

Do Wages Follow Productivity? Evidence from European Countries

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Abstract. *Economic theory assumes that factors are paid according to their marginal productivity, however the empirical validity of this hypothesis has been questioned in some of the literature. We use data from Eurostat to examine the changes of labour remuneration and labour productivity during the period 2004-2020 in a panel of European countries. The results from the panel regression analysis confirm that in general there is a strong link between labour productivity and the compensation of employees. However, exploratory analysis shows that the sample is characterized with internal heterogeneity. Growth is higher in Central and Eastern Europe and for some countries from the region there is decoupling of productivity and labour remuneration. The latter has seen stronger growth, with the exception of Romania, where in real terms productivity has been growing faster than wages. Possible explanations of the decoupling are catching up and convergence, integration in the world economy, factor mobility, difference in labour market institutions and excessive labour demand, but the present research is inconclusive.*

Keywords labour productivity, compensation of employees, wages, European countries

Introduction

Labour, its productivity, and its remuneration have been of interest to economists ever since Economics established itself as a separate field of study. Adam Smith set out to answer the question “what is the source of wealth”. According to him, the main factor that determined the wealth of nations was the labour of its people and he gave special attention to productivity of labour, which depended on the level of specialization and the size of the market (Smith, 1904). Another classical economist - David Ricardo – had the goal of explaining the laws that regulate the distribution of income and wealth among the classes of society and the owners of the factors of production, including labour (Ricardo, 1821). Its importance for the classics was such that they made labour the basis of their theory of value. Even though this theory was rejected during the marginalist revolution of the neoclassical economists, the question of the link between labour productivity and the payment of labour was still examined in the marginal theory of distribution.

To this day it continues to be a topic of political, economic, philosophical, ethical, and practical dimensions. It is a question of fair pay, of winners and losers from institutional change, globalization, and technological development. In the context of European integration the link between productivity and wages thus is important for the process of economic and social cohesion and for the reduction of disparities in the level of development among the member states and its regions. While the European Union has a number of policies and instruments to help the poor and less developed regions, economic convergence is above all the result of the organic integration of the economies of the new member states into the European and the world economy and the transformations that follow from it. Successful convergence is a prerequisite for the political stability of the EU and the smooth functioning of the Economic and Monetary Union. Increases in productivity, being the main driver of sustainable growth in the long term, it is important to examine to what extent they translate into increases in wages and the standard of living.

The main research question of the paper is to establish whether the compensation of employees has followed the increases in productivity in the last two decades or whether there is

decoupling. If yes, in what direction and does it affect all countries in the same way and what could be the possible reasons for it.

Literature review

Theoretical basis for the link between labour productivity and its remuneration

The view that labour productivity is related to its wages is intuitive, morally acceptable to many people, and with the emergence of the neoclassical school it has been placed on theoretical foundations within the more general methodological framework of marginalism. John Bates Clark's theory of the distribution of income takes precedence over the theories of classical economists because of its universal character. The classical theories provide different explanations for the existence of rent, profit and wages, while Clark showed that the incomes received by land, capital and labour correspond to their marginal productivity (Clark, 1908). In the short run, when the quantity of other factors of production is fixed, in the presence of diminishing marginal returns, the firm has an incentive to hire additional workers until marginal labor revenue converges to marginal factor costs, that is, to the workers' wages. If labour productivity increases, other things being equal, this creates an incentive for the firm to increase its demand for labour until a new equilibrium is reached. If the firm hires less than the equilibrium quantity, it forgoes a profit that remains unrealized. If it hires more than the equilibrium quantity, it will realize a loss. An important assumption here is that the firm operates on competitive markets – both the input markets and the final goods markets. Additional assumptions are that the production function is continuous and homogenous and that it is technically possible to measure the contribution of each worker (there are no indivisibilities in production).

In the middle and in the long term there is no marginal productivity, as from the point of view of economic analysis other factors of production also change in quantity. In theory it is possible to measure the productivity of labour at any given capital capacity, but entrepreneurs are not limited to varying the capacity utilisation of capital by employing more or less labour, they can change the capacity by employing more or less physical capital. And if the technology allows it, to substitute capital for labour and to choose different modes of production. The payment to labour then depends not only on its productivity, but also on the productivity and price of the other factors of production. In the very long run, if there is a secular trend of expensive labour, entrepreneurs may invest in the acquisition of new, labour saving technologies, which may push wages down. On the other hand, firm owners may invest in improving the skills of their workers, that is, in human capital. And while it may seem that in the long-run the productivity-wages nexus is not as clear cut and could go in both directions, a perfect competitor makes a normal profit in the long run and rising costs (including labour costs) can get it out of business. Which is why wages in principle shouldn't deviate significantly from productivity over long periods of time, given perfect competition.

Reasons for decoupling of wages from productivity

Competition is not always perfect, however, and under these conditions wages deviate from productivity. Firms still follow the optimisation rule to hire labour up to the quantity where the marginal factor costs are equal to the marginal revenue, but in the case of a monopolist on the market for final goods the value of the marginal product exceeds the marginal revenue of the product, which is what labour is paid. With monopsony on the labour market the firm also hires up to the point where marginal revenue of labour is equal to marginal factor costs, but the upward sloping factor supply curve leads to wages that are less than these costs. Classical monopsony of

this kind rarely exists, but the specifics of the labour market and its spatial and sectoral segmentation proliferate a certain degree of monopsony power to a large number of employers (Manning, 2021).

The decoupling of wages from productivity can go in another direction, more favorable to workers. There is a class of models of efficiency wages (Shapiro & Stiglitz, 1984), which treats higher than the equilibrium market wage as a disciplining device for workers. It motivates them to be more productive and less prone to shirking, as the cost of losing their jobs is higher. An additional stimulus for firms to maintain such wages is that they also keep the turnover of personnel lower.

Sticky wages (or wage rigidities) is a New Keynesian concept which refers to the observation that nominal wages are usually much more likely to go upwards than downwards. The neoclassical view is that during economic crises wages fall alongside prices to clear the market, but for a number of reasons this doesn't happen (among them efficiency wages, but also implicit contracts and the insider-outsider model. See Haley (1990)). So, if there is a fall in productivity (presented not as physical output but in value terms), whereas wages are unchanged, it leads to decoupling of wages from productivity.

Countries, especially those in the process of catching up and converging to the core (such as the countries from Central and Eastern Europe) may have some members of the labour force benefiting from the Baumol effect. According to Baumol (1967) there are two sectors in the economy - with rapid productivity growth and with slow or no growth. A rise in productivity in the former sector leads to a corresponding rise in wages in the latter. In the second sector there is no increase in productivity, but this does not mean that wages will remain the same. Since workers in the second sector will be attracted by higher wages in the first sector, employers in the second sector will also be forced to increase wages in order to retain their personnel. While this accelerated wage growth will only happen in some sectors, on the aggregate level it will appear to be a general trend in the economy. Typically, manufacturing is considered to be the sector with higher productivity growth, whereas services and activities that are difficult to automate and rely on the use of more labour have slower growth.

Bargaining power can move wages in both directions. Especially if there are imperfect market structures, there are rents for redistribution. It is generally considered that strong unions and centralized collective bargaining give a more favorable position to the workers. In fact, Kügler et al (2018) attribute the stagnating wages in the last twenty years in Germany relative to France (despite similar productivity trends) to the decentralization of the wage-setting process in Germany. For historical reasons different countries have differing labour institutions and modes of bargaining (centralised, sectoral or individual) and it could lead to disparities in the overlap of productivity and labour remuneration when doing cross-country comparisons.

Another factor with undetermined effect is trade openness. The expected effect on wages depends on the type of the country and on its relative factor endowments. According to the standard neoclassical model of trade, when a country opens to trade this will cause redistribution of income from the owners of the factor that is relatively scarce to the factor that is relatively more abundant (the Stolper-Samuelson theorem). So, in countries which are relatively rich in capital, we can expect wages to fall, whereas countries that are relatively abundant in labour will have an increase in wages. However, this model assumes that factors are immobile between countries. If we relax the assumption, the factor that can move more easily will be in an advantageous position. The international element is important in the context of factor mobility in another way. It can lead to

increased competition on the labour market in the form of inward migration and exercise downward pressure on wages even if there is no change in the productivity of the labour force.

This is related to productivity in a slightly different aspect of a definitional and more essential character. Is productivity a physical or a value category? When increased competition on the labour market pushes wages down, workers *per se* might remain as productive as before in terms of physical output. Treating productivity as a value category suggests production, technical and allocative efficiency all at once. A company, which innovates and improves the technology of production for goods that are going out of fashion or for goods with falling demand, will actually become less productive. The ability to adapt to changing market conditions is as important for productivity on the level of the firm as its technological prowess (see Penchev (2022) for the concept of the agile enterprise).

Previous empirical research

Previous research varies but for the purposes of this paper we will examine it selectively in two broad categories – that examine the link between productivity and labour remuneration in developed countries and that examine it in the countries of Central and Eastern Europe. This overview only surveys cross-country research with the focus on whether decoupling exists or not.

There is a relatively rich literature on productivity and wages for the developed countries with the contention that wages have lagged behind productivity growth in the last decades. Compagnucci et al. (2021) use OECD data for the period 1970-2015 to study six advanced economies and find a structural break in the 1990s which leads to decoupling of labour compensation from wages, attributed to a structural change towards a service-oriented economy.

Using data from OECD sources, Meager & Speckesser (2011) establish that wages and productivity are clearly related for the period 1995-2009, but wages grew below productivity in most European economies, USA and Canada (especially Germany, and outside Europe – Japan). Countries from Eastern Europe experienced fast growth in both wages and productivity.

Paternes Meloni & Stirati (2021) estimate the decoupling effect of labour compensation from productivity for a panel of 22 high-income economies for the period 1970–2018. They use five year averages to reduce cyclical fluctuations and find that growth rate of productivity affects that of the real average compensation with a coefficient of 0,55. When not averaging over the cycle and using yearly data, the coefficient takes values around 0,4, being higher at the beginning of the period and falling in the last two decades. Through different specifications of their model and the inclusion of various control variables the authors reach the conclusion that the decoupling is the result of the weakening of pro-labour institutions and that trade openness and international capital mobility also have a negative effect on labour compensation.

While not a cross-country study, the work of Feldstein (2008) is included for methodological reasons. He contends that productivity and total labour compensation in USA for the period 1970-2006 followed approximately the same annual growth rate. According to him, research that finds slower growth of wages, compared to productivity, does not take into account that wages form only part of the total labour compensation. While wages have grown at a slower rate, this has been compensated by the increased share of fringe benefits. Another reason for the results is the use of the same deflator for productivity and labour compensation. Wages should be deflated with the producer price index, because firms pay wages according to marginal revenue and they are interested in the price they get, which is often not necessarily the retail price. Productivity should be deflated with CPI.

Schröder (2020) concentrates his research on the countries from Central and Eastern Europe plus Germany and Austria (because they are closely related to the economy of these countries) using EU KLEMS data from the 2019 release for both labour compensation per worker and gross value added (GVA) to calculate productivity. He also uses the Structure of Earnings Survey from Eurostat for median wage in five sectoral aggregates of the economy. He finds great variation in wage-productivity decoupling across European countries. Bulgaria, Estonia, Latvia and Lithuania experience faster growth in labour compensation at the level of the total economy. On the other hand Romania experiences the reverse. The explanation for the differences in performance is attributed to differences in industry structure and changes in the labour share.

Methodology

Data and choice of variables

For the purposes of the study we present productivity as close as possible to the definition by Eurostat, namely that it is real gross value added (GVA) divided by total employment (persons employed and employees). Because the ready-made statistics doesn't have the indices and the sectoral aggregation to fit our purposes, we calculate productivity from the "National accounts aggregates by industry [nama_10_a64]" and "National accounts employment data by industry [nama_10_a64_e]", both of which are annual (the codes for the sector used for the sectoral segmentation of the data further in the paper are given in the table in the Appendix). As the other variable, instead of wages we use compensation of employees, because it captures total remuneration to employees and includes not only wages, but also social security contributions by the employers (OECD, 2010, p. 56), thus overcoming the methodological criticism to using just wages, levied by Feldstein (2008). When we calculate productivity per person we divide GVA to all people employed because it is created by both hired labour and the self-employed. But when calculating the average compensation per employed we calculate it by dividing only total compensation of labour to the number of hired labour. We assume that the earnings by the self-employed would not be this much different from the wages of the employed. While it is an imperfect approximation, it is better than the alternative to use as denominator total employment, because in the context of cross-country studies and international comparisons there can be a large variation between the ratio of employed to self-employed in the different sectors of the economy.

The calculated variables are nominal and they have to be deflated to be presented in real terms. This is done using the annual rate of change of the harmonized index of consumer prices "HICP - annual data (average index and rate of change) [prc_hicp_aind]". This index is preferred because of its availability, covering large number of countries and long time periods. The value for each year is deflated, which allows us to calculate the real annual growth rate for the respective year and then the individual growth rates are compounded, allowing the calculation of the cumulative change for the period 2004-2020. The starting year was chosen as it was the year of EU accession for many Eastern European countries.

Other variables were included as controls in the regression equation. The relative scarcity of labour which *ceteris paribus* might drive upwards the demand for labour and its payment is "Unemployment by sex and age (1992-2020) - annual data [une_rt_a_h]" from the Eurostat database. Openness to trade is represented by the indicator "Exports of goods and services (% of GDP)" from the World Bank's set of World Development Indicators. And finally, labour market institutions and the potential bargaining power is given by Fraser Institute's "Economic Freedom of the World" database, more specifically indicator "5.B. (iii) Centralized collective bargaining" where the lowest value (1) means that bargaining is fully centralized and 10 means that wages are freely determined by the market.

Instruments of analysis

We use a panel regression with individual fixed effects of the following form:

$$\Delta \ln(\text{compensation}) = \Delta \ln(\text{productivity}) + \Delta \text{unemplrate} + \text{exportoGDP\%} + \text{flexiblewage}$$

where the dependent variable $\Delta \ln(\text{compensation})$ is the log difference of the compensation per employee in real terms, $\Delta \ln(\text{productivity})$ – the log difference of productivity per person in real terms, $\Delta \text{unemplrate}$ – the annual change in the unemployment rate, $\text{exportoGDP\%}$ – the share of exports to GDP in percentages, and flexiblewage is the index of centralised collective bargaining. As the regression equations were characterized by serial correlation, indicated by the results of the Durbin-Watson test for serial correlation in panel models, further transformations were made to get robust covariance matrix estimators following the procedure, described in Arellano (1987). Only the coefficients after the transformation are presented in the regression results on Table 1. All data is processed with *R* and *Rstudio* and the panel regression employs the package *plm* for panel data analysis. The data include European Union countries as of 2023, with the exception of Ireland. The reason for this is that many large international corporations have their headquarters in the country, which increases its GDP, but it injects bias as to the GDP's real dimensions and has a very atypical distribution of the shares of labour and capital (Honohan, 2021). Ireland, however, is included in one of the graphs further down just to confirm that it is a special case. Apart from the EU countries, due to data availability in the sample are Norway and Iceland.

Results and discussions

The results from the panel regression are presented below:

Table 1. Panel regression results

	Dependent variable:		
	(1) (All countries)	(2) (CEE countries)	(3) (Not CEE)
$\Delta \ln(\text{productivity})$	0.588*** (0.063)	0.634*** (0.063)	0.422*** (0.084)
$\Delta \text{unemplrate}$	-0.002* (0.001)	-0.003* (0.002)	-0.001 (0.002)
$\text{exportoGDP\%}$	-0.0004* (0.0002)	-0.001 (0.0004)	-0.0001 (0.0001)
flexiblewage	0.004 (0.003)	0.015* (0.009)	-0.002 (0.003)
Observations	476	187	289
R ²	0.444	0.572	0.247
Adjusted R ²	0.405	0.538	0.191
F Statistic	88.532*** (df = 4; 444)	57.575*** (df = 4; 172)	22.004*** (df = 4; 268)

Note:

*p<0.1; **p<0.05; ***p<0.01

Source: Authors' own research.

The table shows three regression equations with identical specification, but each of them is run on different panels of data. The first equation uses data from the full panel of 28 countries. The second is run on the sample of countries from Central and Eastern Europe, and the third equation uses data from the remaining countries in the full panel - the so-called old member states plus Norway and Iceland. The reason for this split is the inclusion of the control for the openness of the economy with the indicator *exports to GDP ratio*. As was already mentioned above, the expected effect on labor compensation would depend on the initial condition of the country, and we could assume that countries from Western Europe are relatively better endowed with capital (hence negative effect), whereas those from Eastern Europe are relatively better endowed with labour (hence positive effect on the dependent variable).

All the regressions show statistically significant coefficients for the changes in productivity. For regression (1) a 1% increase in productivity is associated with a 0,58 % increase in labour compensation (very similar to the findings of Paternesi Meloni & Stirati (2022)) . The effect on the compensation of labor is stronger in Central and Eastern European countries (0,63%) compared to the others (0,42%). This is according to preliminary expectations, as CEE countries start from a lower base and grow faster. Not only this, but the fast growth in the tradable sectors leads to growth in the compensation of labour in other non-tradable sectors in line with the predictions of the Baumol effect.

Apart from that, the countries from CEE experience a weakly significant, but still present, positive effect on the compensation of labour from the fall of unemployment. This effect is absent in the third regression. Trade openness is also statistically significant albeit weakly for the panel with all the countries. Higher openness is associated with negative growth in labour compensation, which may be the result of a disciplining effect on local labour by foreign competition. A slightly surprising result is the positive effect of the more flexible wage bargaining on wages (despite the weak significance of the coefficient).

Behind the aggregated data in the regression panels lays a more diverse picture, which can be seen on Figure 1. We can confirm the observation by Schröder (2020) that Bulgaria, Romania and the Baltic countries experience much higher growth in both productivity and compensation of employees. Romania is the exception from the group in that while it tops all the rest on both indicators, growth in labour compensation is significantly lower than growth in productivity (second only to Ireland in this respect). The most positive achievers in this respect are Latvia and Bulgaria. From the West European countries only Norway has a double digits decoupling in favour of labour compensation at the end of the period. In the beginning of the period there doesn't seem to be any significant decoupling for the countries from this group. It comes immediately or several years after the end of the financial crisis. For Bulgaria in particular it is visible how the trend in labour compensation growth continues unchanged, but there is a structural downward break in the productivity trend in 2012-2013.

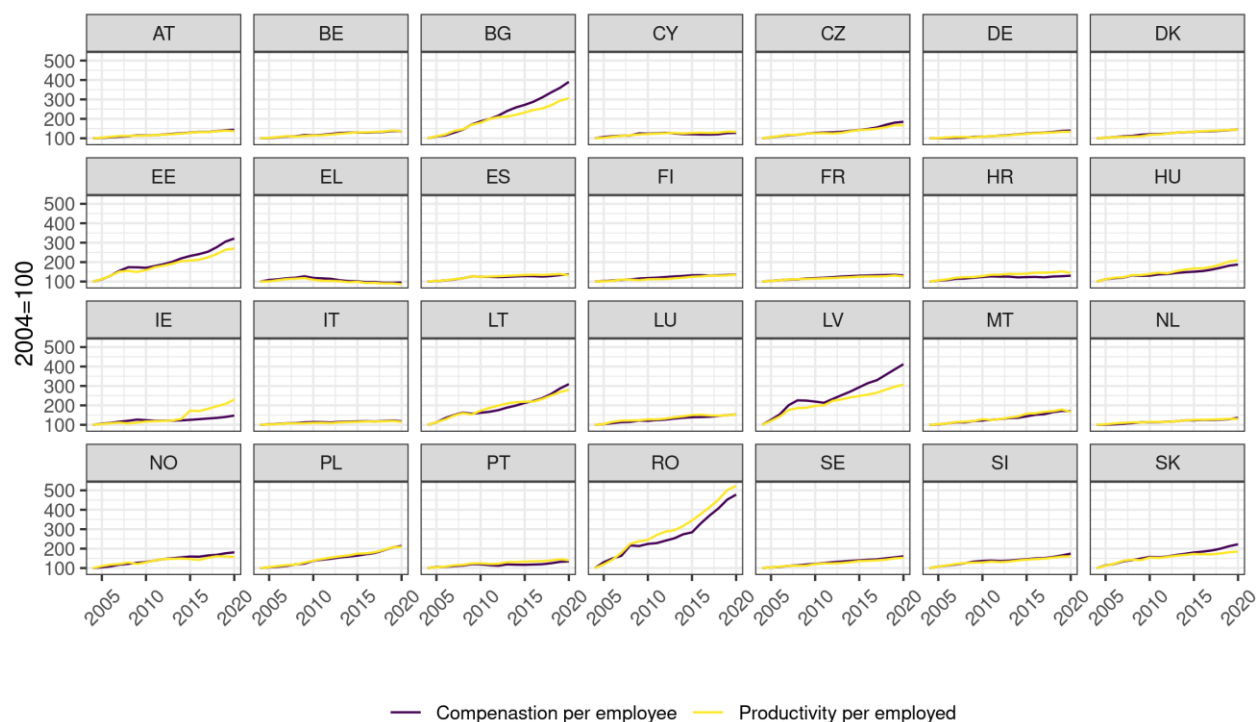


Figure 1. Individual country growth in compensation per employee and productivity per employed, for the period 2004-2020 (2004=100)

Source: Eurostat; author's own estimation.

When it comes to more detailed analysis based on pairs of country-sector growth (not shown on any graph) Romania is the undoubted champion. Of the top 10 pairs of cumulative increase in productivity, increases in sectors in Romania occupy seven of the positions. Romania is doing quite well relative to other countries on the indicator of labour compensation growth, having half of the top 10 country-sector pairs, but relative to its own productivity growth in sectors, it is probably the worst performer.

It is interesting to see (Figure 2, Ireland is excluded) how strong is the nexus between productivity and labour compensation aggregated by sectors with cumulative data for growth in 2020 (base year 2004=100). Over the long run (2004-2020 change) total for all sectors of the economy the link seems to be much more statistically meaningful than the panel regression results using yearly changes, as the $R^2=0,91$ is very high. Sectors, where the state is usually involved as a big employer (N, O, Q), have $R^2 \geq 0,90$. But some sectors which employ a sizable share of the labour force and are driven mostly by private imitation such as C, G, and I also have high coefficients of determination. Albeit differences in the magnitude of the changes, the variations in labour compensation are almost entirely explained by the effect that productivity has on it. For example, C (manufacturing) has seen much higher growth in both productivity (index value of 192 on average in 2020) and compensation (index value of 202) than I (Accommodation and Food Service Activities) – the sector with the lowest increase in productivity (an average index value of just 117 in 2020), and smaller increase than any other sector in compensation (average index value = 168), but the relative increase of compensation over productivity in the sector (decoupling towards higher wages) puts it in much better position to other sectors. Another positive trend, visible from the data of cumulative growth over 2004-2020 is that only in 7 out of the 21 sectors

the average increase in compensation has been less than that of productivity (see Figure A.1 in the Appendix for a box plot graph with summary statistics). Of all the 574 pairs country-sectors for which we have data for 2020, cumulative growth over 2004-2020 in labour compensation exceeds cumulative growth in productivity in 62% of the pairs.

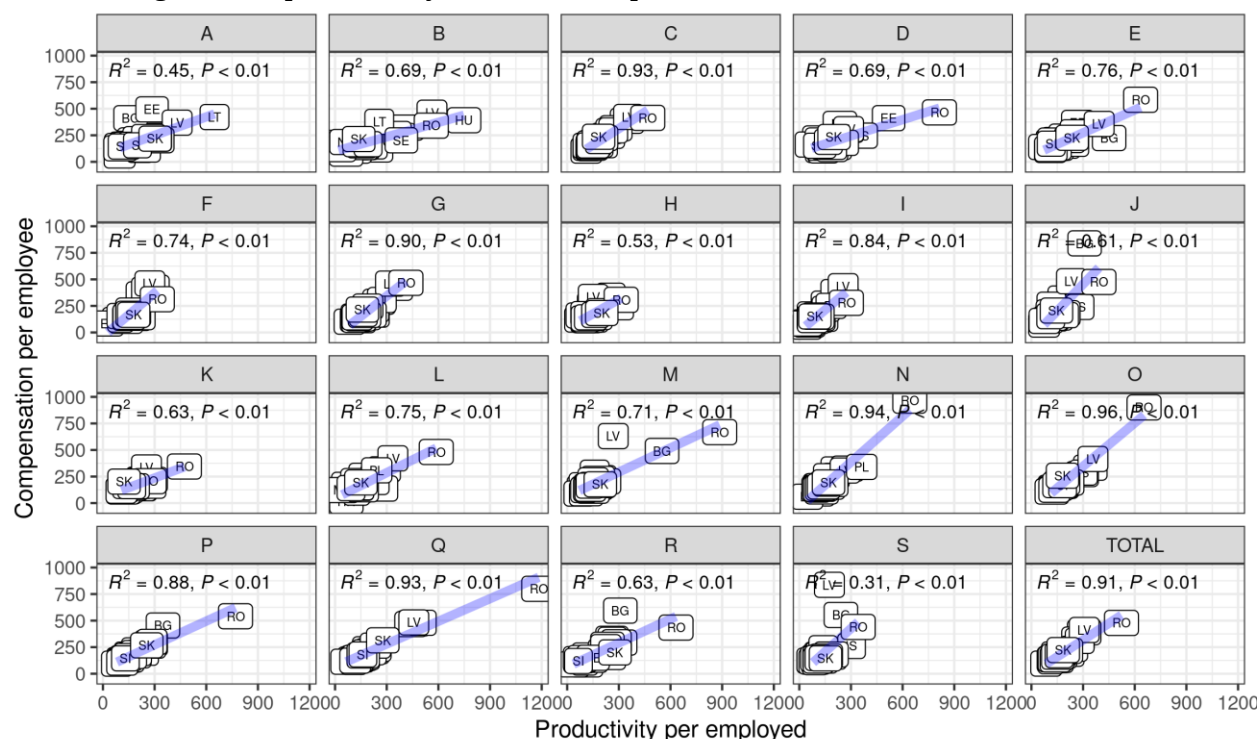


Figure 2. Compensation per employee versus productivity per employed in 2020.
Cumulative growth for the period 2004-2020 (2004=100)

Source: Eurostat; author's own estimator.

Conclusion

The present research confirms some results from previous research of other authors. Productivity and labour compensation dynamics exhibit heterogeneity across Europe, with countries from Central and Eastern Europe growing significantly faster, as confirmed by the visual exploratory analysis. Our panel regression shows that in the region changes in productivity elicit changes of higher magnitude in labour compensation compared to countries from other parts of Europe. Especially for Bulgaria and the Baltic countries there is decoupling towards higher compensation. The long-term nexus between productivity and labour compensation appears to be stronger than that in the short term, but it is still dependent on the economic sector (in C, G, I the link is more pronounced). The controls in the regression model do not conclusively explain what might be the reason for the disparities in the dynamics of the two indicators across Europe. Likely candidates would be labour market conditions (from the regression model) and structural differences in the economy (from the exploratory analysis). Possible areas of future research would involve the use of dynamic panel models and specification of better regression controls.

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Appendix

Table A.1. NACE Rev. 2 Sectors

<i>A</i>	<i>NACE SECTION A - AGRICULTURE, FORESTRY AND FISHING</i>
<i>B</i>	NACE Section B - Mining and Quarrying
<i>C</i>	NACE Section C - Manufacturing
<i>D</i>	NACE Section D - Electricity, Gas, Steam and Air Conditioning Supply
<i>E</i>	NACE Section E - Water Supply, Sewerage, Waste Management and Remediation Activities
<i>F</i>	NACE Section F - Construction
<i>G</i>	NACE Section G - Wholesale and Retail Trade
<i>H</i>	NACE Section H - Transporting and Storage
<i>I</i>	NACE Section I - Accommodation and Food Service Activities
<i>J</i>	NACE Section J - Information and Communication
<i>K</i>	NACE Section K - Financial and Insurance Activities
<i>L</i>	NACE Section L - Real Estate Activities
<i>M</i>	NACE Section M - Professional, Scientific and Technical Activities
<i>N</i>	NACE Section N - Administrative and Support Service Activities
<i>O</i>	NACE Section O - Public Administration and Defence, Compulsory Social Security
<i>P</i>	NACE Section P - Education
<i>Q</i>	NACE Section Q - Human Health and Social Work Activities
<i>R</i>	NACE Section R - Arts, Entertainment and Recreation
<i>S</i>	NACE Section S - Other Service Activities
<i>T</i>	NACE Section T - Activities of Households as Employers
<i>U</i>	NACE Section U - Activities of Extraterritorial Organisations and Bodies

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Source: European Communities. (2008). Statistical classification of economic activities in the European Community NACE Rev. 2. ISBN 978-92-79-04741-1.

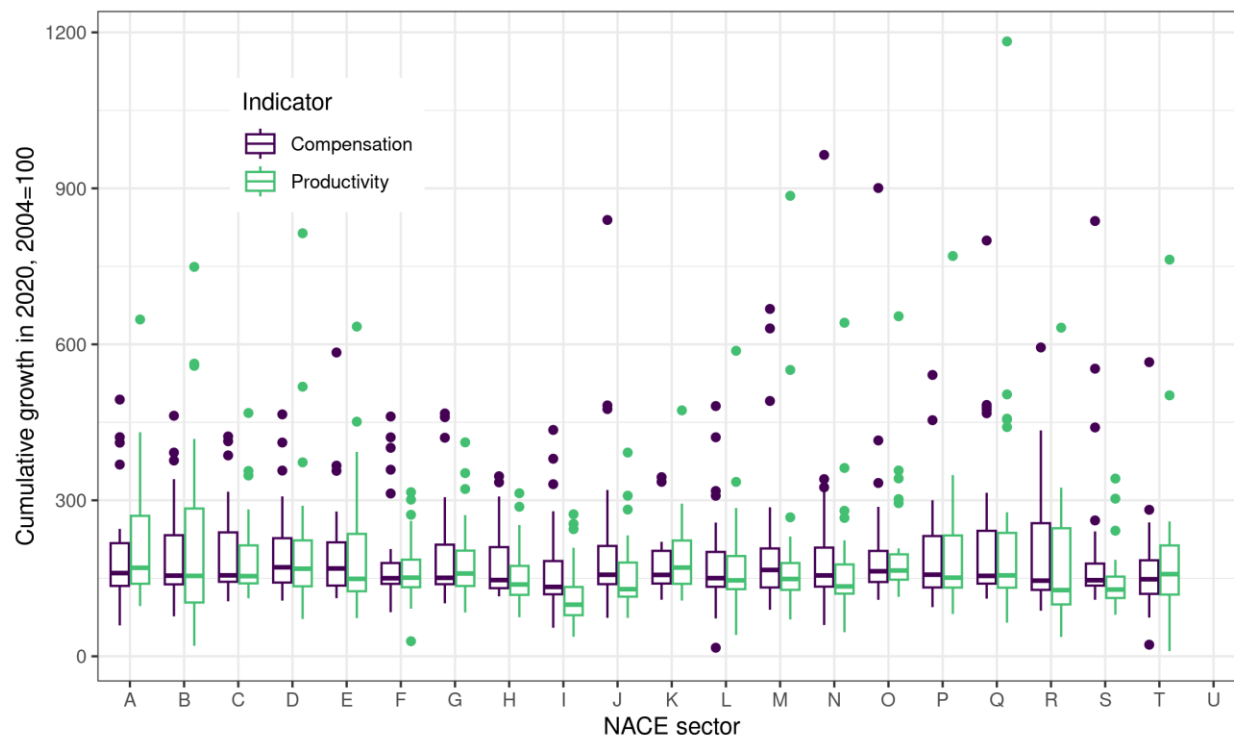


Figure A.1. Summary statistics of compensation per employee and productivity per employed in 2020. Cumulative growth for the period 2004-2020 (2004=100)

Source: Eurostat; author's own estimator.