

# A Statistical Analysis of Productivity and Compensation of Labor in the EU

Vít Pošta<sup>1</sup> | *Czech Technical University in Prague, Prague, Czech Republic*

## Abstract

The presented paper first discusses possible hypotheses on the relationship between compensation and labor productivity, arguing equiproportionality between the two cannot be considered a viable economic hypothesis. The main part of the analysis focuses on the EU countries, presenting a detailed view of the developments in the past twenty years from the point of view of both nominal and real unit labor costs. It shows that the relationship between compensation and labor productivity varies greatly among the economies and no general conclusions may be drawn. In case of the Czech Republic the estimates show that responsiveness of compensation to productivity is relatively high as compared with the EU panel and the growth of compensation surpasses the growth of productivity in both nominal and real terms as compared with the EU or Germany as a benchmark.

## Keywords

*Compensation, labor productivity, statistical analysis, unit labor costs*

## JEL code

*F00, J24, J31*

---

## INTRODUCTION

Recently there has been a rather great deal of popular discussion on the issue of development of productivity and compensation of labor in the Czech economy in relation with the rest of the EU, especially Germany. It is a rather heated topic in the USA as well. Naturally, this economic question is of significant interest to the general public, which is why it is, for the most part, covered in less formal discussions and analyses outside the scientific journals. Compensation of labor is understood throughout this paper in accordance with the system of national accounts ESA 2010, Eurostat (2013), as the total remuneration, in cash or in kind, which is paid by employers to employees in return of work. It consists of both wages and social contributions paid by employers.

The presented paper aims at bringing in some evidence on this issue from the perspective of the EU economy and with a special focus on the Czech economy in its last section using a formal statistical analysis. The form of the analysis is well positioned in the theoretical economic framework, which is presented together with findings in other relevant literature directly after this introduction. Given this starting point, the next section presents information on how the various measures were constructed and which data was used. The third section shows the result for the whole EU economy. While the approach is based on theoretical reasoning, the aim of this section is not an estimation of an economic model but rather economic analysis of the presented data. The fourth section focuses on the Czech economy,

---

<sup>1</sup> Czech Technical University in Prague, Kolejní 2637/2a, 160 00 Prague, Czech Republic. E-mail: vit.posta@cvut.cz, phone: (+420)224353166.

especially giving some estimates of the responsiveness of compensation of employees to productivity in comparison with the EU. The key results are summarized in the last section of the paper.

## 1 ECONOMIC THEORY AND EMPIRICAL ASSESSEMENT OF THE RECENT SITUATION

The standard starting point of all the analyses on the relationship between productivity and compensation is that compensation should somehow correspond to productivity. However, to reach defensible conclusions, it must be argued precisely what nature this correspondence actually may and, on the other hand, may not represent.

In absolute terms, compensation reflects productivity equiproportionally only under the conditions of perfect competition, more precisely it is the equality between wage rate and marginal productivity of labor, a theoretical abstraction out of touch with the real world. A distinction between the short run and the long run is unnecessary in this case as the same conditions of perfect competition imply swift adjustments to changes in economic conditions. It is readily verifiable, e.g. Gravelle and Reese (1992), that when monopoly power of any strength is present the level of compensation ceases to be determined solely by productivity. No other market imperfections, more below, are necessary for this result to occur. Thus, to investigate the relationship between compensation and productivity, the idea of compensation being equiproportional to (labor) productivity must be abandoned right at the beginning because it is not an implication of any economic theory which might attempt at describing economic reality.

A good reference to the complexities of the relationship between compensation and productivity is D'Auria et al (2010), who, in their description of the production function methodology of potential output estimates, lay out the theoretical framework for the estimate of structural unemployment, which rests on a mixture of all the key theoretical approaches to labor market modeling, and closely follows the exposition of Mortensen and Pissarides (1999). From the point of view of labor supply it may be reasonably expected that the compensation is determined by reservation wage, labor productivity, unemployment rate, and bargaining power. The demand side of the model shows that the sole determinant of wages is labor productivity. The exact meaning of the reservation wage depends on the theoretical approach. From the point of view of the neoclassical theory it is derived from the utility of leisure, while in the search model, see Pissarides (2000), it is related to alternative income in form of unemployment benefits or the value of household non-market production. The role of labor productivity is also closely linked to the search theory while it is absent in neoclassical view of the labor market, which in its typical presentation rests on the assumptions of perfect competition. This more complex view of the labor market clearly shows that labor productivity is only one of potentially many determinants of compensation and, thus, there is much more than just the fact of monopoly power which precludes any meaningful analysis of compensation and productivity based on the idea of equiproportionality between the two.

Reviewing some relevant empirical findings, Pessoa and Reenen (2013) practically refuse the hypothesis of decoupling of compensation from labor productivity in the USA and in the UK when average figures are considered. Nevertheless, they point to sharp increases in income inequality since the 1970s. They state that the top 1% of the US households receive 19% of income while in the UK it is 15%.

Schwellnus et al (2017) analyze the OECD countries from a similar perspective as Pessoa and Reenen (2013) did in case of the USA and the UK. They show that between 1995 and 2013 the ratio of median wage to average wage declined in the OECD by app. 2%. In the Czech Republic the decline reached approximately 4%, similarly to Poland, and, on the other hand, a significantly lower decline in comparison with Hungary and the USA, where it amounted to a little over 8%. The share of labor in GDP (gross domestic product) decreased slightly in the OECD between 1995 and 2014. In the Czech Republic the share of labor increased by app. 3% especially due to an increase of labor share in services (non-market services were excluded from this analysis), which was very similar to the development in Slovakia, while in Poland and Hungary there were declines in the labor shares, much more significant in Poland,

and in both economies especially because of decreases in labor shares in manufacturing. They conclude that on average there has been decoupling of wages from labor productivity in the OECD countries, however, they refute the idea that it might be solely due to the effects of globalization and technological change. Based on the analysis, they claim that local policies have played a significant role in the process.

Nikulin (2015), focusing on Central and Eastern European countries, shows that there is a strong relationship between the evolution of wages and labor productivity in the Czech Republic, Estonia and Hungary and a somewhat weaker one in case of Slovakia and Slovenia. He also shows that in the Czech Republic, Slovakia and Slovenia wages increased more rapidly than labor productivity.

Galgóczy (2017) argues that generally the Central and Eastern European countries saw some under proportional increases in wages as compared to increases in labor productivity and claims that higher increases in wages would not harm the competitiveness of these economies.

This is a point which deserves a clearer exposition because it is closely related to the interpretation of the data on labor productivity as well as unit labor costs. Myant (2016) argues that the standard interpretation of unit labor costs, due to labor productivity, and its implications for competitiveness are inherently incorrect given the measurement problems. The key problems are related to how the prices of final output are estimated especially in case of non-market output of government and non-profit institutions and production in multinational companies. National accounts, see Eurostat (2013), resort to costs method in case of public services, whose result is dependent on the wage level of the particular country, and in many cases of the domestic production within multinational firms the prices are set in relation to comparable products produced in the economy. In both cases the relatively lower price and wage level of less developed economies automatically translates into estimates of lower productivity. In case of production within multinational firms, internal pricing policy which might deliberately undervalue the final output of production within a particular economy also plays a role. These facts greatly complicate comparison of absolute levels of compensation and productivity. Myant (2016) also contests the usual interpretation of unit labor costs, a ratio of average compensation (wage) to average productivity, as a measure of competitiveness. Such a typical analysis may be found for example in the relatively recent annual analysis by EC (2017). Beside the problems just mentioned above, the argument rests on the comparison of wages in the mother economy, typically much more developed, with much lower wages in the economy to which the multinational firms moved some parts of their production. Compared with the reallocation costs, unit labor costs would have to increase really significantly to pose any threat to competitiveness of the less developed economies.

## **2 METHODOLOGY AND DATA**

The analysis presented in the following sections focuses on both levels of and relative changes in labor productivity, compensation and unit labor costs as both views offer answers to different questions. As it was discussed above the hypothesis of equiproportionality between compensation and productivity has no economic merit, however, international comparison of the relation between the two casts some light on the question whether or not compensation to relative to productivity in some countries may be considered as lower or higher given a benchmark, which then serves as a starting point to pose the question why. Such a question in turn may only be answered by explicit economic modeling, which, however, should not rest on a uniform approach or panel analysis, which implicitly assumes the same structure and behavior of the labor markets of the countries in questions. Given this part of the analysis is focused on the whole EU, this paper does not aim at answering the question why in the sense of rigorous economic modeling.

As it is crucial to show in which countries the compensation might be considered as relatively low or high given their labor productivity relative to a benchmark, leaving out dynamics of the two would render the final picture incomplete. For example, in case the compensation in one country is found as relatively

low given its labor productivity, the responsiveness of compensation to productivity then indicates, beside other factors, how probable it is that such a state will prolong into the long run.

The data used in the analysis was retrieved from the Eurostat database and runs from 1995 until 2017. There is a risk of misleading information towards the end of the sample because the data from national accounts is subject to revisions, however, for the purpose of the methods used in the analysis the data is included because of the need of sufficient length of the data series. These were data series on: purchasing power parity in terms of gross domestic product (PPPGDP) and final consumption expenditure of households (PPPC), gross value added in nominal (GVAN) and real (GVAR) terms, deflator of final consumption expenditure of households (DEF<sub>C</sub>), compensation of employees (COM), total employment (TEMP) and employees (EMP). Total employment and employees are measured in persons. Given the annual frequency of the data little difference in values of the resulting variables, nominal and real unit labor costs, was expected when using hours instead of persons. This was verified by directly comparing the variables based on persons and hours. Only data based on persons is presented below.

Compensation of employees as well as gross value added were expressed in purchasing power standard (PPS) using purchasing power parities: purchasing power parities at the level of GDP were used for gross value added conversion because purchasing power parities for gross value added are not generally published and purchasing power parities at the level of household consumption were used for the conversion of compensation of employees into purchasing power standard. Both nominal and real compensation and productivities are expressed in PPS.

Average compensation in PPS ( $ACOMP^{PPS}$ ) was calculated as a ratio of nominal compensation of employees to number of employees:

$$ACOMP^{PPS} = \frac{COM / PPP_C}{EMP}. \quad (1)$$

Labor productivity in PPS ( $LP^{PPS}$ ) was calculated as nominal gross value added relative to total employment:

$$LP^{PPS} = \frac{GVA_N / PPP_{GDP}}{TEMP}. \quad (2)$$

Unit labor costs in PPS ( $ULC^{PPS}$ ) were calculated as a ratio of average compensation and productivity:

$$ULC^{PPS} = ACOMP^{PPS} / LP^{PPS}. \quad (3)$$

Both nominal and real unit labor costs are used in the analysis. To calculate real unit labor costs ( $RULC^{PPS}$ ), nominal compensation of employees were deflated by deflator of household consumption and real gross value added was used to compute productivity:

$$RULC^{PPS} = \frac{COM}{DEF_C} \cdot \frac{1}{PPP_C} \Bigg/ \frac{GVA_R}{TEMP} \cdot \frac{1}{PPP_{GDP}}. \quad (4)$$

This means that the issues of compensation and labor productivity are analyzed from the point of view of employees.

The benchmark in the following section is the average of the EU while in the section focused on the Czech Republic, for the purpose of comparison, Germany is also used as a benchmark.

### 3 THE EU PERSPECTIVE

The first look at the data is dedicated to nominal and real unit labor costs, Table 1 and Table 2, respectively, of the European economies. The benchmark used is EU28 and the selected years are

1995, 2005, 2010, and 2017. The sample of the countries is not the same: Bulgaria (BG), Malta (MT) and Romania (RO) do not enter into the analysis of real unit labor costs because in cases of Bulgaria and Romania there are inconsistencies between nominal values, their real counterparts and deflators in the beginning of the sample, which was apparent from the analysis of contributions to changes in real unit labor costs, which is presented further below. In case of Malta data on real gross value added as well as deflator of gross value added are missing completely.

**Table 1** Students enrolled in undergraduate studies at higher vocational

	<b>BE</b>	<b>BG</b>	<b>CZ</b>	<b>DK</b>	<b>DE</b>	<b>EE</b>	<b>IE</b>
1995	105	75	69	98	105	86	86
2005	106	77	82	101	99	81	84
2010	105	78	82	100	99	87	81
2017	107	109	86	98	103	98	53
	<b>EL</b>	<b>ES</b>	<b>FR</b>	<b>HR</b>	<b>IT</b>	<b>CY</b>	<b>LV</b>
1995	78	97	99	96	89	86	76
2005	93	101	102	109	92	98	76
2010	95	96	102	107	96	96	79
2017	90	95	106	97	92	93	94
	<b>LT</b>	<b>LU</b>	<b>HU</b>	<b>MT</b>	<b>NL</b>	<b>AT</b>	<b>PL</b>
1995	72	87	97	91	109	104	
2005	83	96	97	85	106	99	83
2010	75	93	87	85	106	101	87
2017	87	91	90	84	103	101	90
	<b>PT</b>	<b>RO</b>	<b>SI</b>	<b>SK</b>	<b>FI</b>	<b>SE</b>	<b>UK</b>
1995	99	85	115	71	92	83	84
2005	106	94	105	73	93	90	98
2010	96	85	113	73	99	91	102
2017	92	83	108	81	100	92	101

**Notes:** Countries: Belgium (BE), Bulgaria (BG), Czech Republic (CZ), Denmark (DK), Germany (DE), Estonia (EE), Ireland (IE), Greece (EL), Spain (ES), France (FR), Croatia (HR), Italy (IT), Cyprus (CY), Latvia (LV), Lithuania (LT), Luxembourg (LU), Hungary (HU), Malta (MT), Netherlands (NL), Austria (AT), Poland (PL), Portugal (PT), Romania (RO), Slovenia (SI), Slovakia (SK), Finland (FI), Sweden (SE), United Kingdom (UK).

**Source:** Own computation, data source: Eurostat

What can be assumed given this data is that when an economy experienced significantly different developments of nominal or real compensation given the development of productivity then significant

changes in nominal or real unit labor costs should be observed. Three crucial economic reasons for such changes may be readily established: (a) the catching up process of less developed economies linked to the preparations for EU entry and to the period after the actual entrance into the EU, (b) effects of strong economic expansion culminating in 2007, which translated into tighter labor markets leading to the possibility of higher compensation demands of employees, and (c) effects of strong economic downturn after 2008, which lead to not only far less tight labor markets but also to protracted periods of restrictive fiscal policy with both the factors resulting in the possibility of much slower compensation growth relative to productivity.

**Table 2** Real Unit Labor Costs in Purchasing Power Standard (EU28 = 100)

	<b>BE</b>	<b>CZ</b>	<b>DK</b>	<b>DE</b>	<b>EE</b>	<b>IE</b>	<b>EL</b>
1995	109	68	93	114	76	76	77
2005	108	85	98	101	81	85	96
2010	105	82	100	99	87	81	95
2017	107	87	98	107	101	54	87
	<b>ES</b>	<b>FR</b>	<b>HR</b>	<b>IT</b>	<b>CY</b>	<b>LV</b>	<b>LT</b>
1995	95	96	88	88	85	79	68
2005	102	101	108	93	97	76	87
2010	96	102	107	96	96	79	75
2017	89	106	95	90	90	97	91
	<b>LU</b>	<b>HU</b>	<b>NL</b>	<b>AT</b>	<b>PL</b>	<b>PT</b>	<b>SI</b>
1995	78	100	107	107		97	115
2005	88	102	105	100	82	106	109
2010	93	87	106	101	87	96	113
2017	98	93	99	99	92	90	107
	<b>SK</b>	<b>FI</b>	<b>SE</b>	<b>UK</b>			
1995	78	95	81	80			
2005	78	94	89	99			
2010	73	99	91	102			
2017	77	102	96	98			

**Notes:** Countries: Belgium (BE), Czech Republic (CZ), Denmark (DK), Germany (DE), Estonia (EE), Ireland (IE), Greece (EL), Spain (ES), France (FR), Croatia (HR), Italy (IT), Cyprus (CY), Latvia (LV), Lithuania (LT), Luxembourg (LU), Hungary (HU), Netherlands (NL), Austria (AT), Poland (PL), Portugal (PT), Slovenia (SI), Slovakia (SK), Finland (FI), Sweden (SE), United Kingdom (UK).

**Source:** Own computation, data source: Eurostat

Table 3 presents the contributions of changes in compensation and productivity to changes in nominal and real unit labor costs; averages for the whole sample are given in the table. If we single out the last quartile of the set of average growth rates of nominal and real unit labor costs in absolute terms, we arrive at the following result: the countries which experienced the most significant changes in nominal unit labor costs were: Greece, the United Kingdom, Lithuania, Latvia, the Czech Republic, Bulgaria and Ireland. With the exception of Ireland, in which case there was a decline in nominal unit labor costs due to mild increase in compensation and large decrease in productivity, in all the other cases the nominal unit labor costs significantly increased: in Lithuania, Latvia, the Czech Republic and Bulgaria due to a more rapid increase in compensation relative to increase in productivity.

**Table 3** Average Growth of (Real) Unit Labor Costs and Contributions

	<b>ULC</b>	<b>Compensation</b>	<b>Productivity</b>	<b>RULC</b>	<b>Compensation</b>	<b>Productivity</b>
BE	0.1	-0.2	0.3	-0.1	-0.4	0.2
BG	1.7	3.1	-1.4			
CZ	1.0	2.1	-1.1	1.1	1.1	0.1
DK	0.0	0.3	-0.3	0.2	0.2	0.0
DE	-0.1	-0.5	0.5	-0.3	-0.1	-0.1
EE	0.6	4.3	-3.7	1.3	0.9	0.4
IE	-2.2	0.2	-2.5	-1.5	0.3	-1.8
EL	0.7	-0.1	0.8	0.5	-0.7	1.3
ES	-0.1	-0.5	0.3	-0.3	-1.1	0.8
FR	0.3	0.1	0.3	0.5	0.5	0.0
HR	0.0	1.3	-1.3	0.4	0.1	0.3
IT	0.2	-0.9	1.0	0.1	-1.3	1.4
CY	0.3	0.0	0.3	0.3	-0.3	0.5
LV	0.9	4.1	-3.1	0.9	1.0	-0.1
LT	0.8	4.8	-3.9	1.3	3.2	-1.8
LU	0.2	-0.1	0.3	1.0	-0.2	1.2
HU	-0.4	0.8	-1.2	-0.3	-3.7	3.4
MT	-0.3	0.3	-0.7			
NL	-0.3	-0.4	0.1	-0.4	-0.6	0.2
AT	-0.1	-0.3	0.2	-0.4	-0.4	0.1
PL	-0.2	1.8	-2.0	-0.2	0.9	-1.1

Table 3

(continuation)

	ULC	Compensation	Productivity	RULC	Compensation	Productivity
PT	-0.4	-0.2	-0.1	-0.3	-0.9	0.5
RO	-0.1	4.3	-4.4			
SI	-0.3	0.7	-1.0	-0.3	-1.6	1.3
SK	0.6	2.8	-2.2	-0.1	0.8	-0.9
FI	0.4	0.2	0.2	0.4	0.1	0.3
SE	0.5	0.6	-0.1	0.8	0.9	-0.1
UK	0.8	0.6	0.2	1.0	0.4	0.6

**Notes:** Countries: Belgium (BE), Bulgaria (BG), Czech Republic (CZ), Denmark (DK), Germany (DE), Estonia (EE), Ireland (IE), Greece (EL), Spain (ES), France (FR), Croatia (HR), Italy (IT), Cyprus (CY), Latvia (LV), Lithuania (LT), Luxembourg (LU), Hungary (HU), Malta (MT), Netherlands (NL), Austria (AT), Poland (PL), Portugal (PT), Romania (RO), Slovenia (SI), Slovakia (SK), Finland (FI), Sweden (SE), United Kingdom (UK). The slight differences between unit labor costs growth and its contributions are due to rounding.

**Source:** Own computation, data source: Eurostat

From the point of view of real unit labor costs, the last quartile consists of the United Kingdom (and Latvia with a nearly the same figure), Luxembourg, the Czech Republic, Estonia, Lithuania and Ireland. With the exception of Ireland the changes were positive. Focusing on the less developed economies in this group, increases in real compensation surpassed increases in real productivity in Latvia and Lithuania, while growths in real compensation were accompanied by declines in real productivity in the Czech Republic and Estonia.

The question of significant changes in unit labor costs is further explored by unit root testing. Following Arltová a Fedorová (2016) and their results on the applicability of unit roots tests in the presence of relatively short time series, Dickey-Fuller GLS test and KPSS test are employed to detect countries which experienced nonstationary development of unit labor costs, which should be indicative of divergent evolutions of compensation and productivity. The results of the unit root testing are presented in Table 4.

Not surprisingly in various cases the results of the unit roots test give conflicting outcome. Thus, only those series which were considered nonstationary by both the test are considered to be exhibiting trend behavior, either stochastic or deterministic.

Based on these results Table 5 then presents categorization of the economies in question which exhibit trend behavior of unit labor costs, and, therefore, statistically significant divergences between the evolution of compensation and productivity. The categorization is done according to the behavior of unit labor costs, compensation and productivity.

As far as nominal unit labor costs are concerned, only Bulgaria, the Czech Republic and Hungary from the set of relatively young EU members experienced trend behavior and only in cases of Bulgaria and the Czech Republic it may be considered as a result of catching up process since in Hungary nominal unit labor costs decreased on average due to slower growth of compensation relative to productivity. The categorization of Greece, Portugal and Spain indicates the results of restrictive fiscal policies: in case of Portugal increase in productivity was even accompanied by decrease in compensation. The strong fiscal stance in these economies may be readily deduced from the development of structural balance of general government published by AMECO database. Comparing the development of the ratio of structural balance of general government to potential GDP, the ratio increased by 2.4 pp in Greece, 1.2 pp in Portugal and 0.9 pp in Spain between 2010 and 2015, which is indicative of strong fiscal restrictions; the average change in this ratio for the whole EU was 0.6 pp.



**Table 4** Unit Root Tests

	Nominal ULC		Real ULC	
	DF-GLS	KPSS	DF-GLS	KPSS
BE	-2.35**	0.48**	-2.62**	0.25
BG	-0.26	0.53**		
CZ	-0.68	0.66**	-0.20	0.54**
DK	-2.44**	0.13	-2.36**	0.29
DE	-1.20	0.28	-2.22**	0.34
EE	-1.78*	0.48	-1.48	0.61**
IE	0.30	0.42*	0.25	0.29
EL	-1.32	0.46*	-1.46	0.31
ES	-1.22	0.44*	-0.53	0.42*
FR	-0.18	0.62**	-0.38	0.63**
HR	-1.31	0.30	-1.68*	0.20
IT	-1.61*	0.38*	-2.09**	0.28
CY	-1.43	0.38*	-1.63*	0.33
LV	-2.56**	0.33	-2.52**	0.35*
LT	-3.52***	0.06	-2.86***	0.22
LU	-2.08**	0.18	-0.70	0.67**
HU	-1.07	0.54**	-1.24	0.48**
MT	-1.92*	0.15		
NL	-1.23	0.60**	-0.09	0.54**
AT	-1.87*	0.24	-0.94	0.48**
PL	-1.85*	0.17	1.72	0.14
PT	-0.09	0.53**	-0.25	0.49**
RO	-2.09**	0.32		
SI	-1.73*	0.13	-1.42	0.36*
SK	-1.18	0.19	-1.44	0.48**
FI	-2.83***	0.55**	-2.39**	0.52**
SE	-1.39	0.62**	-1.01	0.66**
UK	-1.11	0.53**	-1.46	0.48**

**Notes:** Countries: Belgium (BE), Bulgaria (BG), Czech Republic (CZ), Denmark (DK), Germany (DE), Estonia (EE), Ireland (IE), Greece (EL), Spain (ES), France (FR), Croatia (HR), Italy (IT), Cyprus (CY), Latvia (LV), Lithuania (LT), Luxembourg (LU), Hungary (HU), Malta (MT), Netherlands (NL), Austria (AT), Poland (PL), Portugal (PT), Romania (RO), Slovenia (SI), Slovakia (SK), Finland (FI), Sweden (SE), United Kingdom (UK). Unit root test: DF-GLS (Dickey-Fuller GLS, null hypothesis = unit root), KPSS (Kwiatkowski-Phillips-Schmidt-Shin, null hypothesis = stationarity), \*, \*\*, \*\*\* signifies rejection of the null at 1%, 5%, 10% significance level, respectively.

**Source:** Own estimates, data source: Eurostat

From the point of view of real unit labor costs, catching up process is observed in the Czech Republic and Estonia and Slovakia (real unit labor costs decreased on average but very slightly). While the effects of restrictive fiscal policy are still observable in Portugal and Spain where real compensation decreased more than real productivity, it is not seen in the data for Greece.

**Table 5** Categorization of Countries

Increase of Nominal Unit Labor Costs				Decrease of Nominal Unit Labor Costs			
		Productivity				Productivity	
		Increase	Decrease			Increase	Decrease
Compensation	Increase	BG, CZ, SE	FR, UK, CY	Compensation	Increase	HU, IE	
	Decrease		EL		Decrease	PT	NT, ES
Increase of Real Unit Labor Costs				Decrease of Real Unit Labor Costs			
		Productivity				Productivity	
		Increase	Decrease			Increase	Decrease
Compensation	Increase	FR, SE	CZ, EE, UK	Compensation	Increase	SK	
	Decrease		LU		Decrease		HU, NT, AT, PT, ES, SI

Notes: Countries: Bulgaria (BG), Czech Republic (CZ), Estonia (EE), Ireland (IE), Greece (EL), Spain (ES), France (FR), Cyprus (CY), Luxembourg (LU), Hungary (HU), Austria (AT), Portugal (PT), Slovenia (SI), Slovakia (SK), Sweden (SE), United Kingdom (UK).

Source: Own computation, data source: Eurostat

#### 4 PERSPECTIVE OF THE CZECH REPUBLIC

The development of unit labor costs, both nominal and real, which was presented in the previous section is in case of the Czech economy more or less the same whether the benchmark used is EU28 or Germany. However, especially for the purpose of common discussion when the development of purchasing power of households is frequently compared with Germany, the data is explicitly stated in Table 6.

Over the course of the sample the average growth of the nominal unit labor costs was 1.0% in case EU28 as a benchmark and 1.1% in case of Germany as a benchmark. Looking at the real unit labor costs, the average growths reached 1.1% and 1.4%, respectively.

**Table 6** Comparison of Unit Labor Costs in PPS of the Czech Republic with EU28 and DE as benchmarks

	Nominal Unit Labor Costs		Real Unit Labor Costs	
	EU28 = 100	DE = 100	EU28 = 100	DE = 100
1995	69	65	68	59
1996	73	69	74	64
1997	75	71	77	68
1998	74	70	77	68

Table 6

(continuation)

	Nominal Unit Labor Costs		Real Unit Labor Costs	
	EU28 = 100	DE = 100	EU28 = 100	DE = 100
1999	74	70	77	69
2000	74	70	77	69
2001	75	73	79	73
2002	78	76	82	76
2003	79	78	84	81
2004	80	81	85	83
2005	82	82	85	84
2006	81	83	85	85
2007	82	85	85	88
2008	81	83	82	85
2009	80	80	81	81
2010	82	83	82	83
2011	82	83	82	82
2012	84	83	83	81
2013	84	83	83	80
2014	83	81	84	80
2015	83	81	85	79
2016	84	82	85	80
2017	86	83	87	81

Source: Own computation, data source: Eurostat

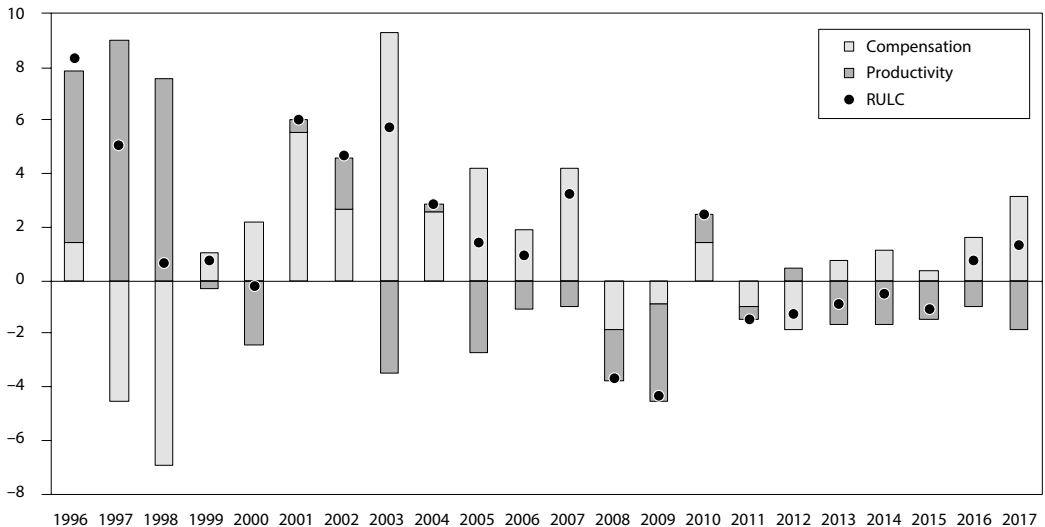
Focusing now on real unit labor costs, it is interesting to look at the structure of their growth, Germany is used as a benchmark. Over the whole sample the growth of the real unit labor costs of 1.4% came from a growth of real compensation of 1.2% and a decline in productivity of 0.2%. More detailed picture is presented in Figure 1. The data is presented in such a way so that the sum of contributions of compensation and productivity directly gives the growth of real unit labor cost, for example, the contribution of compensation in 2006 was 2.0 pp and that of productivity –1.0 pp so that the growth of real unit labor costs was 1.0% and, at the same time, the growth of productivity was 1.0%.

The results show that the real compensation in the Czech Republic has converged to the level in Germany, expressed in PPS, and given the sample, from 49% in 1995 to 64% in 2017 while productivity started at 83% and reached 79% in 2017. The development of productivity is significantly influenced

by its profound decline between 1995 and 1996. However, starting from 1996 the message stays the same: the real unit labor costs increased by 1.1% with contributions of compensation and productivity at 1.2 pp and  $-0.1$  pp, respectively.

Not only does the data show that real compensation has converged to the level of Germany but also that their responsiveness to changes in productivity may be relatively significant.

**Figure 1** Contributions of Compensation and Productivity to RULC Growth in the Czech Republic with Germany as a benchmark



**Note:** RULC: real unit labor costs.

**Source:** Own computation, data source: Eurostat

A closer look at this question shows that real compensation does indeed respond to productivity quite strongly in the Czech Republic as compared with the whole cross-section of EU28 economies (Bulgaria, Germany, Malta, Poland, Romania were excluded: Germany was a benchmark and the data for Poland starts in 2000, which was not a problem in the previous analysis, however, it would significantly reduce the sample here).

The question of the responsiveness of real compensation to productivity was examined by means of dynamic ordinary least squares with one lag and one lead to account for possible feedbacks between the two variables, constant was also introduced in the relationship, however, their estimates are not reported in Table 7 as they have no specific interpretation in this case. In both cases their estimates were not statistically significant.

The stationarity of the data was tested by DF-GLS and KPSS unit root tests in case of the Czech Republic and it was already indicated in the previous section that they were found nonstationary. In case of the panel, the Levin-Lin-Chu test of the common unit root process was used with the statistic at  $-0.85$  for compensation and  $-1.12$  for productivity, confirming common unit root process in both the cases.

Given the estimates of the panel, the results show that real compensation responds positively to productivity and the relationship is highly statistically significant. In case of the Czech Republic the relationship between real compensation and productivity is much stronger than the EU average. Cointegrating relationship was confirmed by the Hansen test as it is shown in Table 7. In both cases

**Table 7** Cointegration

Panel (DOLS), cross-sections	23	Czech Republic (DOLS)	
Observations	19	Observations	19
<i>dependent variable</i>		<i>dependent variable</i>	
compensation		compensation	
<i>independent variable</i>		<i>independent variable</i>	
productivity	0.34***	productivity	0.81***
<i>Residuals</i>		<i>Residuals</i>	
Autocorrelation at 1st lag	0.24	Autocorrelation at 1st lag	0.29
Partial Autocorrelation at 1st lag	0.24	Partial Autocorrelation at 1st lag	0.29
Jarque-Bera	0.30	Jarque-Bera	0.41
		<i>Hansen Cointegration Test</i>	0.06

**Notes:** Autocorrelation of residuals stated, tested with Q-statistic under the null of no autocorrelation, normality of residuals tested by Jarque-Bera under the null of normality, LC statistic for Hansen cointegration test given under the null of cointegration, significance of estimated values of independent variable given under the null of their estimates being zero, \*, \*\*, \*\*\* signifies rejection of the null at 1%, 5%, 10% significance level, respectively.

**Source:** Own estimates, data source: Eurostat

the residuals may be considered normal and without autocorrelation. These results are in line with the research of Nikulin (2015), which has already been referred to above.

## CONCLUSION

The paper presented some stylized facts on the development of compensation and productivity in the EU. To properly handle the issue it refuted right in the beginning the popular belief that compensation should be somehow directly aligned with productivity. Such a hypothesis may only be based on the restrictive assumptions of perfect competition and thus has no empirical merit in the real world. To econometrically evaluate the relationship between compensation and productivity a full-fledged labor market model would need to be constructed and estimated. However, it still would not give an answer to the question whether or not compensation is high or low relative to productivity but rather whether is high or low relative to all the set of variables. Also it must be taken into account that no uniform model might be used for the set of countries examined in this paper because, for example, as far as unemployment benefits are concerned, certainly one of the determinants of compensation, as shown in the theoretical part of the paper, there are countries with a very short or no history of unemployment benefits.

The approach employed in the paper rested on direct comparison of the data on compensation and productivity, both in nominal and real terms, expressed in PPS with the aim to identify countries with trend developments of unit labor costs and thus divergences between the evolutions of compensation and productivity. This was carried out with the use of unit root testing and subsequent categorization of the economies. The analysis showed that about half of the sample experienced divergences in the evolutions of compensation and productivity which may be put down to, especially, catching up process of some of the less developed economies and the effects of severe fiscal restrictions after 2010.

The last section focused on the Czech Republic with the aim to answer the question of responsiveness of compensation to productivity. Using dynamic OLS and comparing the results for the Czech Republic with the whole panel, the outcome showed that the responsiveness of compensation to productivity is relatively high. This goes hand in hand with the finding that, over the course of the sample, compensation increased significantly more than productivity both in nominal and real terms and both with EU28 and Germany as benchmarks.

## References

- ARLTOVÁ, M. AND FEDOROVÁ, D. Selection of Unit Root Test on the Basis of Length of the Time Series and Value of AR(1) Parameter. *Statistika: Statistics and Economy Journal*, 2016, 3, pp. 47–64.
- D'AURIA, F., DENIS, C., HAVIK, K., McMORROW, K., PLANAS, C., RACIBORSKI, R., ROGER, W., ROSSI, A. *The production function methodology for calculating potential growth rates and output gaps* [online]. Brussels: European Commission, 2010. [cit. 5.6.2018]. <[http://ec.europa.eu/economy\\_finance/publications/pages/publication\\_summary752\\_en.htm](http://ec.europa.eu/economy_finance/publications/pages/publication_summary752_en.htm)>.
- EUROPEAN COMMISSION. *Labour Market and Wage Developments in Europe 2017* [online]. Brussels: European Commission, 2017. [cit. 5.6.2018]. <[ec.europa.eu/social/BlobServlet?docId=18371&langId=en](http://ec.europa.eu/social/BlobServlet?docId=18371&langId=en)>.
- EUROSTAT. *European System of Accounts – ESA 2010* [online]. European Union, 2013. [cit. 5.6.2018]. <<https://ec.europa.eu/eurostat/web/products-manuals-and-guidelines/-/KS-02-13-269>>.
- GALGÓCZI, B. *Why central and eastern Europe needs a pay rise* [online]. Brussels: ETUI, 2017. [cit. 5.6.2018]. <<https://www.etui.org/Publications2/Working-Papers/Why-central-and-eastern-Europe-needs-a-pay-rise>>.
- GRAVELLE, H. AND REES, R. *Microeconomics*. 2<sup>nd</sup> Ed. Harlow: Addison Wesley Longman Limited, 1992.
- MORTENSEN, D. L. AND PISSARIDES, C. A. New Developments in Models of Search in the Labor Market. In: ASHENFELTER, O. AND CARD, D. eds. *Handbook of Labor Economics*. Elsevier, 1999.
- MYANT, M. *Unit labour costs: no argument for low wages in eastern and central Europe* [online]. Brussels: ETUI, 2016. [cit. 5.6.2018]. <<https://www.etui.org/Publications2/Working-Papers/Unit-labour-costs-no-argument-for-low-wages-in-eastern-and-central-Europe>>.
- NIKULIN, D. Relationship between wages, labor productivity and unemployment rate in the new EU member countries. *Journal of International Studies*, 2015, 1, pp. 31–40.
- PESSOA, J. P. AND REENEN, J. *Wage growth and productivity growth: the myth and reality of decoupling* [online]. London: LSE, 2013. [cit. 5.6.2018]. <[cep.lse.ac.uk/pubs/download/dp1246.pdf](http://cep.lse.ac.uk/pubs/download/dp1246.pdf)>.
- PISSARIDES, C. A. *Equilibrium Unemployment Theory*. 2<sup>nd</sup> Ed. London: The MIT Press, 2000.
- SCHWELLNUS, C., KAPPELER, A., PIONNIER, P.-A. *Decoupling of wages from productivity: macro-level facts* [online]. Paris: OECD, 2017. [cit. 5.6.2018]. <[https://www.oecd-ilibrary.org/economics/decoupling-of-wages-from-productivity\\_d4764493-en](https://www.oecd-ilibrary.org/economics/decoupling-of-wages-from-productivity_d4764493-en)>.