenditure, and thus reduce by 25% the amount of wages for the employees paid from public funds.
Figure 1. Real Gross Average Monthly Wages

Regarding labour productivity (Figure 2), calculated as the ratio between the output and the average number of employees, we can see that the highest levels were recorded in the industrial sector and the lowest in the tertiary sector (services).

Figure 2. Labour Productivity
The year 2009 is the one in which labour productivity decreased in most economic activities. Another relevant fact is that although the unemployment rate rose in 2009 in all economic activities, labour productivity decreased. The decrease in labour productivity in 2009, despite the unemployment growth, shows that although the economic restructuring was done where this was easier – human resources, it has not been effective. Even though in some sectors dismissal was necessary, this measure proved to be ineffective. It is obvious that the resorts of the loss of productivity in 2009 are not strictly related to the human capital; they may be the result of a defensive strategic approach. The most significant returns on labour productivity growth occurred in *Electricity, gas, steam and air conditioning production* (in 2011 productivity increased by 16.3% compared to 2010), *Mining and quarrying* (increased by 11.05% in 2011), *Manufacturing* (increased by 11% in 2011). Analysing the evolution of wages, we can also notice that in the activities with a high productivity the wage has a high level as well.

At the level of net investment there is a dramatic decrease in almost all national economic activities in the period 2008-2010. The highest levels of net investment are recorded in the secondary sector (*Manufacturing, Construction, Electricity, gas, steam and air conditioning production*), but also in some activities of the tertiary sector (*Wholesale and retail trade, Transportation and storage*). In 2011, net investment had a slight recover, when the highest levels of increase were in *Professional, scientific and technical activities* (an increase of 80% in 2011 compared to 2010), *Administrative and support service activities* (an increase of 68% in 2011 compared to 2010), *Construction* (34%), *Manufacturing* (33%). We could say that in these sectors the investments were focused on equipment, machinery, technology and production lines. The level of investments is high in the activities in which logistics (technical infrastructure) is very important in the production process.
Regarding the level of exports within the national economic activities, the highest value is recorded, as expected, in Manufacturing (114033 million lei in 2011, an increase of 19% compared to 2010). Significant values of this indicator also occur in Wholesale and retail trade and in Mining and quarrying. These sectors export products with a high added value, which are the result of a full process of production. Exports are also recorded in other sectors, possibly in high quantities, but at a low added value, and thus the actual value of exports is low.

The cross-industry comparison shows that overall the correlation between real wage and labour productivity is generally positive, although in some industries, such as Real estate activities, Education, Human health and social work activities and Arts, entertainment and recreation it is negative. The correlations are in general strong, excepting those negative which are also weak.

<table>
<thead>
<tr>
<th>Real Gross Average Monthly Wages</th>
<th>Real Labour Productivity</th>
<th>Export</th>
<th>Net Investment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mining and quarrying</td>
<td>0.83</td>
<td>-0.23</td>
<td>0.34</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>0.98</td>
<td>0.94</td>
<td>-0.56</td>
</tr>
<tr>
<td>Electricity, gas, steam and air conditioning production and supply</td>
<td>0.97</td>
<td>0.88</td>
<td>0.83</td>
</tr>
<tr>
<td>Water supply; sewerage, waste management and decontamination activities</td>
<td>0.82</td>
<td>0.77</td>
<td>0.88</td>
</tr>
<tr>
<td>Construction</td>
<td>0.48</td>
<td>0.66</td>
<td>0.59</td>
</tr>
<tr>
<td>Wholesale and retail trade; repair of motor vehicles and motorcycles</td>
<td>0.99</td>
<td>0.88</td>
<td>-0.70</td>
</tr>
<tr>
<td>Transportation and storage</td>
<td>0.92</td>
<td>-0.23</td>
<td>-0.70</td>
</tr>
<tr>
<td>Hotels and restaurants</td>
<td>0.57</td>
<td>0.49</td>
<td>-0.98</td>
</tr>
<tr>
<td>Information and communication</td>
<td>0.88</td>
<td>-0.09</td>
<td>-0.88</td>
</tr>
<tr>
<td>Real estate activities</td>
<td>-0.06</td>
<td>-0.20</td>
<td>-0.99</td>
</tr>
<tr>
<td>Professional, scientific and technical activities</td>
<td>0.89</td>
<td>0.78</td>
<td>-0.50</td>
</tr>
<tr>
<td>Administrative and support service activities</td>
<td>0.98</td>
<td>-0.04</td>
<td>0.17</td>
</tr>
<tr>
<td>Education</td>
<td>-0.54</td>
<td>0.90</td>
<td>0.24</td>
</tr>
<tr>
<td>Human health and social work activities</td>
<td>-0.22</td>
<td>0.43</td>
<td>0.77</td>
</tr>
<tr>
<td>Arts, entertainment and recreation</td>
<td>-0.34</td>
<td>-0.01</td>
<td>0.60</td>
</tr>
<tr>
<td>Other service activities</td>
<td>0.62</td>
<td>0.05</td>
<td>-0.91</td>
</tr>
</tbody>
</table>

The correlation between real wage and exports is negative in 6 cases out of 16 industries and once again those negative correlations are also weak correlations. The strongest correlations are in Manufacturing, Electricity, gas, steam and air conditioning production and supply, Wholesale and retail trade; repair of motor vehicles and motorcycles and Education.

Regarding the correlation between real wage and real net investment we found that half of them are negative and strong. Among the industries with strong positive correlations we have: Electricity, gas, steam and air conditioning production and supply and Water supply, sewerage, waste management and decontamination activities.
3. Methodology

The econometric analysis was performed using STATA software. Having 16 national economic activities over 4 years we estimated a panel data model which differs from a regular time-series or cross-section regression through the double subscript on the variables:

\[ Y_{it} = a + b \cdot X'_{it} + u_{it}, \quad i = 1, \ldots, N; \quad t = 1, \ldots, T. \]

The subscript \( i \) denotes the cross-section dimension (the activities) and \( t \) denotes the time-series dimension. Our model, as most of the panel data applications, uses a one-way error component model for the disturbances, with: \( u_{it} = \alpha_i + \varepsilon_{it} \) (Baltagi, 2008). The main advantage in pooling a time series of cross-sections consists in widening the database, obtaining better and more reliable estimates of the parameters of the model.

When working with static panel data regression one has to distinguish between two main types of models: fixed-effects models (in which the \( \alpha_i \) are permitted to be correlated with the regressors \( x_{it} \), while continuing to assume that \( x_{it} \) is uncorrelated with the idiosyncratic error \( \varepsilon_{it} \)) and random-effects models (in which \( \alpha_i \) is purely random or in other words \( \alpha_i \) is uncorrelated with the regressors) (Cameron et al., 2009). In order to decide whether a fixed-effects (FE) or random-effects (RE) model is more appropriate for a particular analysis there are several tests that can be applied, out of which the Hausman test is the most common.

Since in this particular case we will estimate a fixed-effects model (the decision between the two models was made based on the above mentioned test and on economic reasons), we will further present some characteristics of these models and problems that may arise.

So, the most common estimator for the FE model is the “within estimator” which eliminates the fixed-effect by mean-differencing. This is why a time-invariant variable will be excluded from the mean-differenced regression. Also, the fixed-effects \( \alpha_i \) will be eliminated by subtraction of the corresponding model for individual means \( \bar{y}_i = \bar{x}_i \cdot b + \bar{\varepsilon}_i \), leading to the within model or mean-difference model:

\[ (y_{it} - \bar{y}_i) = (x_{it} - \bar{x}_i) \cdot b + (\varepsilon_{it} - \bar{\varepsilon}_i). \]

Because \( \alpha_i \) has been eliminated, OLS leads to consistent estimates of \( b \) even if \( \alpha_i \) is correlated with \( x_{it} \) as in the case of FE model.

The default standard errors assume that the error \( \varepsilon_{it} \) is independent and identically distributed. Furthermore, the regression disturbances are supposed to be homoskedastic with the same variance across time and individuals. This may be a restrictive assumption for panels and when heteroskedasticity is present the standard errors of the estimates will be biased (Baum, 2001). In addition, because
serial correlation in linear panel-data models biases the standard errors and causes the results to be less efficient, the serial correlation in the idiosyncratic error term in a panel-data model should also be checked (Drukker, 2003). Some authors have provided a number of tests in order to identify the problems encountered (Drukker, 2003, Baum, 2001, Green, 2012).

If these problems are encountered, the standard error estimates of commonly applied covariance matrix estimation techniques are biased and the statistical inference based on such standard errors is invalid. In order to overcome these problems, Driscoll and Kraay (1998) proposed a nonparametric covariance matrix estimator which produces heteroskedasticity consistent standard errors that are robust to very general forms of spatial and temporal dependence.

4. Econometric results

As mentioned above we decided to estimate a panel data model because panel data control for the individual heterogeneity (Hsiao, 2003) and also because panel data analysis is more efficient, since it provides the opportunity to identify and measure effects that would not be detectable by other analysis. The following general equation was considered:

\[ \ln_{\text{earn}}_it = \text{intercept} + \beta_1 \ln_{\text{prod}}_it + \beta_2 \ln_{\text{invn}}_it + \beta_3 \ln_{\text{exp}}_it + \alpha_i + \epsilon_{it} \]

where all the variables are expressed in logs. The subscript \( i \) stands for each of the 16 economic activities included in the panel, while \( t \) stands for the years 2008-2011.

We decided to estimate a fixed effects model, based on the Hausman test and on economic reasons. We also checked for the presence of heteroskedasticity and autocorrelation of the errors and both tests, the serial correlation test and the test for groupwise heteroskedasticity, indicated that a robust estimation is needed. That is why, in order to ensure the validity of the statistical results, we estimated a robust fixed-effects regression with Driscoll and Kraay standard errors. The final estimation results are presented in the following expression:

\[ \ln_{\text{earn}}_it = 2.05 + 0.47 \ln_{\text{prod}}_it - 0.04 \ln_{\text{invn}}_it + 0.04 \ln_{\text{exp}}_it \]

\[ (1.07)^{***} \quad (0.082)^* \quad (0.016)^{**} \quad (0.004)^* \]

where between brackets are the robust standard errors and the *, **, *** stands for 1%, 5% and 10% significance.

The classic correlation between wages and labour productivity is well represented in the equation (0.47 the coefficient associated to productivity in a logarithmic expression). It is also interesting to see the symmetric distribution (in absolute
value, coefficient 0.04) of the influence that exports and investment have on wages. The signs of the coefficients associated to the two variables are normal. Investment economizes labour force in the short run, but in a fairly balanced way, with a slightly unfavourable trend for wages above the average (negative sign). Regarding the positive influence that exports exercise on wages, this can be attributed to the effect that exports have on the national economy. The significant difference between the coefficient associated to labour productivity and those associated to net investment and exports can be explained by the fact that in the case of labour productivity the growth effects influence wages directly, whilst the other two factors produce structural changes with an indirect influence. For this reason it can be said that the impact of the two factors (investment and exports) is balanced (the negative contribution of one of them is counterbalanced by the positive contribution of the other), labour productivity is the only one that matters in the end.

5. Conclusions

As expected, the panel analysis showed that the greatest influence on wage is exercised by labour productivity (0.47). The other variables in the model (net investment and exports) have a lesser influence. Net investments have a negative impact highlighting the fact that by making investments, companies save labour force; through their positive impact, exports show their driving effect on the economic activity.

The analysis of the activity correlation coefficients between the variables used confirms the correlations in the econometric equation with some exceptions that we could consider normal. For example, the negative coefficients associated to services in the case of labour productivity – Human health and social work activities, Education, Arts, entertainment and recreation. Another somehow natural situation is given by the influence that exports exercise on wages: coefficients are negative, especially in the predominantly non-tradable sectors (Transportation and storage, Real estate activities, Information and communication). Regarding the negative impact of the net investment on wages, we can notice that it occurs mainly in those sectors likely to involve technological improvements (Information and communication, Transportation and storage, Hotels and restaurants, Professional, scientific and technical activities).

The severe austerity measures imposed on the labour markets, without taking into account the social impact, deteriorate the labour market relations. In Romania, the workers at the bottom of the wage distribution were the most affected, although they should be stronger protected in order to not become working poor. Therefore, in the light of these aspects policy-makers should aim at policies that promote a stronger link between the growth of wages and productivity.
References

Cameron, A.C., Trivedi, P.K. (2009). *Microeconometrics Using Stata*, Stata Press