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Article

Personnel Costs and Labour Productivity: The Case of European Manufacturing Industry

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Abstract: The objective of the article is to evaluate the impact of personnel costs on apparent labour productivity by employing the 1995–2018 panel data of the manufacturing industry in 27 European countries. The methods of independent samples *t*-test, correlation analysis, Granger causality test, unit root test, and ARDL were employed. The analysis shows that a long-term relationship exists among personnel costs and apparent labour productivity, and there are not significant differences among European countries concerning the impact of personnel costs on apparent labour productivity, but it varies in time. Companies often avoid increasing wages, as it decreases the profit of the company, and seek to increase the turnover in order to reduce the cost of goods sold. This research shows that growth of personnel costs does not necessarily mean lower profitability. The growth of personnel costs increases the gross operating rate if the turnover per person employed is stable. Turnover growth has a positive effect on apparent labour productivity, but a negative impact on the gross operating rate. Thus, the impact of turnover on apparent labour productivity is significantly lower than the impact of personnel costs on apparent labour productivity.

Keywords: labour productivity; personnel costs; wages; manufacturing industry

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1. Introduction

The high quality of the labour force can be considered as an indicator of labour productivity, which is one of the key endogenous drivers of competitiveness of a company. The research problem on how to increase labour productivity remains a topical issue for developing as well as developed nations, as it is closely related to the processes of long-term sustainable development (Herman 2020). The question of whether personnel costs and wages matter for the level of labour productivity and allow attracting motivated employees is relevant to every company which wants to gain comparative advantages in competing markets. The reverse approach states that companies consider the growth of productivity as a ground for the rise of wages (Yusof 2008; Sharpe et al. 2008). Nevertheless, when seeking for practical ways to increase productivity, the question of how the growth in wages and overall personnel costs may affect the growth in productivity also rises.

The list of endogenous and exogenous productivity influencing factors is widely discussed and empirically analyzed in the scholar literature when looking for opportunities to improve the total factor productivity and partial productivity indicators, such as labour productivity and capital productivity. Since our empirical study is focused on the links between personnel indicators and labour productivity, we concentrate our attention on arguing the causality which runs from real wages and other components of personnel costs to labour productivity. An employer's economic gains from higher wage policies were highlighted by some economists who were trying to explain the positive links between higher wage paid and productivity, morale and loyalty (Leibenstein 1957; Reynolds 1978; Solow 1979; Dunlop 1985; Lawrence 2016). The relationship between wages and productivity garnered a great deal of attention from researchers who were trying to justify the links between these two indicators (Katz 1986; Erenburg 1998; Wakeford 2004; Mora et al. 2005;

Feldstein 2008; Zhang and Liu 2013; Stansbury and Summers 2018; Herman 2020). Other empirical studies were directed towards the analysis of interrelation in a set of indicators: labour productivity, real wages, temporary employment, and unemployment (Alexander 1993; Yusof 2008; Lopez-Villavicencio and Silva 2011; Cirillo and Ricci 2020) or productivity, real wages, and inflation (Kumar et al. 2012; Tang 2014; Yildirim 2015; Piper et al. 2020). The impact of endogenous factors (such as staff training system, intangible investment in human resources and knowledge) on labour productivity was also empirically tested in the modern literature (Black and Lynch 2002; Corrado et al. 2014; Dosi et al. 2019). The empirical evidence of the impact of labour market regulation on productivity growth was presented in empirical studies (Storm and Naastepad 2007; Bassanini and Venn 2008; Kleinknecht 2020). The effects of PGs (pay gaps between executives and employees) on firm productivity were analysed and discussed (Faleye et al. 2013; Banker et al. 2016; Dai et al. 2017), while the effects of wage inequality on labour productivity were examined by Liu (2002); Policardo et al. (2019); Kampelmann et al. (2018) empirically analysed the links between labour productivity and national education and training system, which could be treated as a problem closely related to the quality of human resource and labour productivity issues.

We aim to expand previous empirical research on labour productivity factors by focusing on the analysis of personnel costs. Our empirical study examines the links between personnel costs and apparent labour productivity to justify a company's efforts to stimulate productivity. The purpose of our empirical research is to evaluate the impact of personnel costs on apparent labour productivity by employing the panel data of the European manufacturing industry. The manufacturing industry sector includes the activities provided by NACE Rev. 2 Section C (Eurostat 2021). The research was conducted to answer the following questions: How do personnel costs, which include wages and security costs, contribute to apparent labour productivity growth and why is it beneficial to increase wages? With reference to the literature analysis, the methods of independent samples *t*-test, correlation analysis, Granger causality test, unit root test, and ARDL were employed.

Although there is a sufficient number of researches concerning the analysis of links between productivity and wages, still there is not one answer to how much the increase in salary contributes to the growth of productivity. The results depend mostly on the country or region that is analysed. Moreover, the literature does not highlight the motivation of companies to increase wages. Our contribution to the issue is based on performing a detailed analysis of impact of personnel costs on apparent labour productivity, finding out that salary increase has a significant positive impact on productivity in manufacturing industry, and this way to increase productivity is more beneficial compared with the possibility to boost it through turnover. The results of the research can be useful for managers of companies and policymakers of states in order to stimulate the faster growth of productivity in low-productive European countries.

The remainder of this paper has been organized as follows. The second section introduces the review of the scientific literature on the relationship between labour productivity and the personnel costs. The third section covers the methodology and description of the data used in the empirical study. The fourth section of the paper presents the results of the analysis and discussion. The final section provides the summary of the results and the main conclusions.

2. Literature Review

According to the statistical definition (Eurostat 2021), personnel costs refer to the total remuneration, in cash or in kind, payable by an employer to an employee in return for work done by the latter during the reference period. Personnel costs also include taxes and employees' social security contributions retained by the unit; in addition, they cover an employer's compulsory and voluntary social contributions. Total personnel costs consist of wages, salaries, and social security costs of an employer. As wages are the main component of personnel costs, earlier scientific literature is rich in various approaches that try to conceptually explain the relationship between wages and productivity (Leibenstein 1957; Reynolds 1978; Solow 1979; Dunlop 1985; Katz 1986). A generic efficiency wage model distinguishes between two cases: if total labour demand is less than total labour supply, wages are set in such a way that the elasticity of effort with respect to wage is unity (Romer 2018). If total labour demand (based on efficiency calculation) is equal or greater than labour supply, wage is bid up so that labour market is in equilibrium; in this case, productivity determines wages. Leibenstein (1957) developed a simple model in which an employee's physical health and, accordingly, the productivity is assumed to depend positively on the real wage paid. By this approach, companies get more productive and healthier employees if they pay higher wages. Solow (1979) suggested a formally similar concept for developed economies. By this concept, increased wages improve morale and motivation, and thus directly influence productivity through the enlarged employee effort. The viewpoints of other scholars (Reynolds 1978; Dunlop 1985) are based on the potential benefits gained by the companies with higher levels of wages. The benefits mentioned above include increased effort and lower employee shirking, higher quality of work, improved morale, and greater employee loyalty to the company. According to efficiency wage theory, the links between productivity and wage can be justified by economic gains to an employer of high-wage policies. Companies offering higher wages are likely to attract more capable and productive employees (Hellebrandt et al. 2015). However, Katz (1986) argues that the criticism of efficiency wage models is that bonding mechanisms can solve effort elicitation, turnover, and adverse selection problems in an efficient manner, meaning that bonding mechanisms solving one efficiency wage problem exacerbate other problems. Wakeford (2004); Storm and Naastepad (2007) highlight another aspect of wages and endeavours: if companies pay higher wages, employees exert greater effort to avoid being dismissed. Higher real wages raise the opportunity cost of a job loss, which can stimulate greater work effort to avoid redundancy. An important aspect is that an increase in real wages will result in a growth of unit labour costs and cause companies to substitute capital for labour, which, in turn, will be reflected in an increase in the marginal productivity of labour. Greater capital stocks raise the demand for labour, affecting the rise of the real wage and productivity.

Reverse causality that explains the links between productivity and real wages is highlighted in marginal productivity theory and bargaining theory (Yusof 2008). According to these theories, causality runs from productivity to real wages. A key assumption of marginal productivity theory is that productivity developments are exogenous, whereas wages adjust to productivity. When the labour share remains constant, labour productivity growth should be reflected proportionally in real wage growth (Sharpe et al. 2008). As was pointed out by Meager and Speckesser (2011), in practice this model is commonly used to justify wage-setting rules, in order to ensure that wage growth does not exceed productivity growth when aiming at generation of full employment. Stansbury and Summers (2018) findings confirm substantial evidence of linkage between productivity and compensation, as 1 percentage point higher productivity growth has been associated with 0.7 to 1 percentage point higher median and average compensation growth. Wakeford (2004) notices that the concept of marginal productivity takes into account the contribution to output of the last worker hired, although this indicator cannot be readily measured. Blanchard (2006) states that bargained wages are aligned to anticipated future output and proposes this as the key process causing increased unemployment.

The modern literature provides empirical studies on the problem under investigation and covers different findings. A long-term equilibrium (cointegrating) link between real wages and productivity was found in the empirical studies of Wakeford (2004), who employed the data of South Africa and argued that a long-term wage and productivity elasticity consists of 0.58; the author also indicated that productivity grows more rapidly than wages. The econometric evidence showed that in a short-term real wages negatively impact productivity, but productivity has no effect on real wages; what is more, productivity has a weak autoregressive pattern, while real wages lack this altogether. The scholar noted that unemployment is divorced from the long-term equilibrium between real wages and productivity. The findings of Tang (2014), who employed Malaysian data, supported the assertion of efficiency wage theory and suggested that the effect of real wages on labour productivity is non-linear and has an inverted U-shaped relationship. The Granger causality test showed that real wages Granger-cause labour productivity, but there is no evidence of any reversal causation. According to the empirical evidence of Bildirici and Alp (2008), who employed the TAR cointegration analysis, the long-run linear relation between wages and productivity in Turkey was rejected against the nonlinear long-run relation. The application of Granger causality tests in Kumar et al. (2012). empirical studies revealed a bidirectional causality running between real wages and productivity in Australia and led to fairly consistent results on the impact of real wages on productivity with an estimated wage elasticity ranging between 0.5 and 0.8. Policardo et al. (2019). investigated whether there is a relationship between wage inequality and average labour productivity and confirmed that high wage inequality is associated with lower labour productivity. Yildirim (2015) examined the interrelationships among productivity, real wages, and inflation in Turkish manufacturing industry and concluded that there is unidirectional causality from real wages to productivity, implying a broken link between productivity and wage. According to Alexander's (1993) empirical evidence, real wages, inflation, and productivity have a co-integrating link in the United Kingdom, which proposes that higher wage rates stimulate labour productivity through the argument of efficiency wages. Meager and Speckesser (2011) used data from the EU and OECD economies over 1995–2009 and assumed that wage increases and productivity growth are clearly related in the long run. Wages grew below productivity in most continental European economies, but the wage-productivity gap was quite dissimilar across the different EU member states. Sharpe et al. (2008), who conducted the empirical study in Canada by employing the long-run data, found that real wage growth is slower than labour productivity growth. The analysis was focused on assessment of the impact of labour productivity on real wages and led the authors to conclude that the real wage growth rate can diverge from the labour productivity growth rate in the short and medium terms due to the impact of cyclical factors, but in the long-term wage growth tends to closely follow labour productivity growth.

Concluding the literature review, it can be stated that although scholars pay attention to the effects of wages on labour productivity, the evidence is not conclusive. The findings vary due to the different levels of economic development in selected countries, the different rates of wages and total personnel costs in different manufacturing industries, the impact of environmental factors, and the distinctive behaviour of individual companies. Our paper is designed to expand previous empirical research employing sectoral data of manufacturing industries in European countries to draw conclusions about the effects of personnel costs on labour productivity in the region.

3. Methodology

This empirical study uses annual data from manufacturing industries in 27 European countries for the period 1995–2018. The manufacturing sector includes a vast range of activities and production techniques, from small-scale enterprises using traditional production techniques (e.g., manufacture of musical instruments), to very large enterprises sitting atop a high and broad pyramid of parts and components suppliers collectively manufacturing complex products, such as aircraft (Eurostat 2021). Two European countries are not included in the econometric analysis, as Ireland is found as outlier and Malta has many missed data. The analysis encompasses all the indicators related to productivity and personnel costs that are provided for manufacturing industry by Eurostat. Control variables are selected based on their potential impact on productivity indicators (i.e., indicators related to the industry or macroeconomics). The indicators under investigation include:

- indicators related to productivity:
    - apparent labour productivity (gross value added per person employed)—thousand euros (ALP);

- ○ wage-adjusted labour productivity (apparent labour productivity by average personnel costs)—percentage (WALP);
- ○ turnover per person employed—thousand euros (TPE);
- indicators related to personnel costs:
  - ○ average personnel costs (personnel costs per person employed)—thousand euros (AC);
  - ○ employer's social charges as a percentage of personnel costs—percentage (CH);
  - ○ share of personnel costs in production—percentage (CPR);
  - ○ share of personnel costs in gross value added—percentage (CGVA);
  - ○ of wages and salaries in gross value added—percentage (WGVA);
  - ○ share of social security costs in gross value added—percentage (SSGVA);
- other indicators related to the industry or macroeconomics:
  - ○ persons employed—number (PE),
  - ○ enterprises—number (EN),
  - ○ persons employed per enterprise—number (PEE),
  - ○ gross operating rate—percentage (GOR),
  - ○ price level indices, EU15 = 100 (PL),
  - ○ gross domestic product at market prices, current prices, euro per capita (GDP).

The following research methods are used:

- the independent samples *t*-test is used to distinguish indicators that differ significantly between countries with higher apparent labour productivity and countries with lower apparent labour productivity;
- unit root test is employed to define the order of integration of a time series;
- correlation analysis is used to show how strong the relationship between apparent labour productivity and other indicators under investigation is;
- the Granger causality test is used to define the delayed effect (lags) and the direction of the relationship between apparent labour productivity and other indicators under investigation;
- cointegration analysis is used to examine if there is a long run equilibrium relationship between ALP and AC or other indicators. The autoregressive distributed lag (ARDL) cointegration technique (ARDL bounds testing) developed by Pesaran et al. (2001) is adopted. The advantage of this model is that it can be used in time series that are not integrated in the same order (i.e., mixture of I(0) or i(1), but not I(2)). It also allows the series to have different optimal lags. ARDL test estimates of the following unrestricted error correction model:

$$\Delta y_t = \beta_0 + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + \sum_{j=0}^{q} \gamma_j \Delta x_{t-j} + \theta_1 y_{t-1} + \theta_2 x_{t-1} + e_t, \quad (1)$$

here Δy_t and Δy_{t-i}, $i = 1, \ldots, p$, are differenced apparent labour productivity at time t and $t-i$ respectively, y_{t-1} is apparent labour productivity at time $t-1$, Δx_{t-j}, $j = 1, \ldots, q$, are differenced average personnel costs at time $t-j$, x_{t-1} is average personnel costs at time $t-1$, p and q are numbers of lags of apparent labour productivity and average personnel costs, respectively, β_0, β_i, γ_j, θ_1, and θ_2 are parameters, and e_t is an error term.

The values for lags p and q are found using the Schwarz Information Criterion (SC). A prerequisite on the ARDL model is that errors are serially independent. Cointegration between two variables exists if H_0 is rejected:

$$H_0: \theta_1 = \theta_2 = 0,$$
$$H_1: \theta_1 \neq \theta_2 \neq 0.$$

The long-run result of the unrestricted error correction model is found by the formula $-(\theta_2/\theta_1)$.

The significance level of 0.05 is used for all the hypotheses tests. Calculations are made using EViews (2021) 11 software.

4. Results and Discussion

The average apparent labour productivity (ALP) of the European manufacturing industry for the period 1995–2018 amounts to 46.0 thousand euros and varies in a comparatively large interval, i.e., from 2.9 to 118.6 thousand euros. The median value of ALP (44.4 thousand euro) is close to the mean. The highest apparent labour productivity has been recorded in Denmark and Belgium in the last three years. Meanwhile, Bulgaria, Romania, Latvia, and Lithuania are distinguished by the lowest apparent labour productivity with a comparatively slow improvement. The apparent labour productivity in these countries has increased twice in the last 10 years but was still five–eight times lower than in Denmark or Belgium in 2018 (Figure 1).

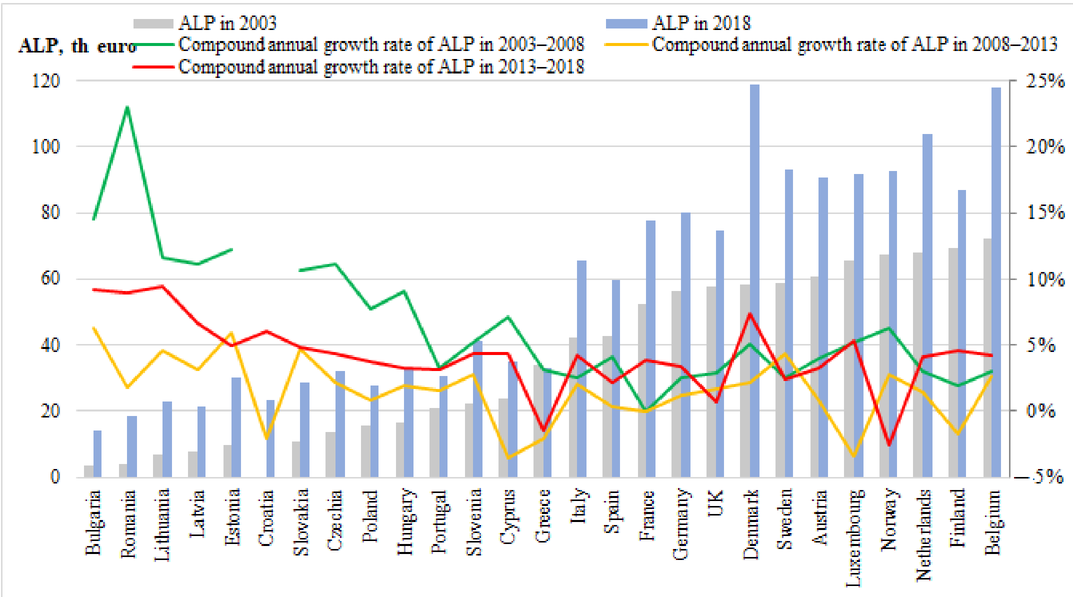

Figure 1. The tendency of apparent labour productivity. Source: own elaboration based on Eurostat data and authors' calculations.

It can be seen that the growth of ALP recently is not so fast in less productive countries than it was 15 years ago. Thus, the problem arises that the gap between less and more productive countries will stop narrowing soon. The ALP growth rate in more productive countries did not change over 15 years and usually varied in the interval of 0–5 percent per year. It leads to the conclusion that the higher the ALP, the lower the growth of ALP is expected in the future. The relationship between ALP and its growth rate can be defined by the logarithmic function (Figure 2). As ALP in less productive countries (Bulgaria, Romania, Lithuania, Latvia, Estonia, Slovakia, Slovenia, Czechia, Croatia, Hungary, Poland, Portugal, Cyprus, and Greece where ALP is lower than the average) reached 14–41 thousand euros in 2018, the future growth rate of ALP is expected to be 3–6 percent per year, which is not much higher than the expected growth rate of more productive countries (1–2 percent per year).

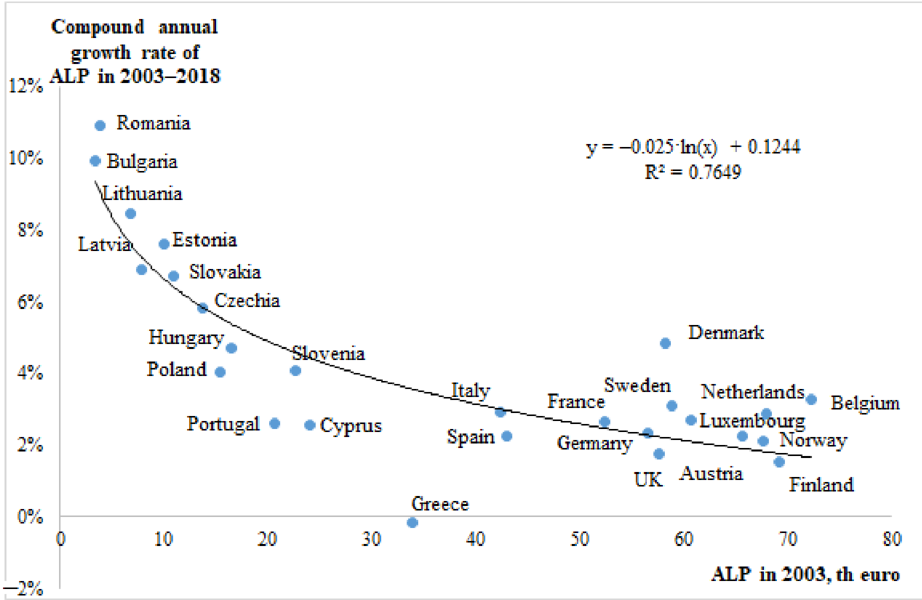

Figure 2. The relationship between ALP and its future growth rate. Source: own elaboration based on Eurostat data and authors' calculations.

So, it is important to find ways to boost ALP especially in less productive countries. The possibility to boost ALP by increasing salaries is further tested. The average personnel costs (AC) ranged from 1.2 to 76.1 in 1995–2018 with a mean value of 27.7 and a median value of 24.1. AC is lower and its growth rate is higher in less productive countries compared to more productive countries (Figure 3). Thus, there can be suspected that AC is related with ALP, i.e., higher wages allow for an increase in apparent labour productivity.

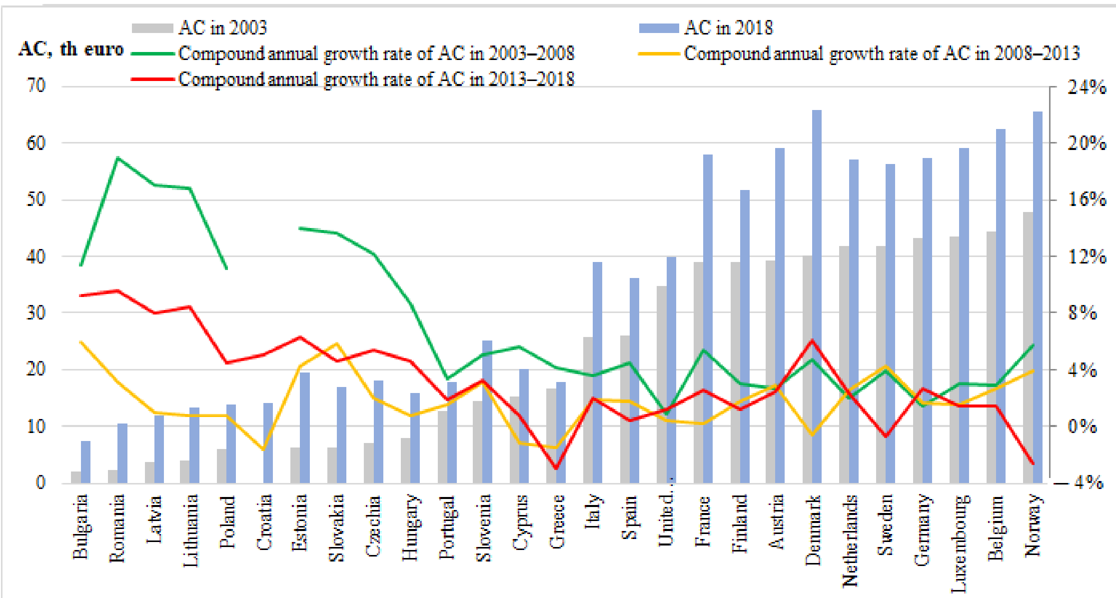

Figure 3. The tendency of average personnel costs. Source: own elaboration based on Eurostat data and authors' calculations.

ALP is a stationary process with trend and intercept, and AC is an integrated process of order one without trend and intercept. Thus, the cointegration between them is analysed using ARDL bound testing. The relationship between the changes in ALP (ΔALPt) and the changes in AC (ΔACt) is moderate (correlation coefficient is 0.60). The Granger causality test shows that changes in ALP can be explained by changes in AC, but not vice versa. The results are similar to those, which are presented by Tang (2014) who shows that real wages Granger-cause labour productivity in Malaysia, but there is no evidence of reversal causation. However, he contradicts to Yusof (2008) who states that higher productivity leads to higher wages in Malaysia. Wakeford (2004) and Yildirim (2015) also agree that productivity has no effect on real wages in South Africa and Turkey, respectively. It is also in line with the results got by Kumar et al. (2012), Storm and Naastepad (2007), but does not support the research performed by Herman (2020), Stansbury and Summers (2018) and others, who tested the impact of productivity on wages (i.e., opposite relationship).

The VAR lag order selection criteria indicate that ARDL(2, 0) is the best as its SC value is the lowest. The Lagrange multiplier test for random effects indicates that time effects should be included. The Hausman test rejects H0 indicating that fixed effects should be included. The results of the estimated ARDL(2, 0) model are presented in Table 1.

Table 1. Results of ARDL bounds testing.

Independent Variables	Coefficient	Std. Error	*p*-Value
C	0.3946	0.2566	0.1249
ΔALP(−1)	−0.0699	0.0387	0.0718
ΔALP(−2)	−0.1486	0.0380	0.0001
ΔAC	1.3101	0.0811	0.0000
ALP(−1)	−0.0580	0.0244	0.0178
AC(−1)	0.1032	0.0359	0.0042
Adjusted R-squared			0.5848
p-value of Pesaran CD			0.3136
H_0: all $\theta_i = 0$ jointly	F-statistic		Chi-square
p-value	0.0016		0.0015
Long-run multiplier of AC			1.7776

The model is stationary (i.e., dynamically stable), has moderate precision, and residuals are not correlated. Based on the results of the Wald test, the null hypothesis is rejected, which means that the coefficients are not equal to zero jointly. In other words, ALP and AC have a long-term association. AC has a positive and significant impact on ALP. Thus, the long-term effect of personnel costs per person employed on apparent labour productivity amounts to 1.7776 with a standard error of 0.1879. It means that a 1% increase in personnel costs has a 1.78% long-term effect on apparent labour productivity. The Wald test rejects the null hypothesis about its equality to zero (prob(t-statistic) = 0.0000; prob(F-statistic) = 0.0000; prob(chi-square) = 0.0000). Thus, the effect of AC on ALP is significant. The effect of personnel costs on labour productivity is got by this research stronger in comparison with the results produced by Kumar et al. (2012), who estimated that a 1% increase in real wages led to an increase in productivity of between 0.5% and 0.8%.

The research indicates that wage-adjusted labour productivity (WALP) is higher and a share of wages, as well as of personnel costs in GVA or production, is lower in less productive countries (Table 2). The average value of WALP is 159.3% for the period 1995–2018 and is slightly higher than the median (155.8%). WALP varies in the interval from 116.3% to 283.1% during the investigation period. The highest values of WALP are estimated for Latvia (283.1% in 2001), Poland (224–260% in 2003–2005), Bulgaria (230.7% in 2007), and Hungary (224% in 2015). However, Poland had only 117.1% WALP in 2002, which was just a bit higher than the minimum of 116.3%, which belonged to Luxembourg in 2009. Bulgaria, Hungary, and Poland are still found to be the leaders in WALP, which was equal to 183.9%, 198.5%, and 185.5% respectively in 2018. However, the United Kingdom (184.4%) and Denmark (176.6%) were also among the leaders in 2018. Meanwhile, the lowest values of wage-adjusted labour productivity are estimated for France (130.0%), Germany (136.2%), and Norway (138.6%) in 2018. The situation indicates that each employee in high income countries, such as Norway, Sweden, Austria, Finland, France, Germany, Luxembourg, and Italy, creates a great value added (GVA), but it is not so high relative to personnel costs.

Meanwhile, employees in many countries that are characterized by low apparent labour productivity, for instance, Bulgaria, Romania, Hungary, Latvia, Lithuania, and others, create low value added, but it is quite high relative to personnel cost, which means that a greater share of GVA in these countries compared with high income countries is left for savings (profits, depreciation) and taxes.

Table 2. Results of independent samples *t*-test.

Indicator	Countries with ALP Lower (1) or Higher (2) than the Average	Group Statistics			Equal Variances Assumed (A)/Not Assumed (NA)	Levene's Test for Equality of Variances		*t*-Test for Equality of Means	
		N	Mean	Std. Dev.		F	Sig.	t	Sig. (2-Tailed)
ALP	1	280	22.65	10.96	A	28.70	0.000	−41.82	0.000
	2	267	70.48	15.50	NA			−41.49	0.000
WALP	1	276	167.86	24.18	A	30.49	0.000	9.89	0.000
	2	267	150.35	16.15	NA			9.95	0.000
TPE	1	280	94.19	43.54	A	94.54	0.000	−29.88	0.000
	2	267	285.83	97.63	NA			−29.41	0.000
AC	1	324	13.12	8.66	A	8.80	0.003	−44.40	0.000
	2	267	47.07	9.92	NA			−43.82	0.000
CH	1	323	21.62	5.82	A	12.16	0.001	1.70	0.090
	2	266	20.73	6.90	NA			1.67	0.095
CPR	1	329	15.19	3.68	A	9.86	0.002	−10.91	0.000
	2	267	18.30	3.17	NA			−11.08	0.000
CGVA	1	285	0.57	0.08	A	3.12	0.078	−11.77	0.000
	2	267	0.64	0.07	NA			−11.84	0.000
WGVA	1	282	0.45	0.07	A	0.09	0.761	−10.26	0.000
	2	266	0.51	0.07	NA			−10.28	0.000
SSGVA	1	282	0.12	0.04	A	17.85	0.000	−3.27	0.001
	2	266	0.13	0.05	NA			−3.25	0.001
GOR	1	279	10.40	2.52	A	3.87	0.050	5.65	0.000
	2	267	9.20	2.47	NA			5.65	0.000
EN	1	333	77,276.16	110,557.56	A	4.86	0.028	−1.73	0.084
	2	263	92,842.19	106,857.11	NA			−1.74	0.083
PE	1	312	933,999.82	1,103,793.57	A	89.69	0.000	−5.42	0.000
	2	267	1,655,737.49	2,027,583.93	NA			−5.19	0.000
PEE	1	308	16.94	12.40	A	5.52	0.019	−3.83	0.000
	2	263	20.46	8.98	NA			−3.92	0.000
GDP	1	374	12,023.48	6,940.51	A	65.30	0.000	−29.02	0.000
	2	267	37,935.96	15,195.13	NA			−26.00	0.000
PL	1	329	78.57	14.31	A	0.03	0.873	−25.39	0.000
	2	267	107.55	13.28	NA			−25.59	0.000
ALP_PL	1	280	27.99	11.15	A	5.36	0.021	−35.16	0.000
	2	267	65.92	13.98	NA			−34.97	0.000
TPE_PL	1	280	117.37	47.09	A	47.53	0.000	−23.14	0.000
	2	267	269.41	98.83	NA			−22.79	0.000
AC_PL	1	295	17.11	8.40	A	0.47	0.493	−38.12	0.000
	2	267	43.92	8.24	NA			−38.16	0.000

However, there is a group of countries where both ALP and WALP are high, based on the 2018 data. It includes Belgium, Denmark, and the Netherlands. Meanwhile, Czechia, Estonia, and Slovakia have quite low ALP and WALP.

The independent sample *t*-test indicates that significant differences exist in many indicators between the less productive countries and the more productive countries (Table 2).

Assume that the countries with ALP lower than average make up the first group, while the countries with ALP higher than average make up the second group. It is obvious that the average ALP in the first group is significantly lower (three times) than the average ALP in the second group, while the average WALP in the first group is significantly higher than the average WALP in the second group. Many other indicators, such as turnover per person employed (TPE), average personnel costs (AC), share of personnel costs in production (CPR), share of personnel costs in gross value added (CGVA), share of wages and salaries in gross value added (WGVA), and share of social security costs in gross value added (SSGVA), in the first group are significantly lower compared with the indicators in the second group. Meanwhile, an employer's social charges as a percentage of personnel costs (CH) do not have significant difference between two groups of countries. A relatively small share of personnel costs in production and in GVA as well as a significantly high gross operating rate (GOR) give the basis to increase wages further, thus enhancing the problem of stagnant ALP in the countries of the first group.

In general, low ALP can be caused by low turnover per person employed, which, in turn, can be determined by the size of an industry (a country). The second group has a significantly larger GDP, number of enterprises (EN), and persons employed (PE) as well as a larger number of persons employed in an enterprise (PEE). Although EN is lower in the first group, the difference is not significant (at the significance level of 0.05). Larger companies could reduce certain administrative costs, earn higher profits, and create more opportunities to invest in technologies and personnel so as to work more efficiently. The absolute value of turnover, as well as turnover per person employed, is also influenced by the price level (PL), which is significantly higher in the second country group. However, it is not a reason of low turnover as ALP in the first group, as ALP, turnover per person employed, and average personnel costs after elimination of the influence of prices (respectively ALP_PL, TPE_PL, and AC_PL in Table 2) are still significantly lower in the first group.

The correlation coefficients between the differences of ALP and the differences of other indicators are presented in Table 3. ALP is strongly positively correlated not only with average personnel costs but also with GDP. However, the Granger causality test shows that ALP Granger causes GDP, but not vice versa. Meanwhile, an increase in the share of wages or personnel costs in GVA has a significant negative effect on ALP. Reciprocal causality exists between ALP and relative indicators related with personnel costs, i.e., personnel costs in production value, personnel costs in GVA and wages in GVA that in turn are closely correlated. The results also show that growth of ALP allows reducing employer's social charges and number of employees in the company. The growth of ALP increases GOR and GDP as well. A reciprocal relationship exists between ALP and GDP in the long run. Thus, the Granger causality test shows that apparent labour productivity is mainly influenced by personnel costs.

Table 3. Results of Granger causality test and correlation analysis (r).

H: ****	Granger Causality Test When			r
	l = 1	l = 2	l = 3	
ΔWALP → ΔALP ΔALP → ΔWALP	0.3852 0.0337	0.1756 0.0021	0.4126 0.0001	0.4683 ***
ΔAC → ΔALP ΔALP → ΔAC	0.0988 0.3414	0.0185 0.7779	0.0939 0.8748	0.6018 ***
ΔCH → ΔALP ΔALP → ΔCH	0.8024 0.0272	0.9229 0.0222	0.4981 0.0181	−0.0129
ΔCPR → ΔALP ΔALP → ΔCPR	0.0051 0.9900	0.0041 0.0000	0.0012 0.0000	−0.3170 ***
ΔCGVA → ΔALP ΔALP → ΔCGVA	0.1559 0.0291	0.0486 0.0003	0.1604 0.0012	−0.5534 ***
ΔWGVA → ΔALP ΔALP → ΔWGVA	0.0768 0.1015	0.0284 0.0130	0.1318 0.0106	−0.6164***
ΔSSGVA → ΔALP ΔALP → ΔSSGVA	0.7897 0.0002	0.3142 0.0000	0.3790 0.0001	−0.2672 ***
ΔGOR → ΔALP ΔALP → ΔGOR	0.1211 0.9587	0.0694 0.0016	0.3251 0.0001	0.4588 ***
ΔPE → ΔALP ΔALP → ΔPE	0.2634 0.3031	0.3841 0.1503	0.1509 0.3123	0.0970 **
ΔPEE → ΔALP ΔALP → ΔPEE	0.1337 0.0230	0.6224 0.0693	0.5387 0.1529	−0.0324
ΔEN → ΔALP ΔALP → ΔEN	0.1859 0.9813	0.2597 0.4665	0.2428 0.4731	0.0762 *
ΔPL → ΔALP ΔALP → ΔPL	0.9699 0.9368	0.7594 0.6465	0.9712 0.7501	0.2357 ***
ΔGDP → ΔALP ΔALP → ΔGDP	0.2521 0.7236	0.2635 0.0100	0.0363 0.0088	0.6125 ***
ΔALP → ΔTPEΔTPE → ΔALP	0.0000 0.0000	0.0001 0.0000	0.0001 0.0001	0.5203 ***
ΔAC → ΔTPE ΔTPE → ΔAC	0.3408 0.1400	0.2202 0.3317	0.4171 0.5912	0.3029 ***

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. **** the hypothesis that the indicator X do not Granger-cause Y (X → Y) is tested in the first row, while the hypothesis that Y does not Granger-cause X (Y → X) is tested in the second row.

The growth of salaries is beneficial at both the micro and macro levels. However, companies often avoid increasing wages because it decreases the profit of the company. The gross operating rate (GOR) varied from 3.4 to 29.2 in Europe in 1995–2018 with a median and mean value of 9.8. The GOR in less productive countries (the average is 9.2) is a bit higher than in more productive countries (the average is 10.4) and based on the results of the independent samples *t*-test, this difference is significant.

However, the growth of AC does not necessarily mean lower profitability. GOR in Bulgaria, Denmark, and Luxembourg has increased the most during 15 years, while GOR in Poland and Greece has decreased the most (Figure 4). Denmark and Cyprus were characterized by the highest GOR in 2018, while the GOR was the lowest in France (Figure 5).

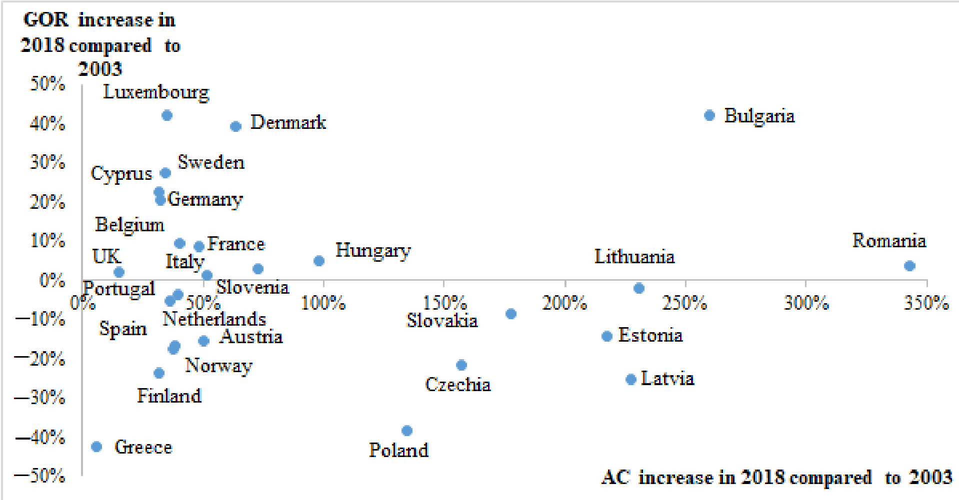

Figure 4. Comparison of changes of AC and GOR. Source: own elaboration based on Eurostat data and authors' calculations.

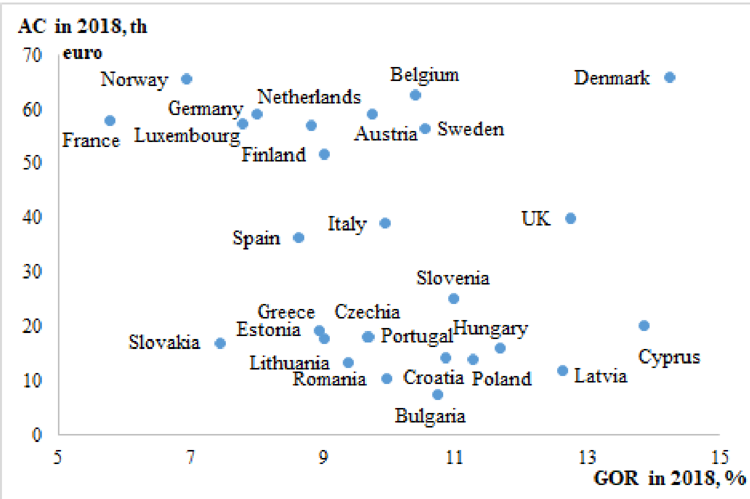

Figure 5. Scatter plot of AC and GOR in 2018. Source: own elaboration based on Eurostat data and authors' calculations.

GOR is an indicator of profitability that corresponds to the share of gross operating surplus in turnover. The gross operating surplus is the surplus generated by operating activities after the labour factor input has been recompensed. It can be calculated from the value added at the factor cost less the personnel costs. If all these indicators are divided by the number of persons employed, then GOR can be calculated as follows:

$$GOR = \frac{ALP - AC}{TPE}. \tag{2}$$

It can be shown that if TPE is stable, growth of personnel costs (AC) increases GOR as well because growth of AC rises ALP, i.e.,

$$\frac{GOR_t}{GOR_{t-1}} = \frac{ALP_t - AC_t}{TPE_t} / \frac{ALP_{t-1} - AC_{t-1}}{TPE_{t-1}}, \tag{3}$$

$$\text{if } TPE_t = TPE_{t-1} \text{ then } \frac{GOR_t}{GOR_{t-1}} = \frac{ALP_t - AC_t}{ALP_{t-1} - AC_{t-1}}. \tag{4}$$

Based on the estimated ARDL(2, 0) model, an increase in AC by 1 thousand euro causes an increase in ALP by 1.3101 thousand euro during the current year. Thus,

$$\frac{GOR_t}{GOR_{t-1}} = \frac{1.3101 + ALP_{t-1} - 1 - AC_{t-1}}{ALP_{t-1} - AC_{t-1}} = \frac{0.3101 + ALP_{t-1} - AC_{t-1}}{ALP_{t-1} - AC_{t-1}}. \quad (5)$$

As the numerator is higher than the denominator with any value of ALP_{t-1} and AC_{t-1} it proves that increasing salary allows increasing profitability of the company as well. The expected increase in GOR due to the growth of AC by 1000 euros in each country based on data from 2018, assuming that turnover and the number of people employed are stable, is presented in Table 4. Calculations show that due to growth of AC by 1 thousand euros, GOR increases by 0.6–4.6%. The largest effect of the increase in AC on GOR is recorded in Bulgaria and Romania, while the smallest effect is recorded in Denmark and Belgium.

Table 4. The expected increase in GOR due to growth of AC and changes in AC needed to keep GOR stable when TPE increases.

Predicted Indicator	The Expected Increase in GOR	Growth of AC
Assumptions / Country	AC Increases by 1 Thousand Euro TPE Is Const. PE Is Const.	TPE Increases by 1 Thousand Euro GOR Is Const. PE Is Const.
Belgium	0.56%	−0.11%
Bulgaria	4.58%	−1.00%
Czechia	2.24%	−0.35%
Denmark	0.59%	−0.17%
Germany	1.37%	−0.08%
Estonia	2.89%	−0.29%
Greece	2.03%	−0.32%
Spain	1.32%	−0.14%
France	1.59%	−0.04%
Croatia	3.39%	−0.53%
Italy	1.18%	−0.17%
Cyprus	2.05%	−0.52%
Latvia	3.21%	−0.78%
Lithuania	3.26%	−0.46%
Luxembourg	0.95%	−0.08%
Hungary	1.83%	−0.52%
Netherlands	0.66%	−0.10%
Austria	0.98%	−0.11%
Poland	2.22%	−0.57%
Portugal	2.47%	−0.35%
Romania	3.89%	−0.63%
Slovenia	1.93%	−0.30%
Slovakia	2.61%	−0.24%
Finland	0.88%	−0.11%
Sweden	0.84%	−0.13%
United Kingdom	0.89%	−0.23%
Norway	1.15%	−0.05%

Increasing TPE has a negative impact on GOR, so if turnover increases, GOR can rise not so much or even decrease. However, increasing sales volume can reduce the cost of goods sold and increase ALP. Changes in TPE are positively related to changes in ALP and changes in AC, although the correlation coefficient is not that high (0.52 and 0.30, respectively). TPE is a stationary process with intercept based on the method of Levin, Lin & Chu t (assumes common unit root process), but an integrated process of order 1 without trend and intercept according to ADF—Fisher Chi-square and PP—Fisher Chi-square methods (assumes individual unit root process). The Granger causality test shows that there is reciprocal causality between ALP and TPE, but AC and TPE do not have a Granger causal relationship (Table 3).

The cointegration among ALP, AC, and TPE is analysed using ARDL bounds testing. The selection criteria of the VAR lag order indicate that ARDL(3, 0, 1) is the best, as its SC value is the lowest. The Lagrange multiplier test for random effects indicates that time effects should be included. The Hausman test rejects H0 indicating that fixed effects should be included. The results of the estimated ARDL(3, 0, 1) model are presented in Table 5.

Table 5. Results of ARDL bounds testing.

Independent Variables	Coefficient	Std. Error	*p*-Value
C	0.1782	0.2487	0.4741
ΔALP(−1)	−0.0584	0.0438	0.1830
ΔALP(−2)	−0.0577	0.0373	0.1226
ΔALP(−3)	0.1117	0.0393	0.0047
ΔAC	1.1797	0.0781	0.0000
ΔTPE	0.0337	0.0049	0.0000
ΔTPE(−1)	0.0279	0.0053	0.0000
ALP(−1)	−0.0854	0.0263	0.0013
AC(−1)	0.1011	0.0342	0.0033
TPE(−1)	0.0048	0.0027	0.0701
Adjusted R-squared			0.6703
p-value of Pesaran CD			0.5535
H_0: all $\theta_i = 0$ jointly	F-statistic		Chi-square
p-value	0.0083		0.0077
Long-run multiplier of			
AC			1.1836
TPE			0.0565

The model is stationary (i.e., dynamically stable), has moderate precision, and residuals are not correlated. Based on the results of the Wald test, the null hypothesis is rejected, which means that the coefficients are not equal to zero jointly. In other words, ALP, AC and TPE have long-run association. TPE has a positive and significant impact on ALP. Thus, the long-term effect of turnover per person employed on apparent labour productivity amounts to 0.0565 with a standard error of 0.0277. It means that a 1% increase in turnover per person employed has a 0.0565% long-term effect on apparent labour productivity. The Wald test rejects the null hypothesis about its equality to zero (prob(t-statistic) = 0.0420; prob(F-statistic) = 0.0420; prob(chi-square) = 0.0413). Thus, the effect of TPE on ALP is significant.

The effect of AC on ALP is slightly smaller compared to the results presented in Table 4 as a part of the changes in ALP that were described by the changes in AC can be better explained by TPE. The long-term effect of personnel costs on apparent labour productivity amounts to 1.1836 with a standard error of 0.1865. The Wald test rejects the null hypothesis about its equality to zero (prob(t-statistic) = 0.0000; prob(F-statistic) = 0.0000; prob(chi-square) = 0.0000).

If the industry wants to keep the GOR stable, the possible growth of personnel costs per person employed when turnover per person increases can be calculated using the formula:

$$\frac{\mathrm{ALP_t} - \mathrm{AC_t}}{\mathrm{TPE_t}} = \frac{\mathrm{ALP_{t-1}} - \mathrm{AC_{t-1}}}{\mathrm{TPE_{t-1}}}, \tag{6}$$

$$\frac{\mathrm{AC_t}}{\mathrm{AC_{t-1}}} = \frac{\mathrm{ALP_t}}{\mathrm{AC_{t-1}}} + \frac{\mathrm{TPE_t}}{\mathrm{TPE_{t-1}}} - \frac{\mathrm{ALP_{t-1}}}{\mathrm{AC_{t-1}}} \cdot \frac{\mathrm{TPE_t}}{\mathrm{TPE_{t-1}}}. \tag{7}$$

According to the results of the ARDL(3, 0, 1) model, if TPE increases by 1 thousand euros, ALP increases by 0.0337 thousand euros during the same year assuming that other indicators are stable. So,

$$\frac{AC_t}{AC_{t-1}} = \frac{0.0337 + ALP_{t-1}}{AC_{t-1}} + \frac{1 + TPE_{t-1}}{TPE_{t-1}}\left(1 - \frac{ALP_{t-1}}{AC_{t-1}}\right). \quad (8)$$

The possible growth of personnel costs for each country based on 2018 data when turnover per person increases by 1 thousand euros aiming to keep GOR undiminished is calculated in Table 4. It is obvious that growth of turnover leads to a reduction in wages in order to keep profitability. This is because the growth of TPE increases ALP considerably less than the growth of AC.

5. Conclusions

The apparent labour productivity varies among European countries significantly and the highest ALP (in Denmark) exceeds the lowest ALP (in Bulgaria) more than eight times. ALP is growing slower than the cost of personnel in countries with lower productivity. A relatively small share of personnel costs in production and in GVA as well as a significantly higher gross operating rate give the basis to increase wages further, thus enhancing the problem of stagnant ALP in the less productive countries.

Our research shows that personnel costs have a positive impact on apparent labour productivity. The ARDL bound test shows that there is a long-term relationship among these indicators. A 1% increase in personnel costs has a 1.7776% long-term effect on apparent labour productivity assuming that the impact of other indicators on ALP is not significant. The analysis shows that there are no significant differences in European countries in the impact of AC on ALP, but it varies over time.

Companies often avoid increasing wages, as it decreases the profit of the company, and seek to increase the turnover in order to reduce the cost of goods sold. This research shows that growth of AC does not necessarily mean lower profitability. Growth of AC by 1 thousand euros increases GOR by 0.6–4.6% if turnover per person employed is stable. Turnover growth has a positive effect on ALP but a negative impact on GOR. A 1% increase in turnover per person employed has a 0.0565% long-term effect on apparent labour productivity. Thus, the impact of turnover on ALP is notably lower than the impact of AC on ALP.

As the growth of ALP is slowing in all European countries, it may take many years for lower productivity countries to catch up with other European countries, and it needs significant changes and efforts. First of all, countries are different in the technology used, level of process automation in the companies. Second, managers of manufacturing companies seek to increase their profits and increase wages to a limited extent. Knowing that, employees are not keen to be much more productive. Thus, not only an increase in wages, but also growing investments in new technologies can lead to faster growth of productivity in less productive countries. However, it can take much more effort and time to change the mentality of managers.

This research contributes to the existing literature that investigate the link between productivity and wages as well as encourage the discussion how to solve the problem of slow growth of labour productivity. The results of this research can be useful for employers and policymakers who try to find a solution to increase labour productivity especially in less productive countries.

This research does not analyse the impact of level of technology, investment in technology, as well as other indicators, which can influence the apparent labour productivity. It does not take into account the changes in wage due to the changes in type and quality of specialists needed for companies because of the changes in technology. However, the results of this research prove that increase in wages, in spite of the reasons for that, have a positive impact on apparent labour productivity.

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