

Wage Polarization in the Context of the Czech Republic

Radek Náplava¹

Abstract: Existing studies have provided evidence of job polarization in many developed countries. The issue of wage polarization is less obvious: many articles do not address it at all, and some even confuse it with job polarization. At the same time, the significance of the phenomenon of polarization results precisely from the consequence of wage polarization: the increase in wage inequality. The aim of this article is to find out whether wage polarization occurred in the Czech Republic during the period 2004–2018. Wage development in the private sphere does not imply wage polarization, but in the public sphere, results imply a very slight wage polarization mainly due to the development between 2004 and 2010. This phenomenon has occurred in both male and female occupations. Panel regression analysis shows that globalization reduces upper-tail inequality (the ratio Q90/Q50) while increasing lower-tail inequality (the ratio Q50/Q10). At the level of the whole economy, technology seems to contribute to reducing both upper-tail and lower-tail inequality. These results probably correspond to the nature of the Czech economy, which is based on middle-skilled workers with a pro-export focus.

Key words: wage polarization, labor market, wage inequality, panel analysis

JEL Classification: J21, J23, J31

Received: 21 April 2021 / Accepted: 4 March 2022 / Sent for Publication: 07 June 2022

Introduction

The unprecedented technological progress of recent decades has led to a change in the structure of employment, with technological changes favouring workers in non-routine occupations, while workers from routine (middle-skilled) occupations are being replaced by capital and pushed out to other productions. The result is the emergence of job polarization, which could be described as increasing the share of high-skilled and low-skilled workers and decreasing the share of middle-skilled workers. The above explanation briefly describes the routine-biased technological change (RBTC) hypothesis, which credibly explains this phenomenon (Autor, Levy and Murnane, 2003). In the sense of polarization, attention is most often turned to the detection of job polarization (related to

¹ Mendel University in Brno, Faculty of Business and Economics, Department of Economics, The Czech Republic, radek.naplava@mendelu.cz.

skills), while wage polarization (related to wages itself) is often neglected.² This is despite the fact that one of the reasons why we are interested in the phenomenon of polarization (in general) is the increase in wage inequality, which in itself results from wage polarization, while job polarization does not necessarily imply that.

Wage polarization means that wages in the high-wage and low-wage occupations are growing relatively faster than wages in the middle-wage occupations. In other words, the edges of the wage distribution function are growing relatively faster than the middle part. Wage polarization is tightly tied to relative wage changes. It doesn't matter whether we assign wages to specific workers or specific occupations – wage polarization is related to changes in real wages.

On the other hand, there is job polarization, which by its nature relates to changes in the proportion of employment, regardless of whether the criterion of employment distribution is the level of skills or the content of the occupation itself (in the context of the RBTC hypothesis). Job polarization has been demonstrated by significant studies in many developed countries (Autor and Dorn, 2013; Goos and Manning, 2007; Goos, Manning and Salomons, 2014, and others), although we find studies that are less clear and whose results are caused by a different approach to the polarization measurement itself (Fernández-Macías, 2012; Hunt and Nunn, 2019). The identification of wage polarization may have a higher telling power about changes in the structure of the labor market than job polarization. The reason may be a bias in determining job polarization if the skill level criterion is the level of the average wage (see e.g. Acemoglu and Autor, 2011; Autor and Dorn, 2013); thus not the median wage, but the average wage.

The aim of this article is to find out whether wage polarization occurred in the Czech Republic during the period 2004–2018. The Czech Republic is relatively neglected in this area of research, as are other Central and Eastern Europe countries. For this reason, we focus on the Czech Republic, as a representative of this area. We identify wage polarization based on changes in wage inequality: more specifically, we observe changes in upper-tail inequality (the ratio $Q90/Q50$) and lower-tail inequality (the ratio $Q50/Q10$). Furthermore, a panel regression analysis is performed, which seeks to identify how globalization and technology – according to the literature the main drivers – affect the development of upper- and lower-tail inequality.

The contribution of the paper is twofold: First, we document the development of wage inequality in private and public sphere occupations in the context of wage polarization with regard to gender. Wage development in the private sphere does not imply wage polarization, but in the public sphere, results imply a very slight wage polarization mainly due to the development between 2004 and 2010. This phenomenon has occurred in both male and female occupations. The results do not imply any trends in increasing wage inequality. The Czech Republic is considered one of the most egalitarian countries (Náplava, 2019) and the results confirm this. Our results also tell us something about the wage dynamics regarding gender. Females' wages in the private sphere grew relatively

² Alternatively, wage polarization is unintentionally confused with job polarization, e.g. vom Lehn (2019).

faster than males' wages. In the public sphere, the dynamics of wage development was similar.

Second, we analyze globalization and technology as factors influencing upper-tail and lower-tail inequality. The results imply that these factors favour middle-wage workers over the high-wage and low-wage workers, which probably corresponds to the nature of the Czech economy, which is based on middle-skilled workers with a pro-export focus.

The rest of the article is structured as follows: The next section provides information about wage polarization, its causes and consequences. The third section includes a description of the used data and methods. The fourth section presents and discusses the main results of descriptive and regression analysis. The last part summarizes the achieved results and concludes the article.

The Context of Wage Polarization

The reason for the research of wage polarization is mainly its direct link to wage inequality. The measurement and identification of wage polarization itself provide information on the change in wage inequality. In this context we observe changes in the development of the wage ratio $Q90/Q50$ (how the upper decile deviates from the median), which expresses the upper-tail inequality, and $Q50/Q10$ (how the lower decile deviates from the median), which expresses the lower-tail inequality. Autor, Katz and Kearney (2008) follow the development of wage inequality in the United States in the context of wage polarization in this way.

The skill-biased technological change (SBTC) hypothesis is considered to be the main cause of the growth of wage inequality, see Autor and Katz (1999), Acemoglu and Autor (2011) and Antonczyk, DeLeire and Fitzenberger (2018). This hypothesis states that technological changes are biased towards more skilled (and educated) workers who complement new technologies, and therefore the relative demand for them is growing. Thus, if more qualified (and more educated) workers are paid relatively more than other workers, then it will be true that these workers are the best paid. An increase in the relative demand for them will cause their wages to grow faster than that of other workers. The result is an increase of the ratios $Q90/Q50$ and $Q50/Q10$.

The increase in wage inequality may be a consequence of wage polarization. The SBTC hypothesis cannot explain the increase in the relative wages of the least skilled (and educated) workers who are the worst paid. This increase is related to the higher relative demand for the least skilled workers compared to middle-skilled workers and is a consequence of job polarization. This is exactly the nature of wage polarization – a relatively larger increase in the low-wage occupations compared to the middle-wage occupations is reflected in a decrease in the ratio $Q50/Q10$. The result of the SBTC hypothesis should be a clear growth trend of the ratio $Q90/Q50$ and a growth or relatively stable or increasing trend of the ratio $Q50/Q10$. A declining trend of the ratio $Q50/Q10$ should be evident for wage polarization. An important difference is therefore the behavior of the trend of $Q50/Q10$, which is relatively stable or increasing in the case of the SBTC hypothesis, while decreasing in the case of wage polarization due to the faster growth of the lower decile ($Q10$).

Technological changes are most often cited as the cause of polarization (Acemoglu and Autor, 2011); the next factors are globalization (Cozzi and Impullitti, 2016) and consumption spillovers (Mazzolari and Ragusa, 2013). These factors explain both job polarization and wage polarization. Cortes (2016) explains wage polarization with the RBTC hypothesis, which exerts pressure on the transition of workers from routine (middle-skilled) occupations to manual (low-skilled) and abstract (high-skilled) occupations. This should theoretically have a direct impact on wages (but it does not have to, see the text below). The relative wages of routine (middle-skilled) occupations will decrease compared to manual (low-skilled) and abstract (high-skilled) occupations. Cozzi and Impullitti (2016) explain the mechanism by which globalization leads to wage polarization. Greater globalization means that companies need to innovate in order to succeed in global competition. Innovation requires a larger number of more skilled workers, which increases the relative demand for them and thus also increases their relative wages. As the leisure time of high-skilled workers becomes rarer, the demand for personal services (e.g. cleaning, babysitting, food services) performed by the low-skilled workers increases, and their relative wages increase. Although not explicitly stated by the authors, this mechanism shows, in other words, how globalization leads to wage polarization through consumption spillovers (see Autor and Dorn, 2013 and Mazzolari and Ragusa, 2013).³

Wage polarization is related to job polarization but does not necessarily result from it; the presence of job polarization does not necessarily mean the presence of wage polarization. Autor, Katz and Kearney (2006) showed that in the United States, wage polarization was accompanied by job polarization, but Naticchioni, Ragusa, and Massari (2014) found the presence of job polarization, but not wage polarization, in 11 European countries. Similarly, Goos and Manning (2007) in the United Kingdom showed strong job polarization, but not wage polarization. Goos and Manning explain this by the fact that the disappearing middle-skilled workers are at first "the least qualified of them".⁴ As a result of their exit, the average skill level of those who remain increases, which counteracts the downward pressure on their wages due to lower demand.

Wage polarization was proved by Acemoglu and Autor (2011), Cortes (2016), Cozzi and Impullitti (2016) and Firpo, Fortin and Lemieux (2011) in the United States, Machin (2011) in United Kingdom, Antonczyk, DeLeire and Fitzenberger (2018) and Dustmann, Ludsteck and Schönberg (2008) in Germany, Centeno and Novo (2009) in Portugal and Wang (2009) in Taiwan. However, there are also studies that have not shown wage polarization and an increase in wage inequality, such as Naticchioni, Ricci and Rustichelli (2008) for Italy, Charnoz, Coudin and Gaini (2011) for France and Izquierdo and Lacuesta (2012) for Spain.

The current empirical evidence about wage polarization does not cover the countries of Central and Eastern Europe. For this reason, we choose the Czech Republic as one of these countries. Nevertheless, we are able to discuss our results at least regarding job

³ In addition to the technological changes (biased toward routine workers), globalization and consumption spillovers, Firpo, Fortin and Lemieux (2011) emphasize institutional factors. Their analysis shows the important role of the declining influence of trade unions in shaping wage polarization.

⁴ In other words, they are the weakest, the worst.

polarization, thus we can compare the result with studies of Nchor and Rozmahel (2020) and Martiňák (2020) focusing on job polarization in the Czech Republic.

Data and Methods

For identification of wage polarization, we present the results of the development of wage inequalities, which are captured as the ratios Q90/Q50 (upper-tail inequality) and Q50/Q10 (lower-tail inequality) between 2004 and 2018. We also present the development of coefficients Q10 (lower decile), Q50 (median) and Q90 (upper decile) – it allows us to determine exactly the cause of change in the development of ratios Q90/Q50 and Q50/Q10.⁵

Data for Q10, Q50 and Q90 are taken from the Average Earnings Information System (2019) which contains regional data taking into account gender. As the Average Earnings Information System works with nominal earnings, the data obtained are adjusted using a deflator (Worldbank, 2020).

We employ a panel regression analysis, which works with the time series $T = 15$ (years 2004 to 2018) and $N = 28$ (14 regions divided into private and public spheres, i.e. 14x2); the total number of observations is therefore 364 ($T \times N$). Panels for the private sphere and public sphere separately contain 182 observations. The regression equation has the following form:

$$\begin{aligned} \log(Y_{it}) = & \beta_0 + \beta_1 \log(RaD_{it}) + \beta_2 \log(capital_{it}) \\ & + \beta_3 \log(openness_{it}) \\ & + \beta_4 \log(high - technology\ products_{it}) \\ & + \beta_5 \log(minimum\ wage_{it}) + u_{it} \end{aligned} \quad (1)$$

The dependent variable is upper-tail inequality or lower-tail inequality. Explanatory variables include expenditure on research and development (RaD), fixed gross capital formation (capital), the ratio of export and import turnover to GDP (openness), which represents the variable for globalization, the ratio of high-tech products to total international trade, which represents technology flows (high-technology products), and the minimum wage. As in similarly focused literature, we express all variables in a logarithmic form due to better information value. Data for explanatory variables come from the Czech Statistical Office (2020).

Two variables RaD and capital serve as control variables – see Amoroso and Moncada-Paternò-Castello (2018). Another control variable, the minimum wage, should control lower-tail inequality. Variables openness (globalization) and high-technology products are determined on the basis of literature (see Afxentiou and Kutasovic, 2011) and their influence is crucial in the context of polarization: both globalization and technology are considered triggers for polarization (Cortes, 2016; Cozzi and Impullitti, 2016). In the sense of wage polarization, we expect a positive relationship between globalization and

⁵ For example, an increase in the Q90/Q50 coefficient may mean that the numerator value increases or the denominator value decreases.

technology and upper-tail inequality ($Q90/Q50$), and a negative relationship between them and lower-tail inequality ($Q50/Q10$).

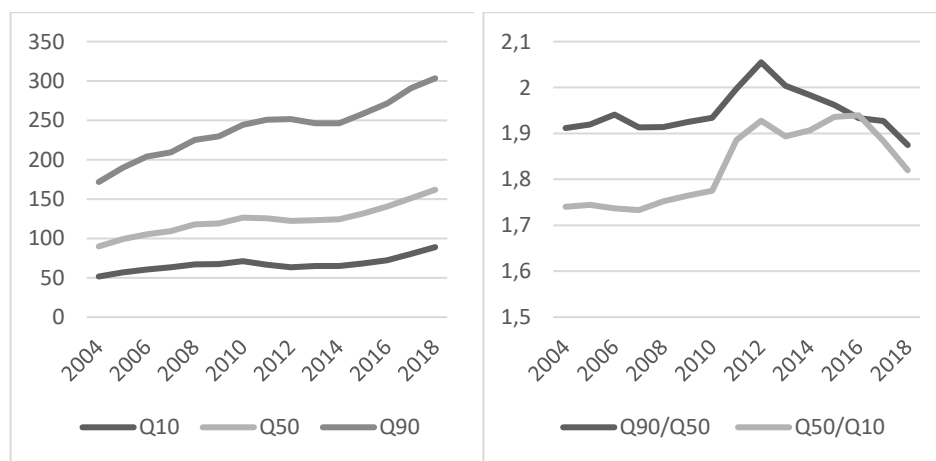
The selection of a suitable model for panel analysis is based on the Hausman test and its p -value. The Hausman's test examines the consistency of GLS estimates. If the value of the Hausman test is large (p -value is small), it means that the estimation of a model with random effects (REM) is not consistent and it is more appropriate to use a model with fixed effects (FEM) (Baltagi, 2008). In the case of p -value < 0.05 , the FEM model is selected, otherwise, the REM model (GLS) is selected. For the robustness of the results, a dynamic panel is also employed. Since N panels $> T$, we estimate using the GMM system. Due to the presence of heteroscedasticity and serial correlation, all regression models contain robust standard errors incorporated as a cluster option at the region level.

Results and Discussion

Trends in Wage Inequalities or how it is with Wage Polarization – descriptive analysis

In the occupations of the private sphere, results do not imply the presence of wage polarization. Until about 2010, the development of indicators $Q10$, $Q50$ and $Q90$ was consistent (approximately the same growth rate), then there was a fall in real wages in the lowest decile ($Q10$). While real wages for $Q10$ have fallen, for $Q50$ and $Q90$ they are stagnating until 2014; this affected the values of the ratio $Q50/Q10$, which increased as a result. After 2015, real wages of all indicators are growing. The results are shown in Figure 1 below.

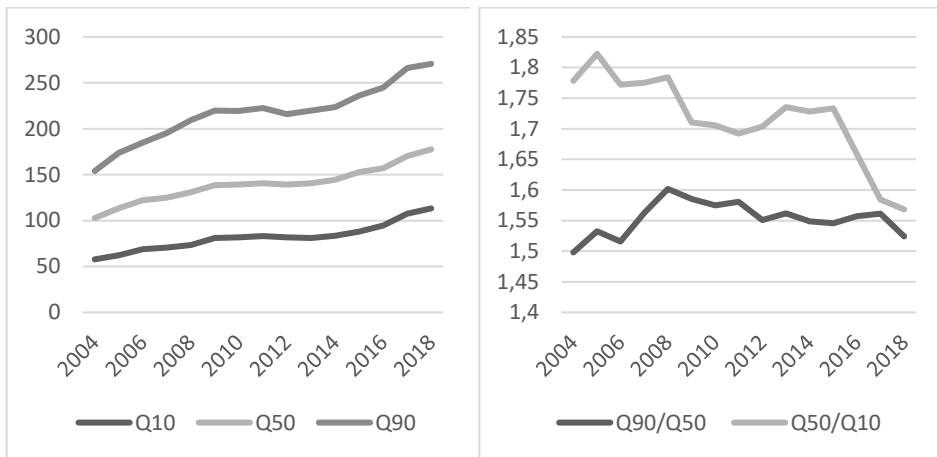
Figure 1. The Czech Republic – results of the private sphere



Note: On the left, the development of real wages in CZK through indicators $Q10$ (lower decile), $Q50$ (median) and $Q90$ (upper decile), on the right the development of the ratio $Q90/Q50$ (upper-tail inequality) and $Q50/Q10$ (lower-tail inequality). Source: Average Earnings Information System (2019), authors' calculations

Within all occupations of the public sphere (the results are illustrated in Figure 2 below), we are witnessing a decrease in the trend of the ratio $Q50/Q10$. The decrease in the trend of the ratio $Q50/Q10$ is evidently due to a relatively higher increase in wages in the lower decile of the wage distribution than the median wage, especially after 2014. The decline in the trend of $Q50/Q10$ is consistent in scope with the conclusions of Autor, Katz and Kearney (2008), who examined the development of wage inequality in the United States between 1980 and 2005. However, their results implied a massive increase in upper-tail inequality, i.e. a relatively large increase in the $Q90/Q50$ coefficient due to wage growth, especially in the upper decile ($Q90$), while in our case the $Q90/Q50$ coefficient is relatively stable.

Figure 2. The Czech Republic – results of the public sphere



Note: On the left, the development of real wages in CZK through indicators $Q10$ (lower decile), $Q50$ (median) and $Q90$ (upper decile), on the right the development of the ratio $Q90/Q50$ (upper-tail inequality) and $Q50/Q10$ (lower-tail inequality). Source: Average Earnings Information System (2019), authors' calculations

Results imply the presence of very slight wage polarization. This is evident if we compare changes in the upper-tail and lower-tail inequality (see Table 1) with the help of the average annual growth value. A positive value of the coefficient expressing upper-tail inequality and a negative value expressing lower-tail inequality in the public sphere imply the presence of wage polarization. In other words, $Q10$ and $Q90$ grew relatively faster than $Q50$.

In the appendix, there is Figure 5, which compares the development of the lower deciles and the minimum wage. It is clear from the figure that the minimum wage does not in itself directly affect the development of lower deciles. The minimum wage can potentially affect the lower decile (and indeed the whole lower-tail inequality) by its connection to a guaranteed wage. But during the period when wage polarization in the public sphere is most evident, there was no significant increase in the minimum wage, as its level stagnated for 6 years. On the other hand, the rapid growth of the minimum wage after 2014 (in the context of its connection to the guaranteed wage) may have contributed to the relatively rapid decline in the $Q50/Q10$ coefficient mentioned above.

Table 1. Average annual wage growth in private and public spheres (2004–2018)

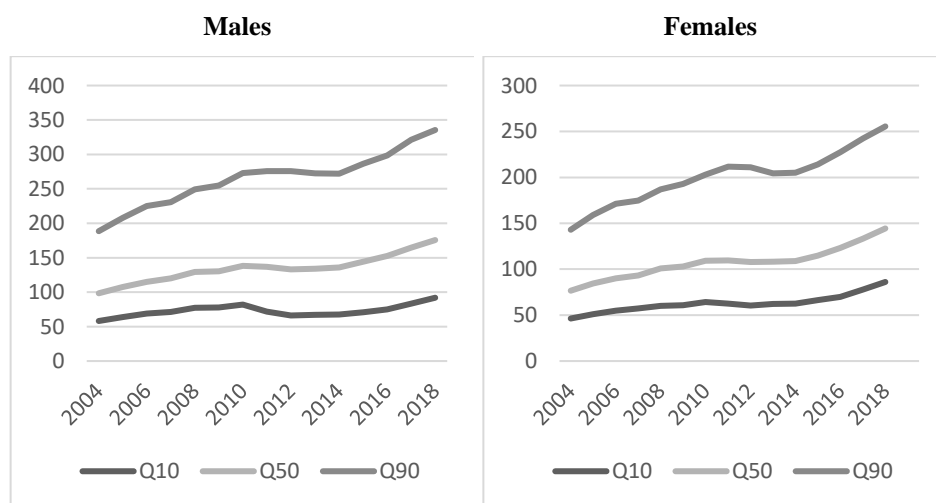
	Private sphere	Public sphere
Q10	3.7 %	4.6 %
Q50	4 %	3.7 %
Q90	3.9 %	3.8 %
Q90/Q50	-0.1 %	0.1 %
Q50/Q10	0.3 %	-0.1 %

Source: *Average Earnings Information System (2019)*, authors' calculations

Gender differences in the private sphere – descriptive analysis

We now examine differences regarding gender. We present the development in the private sphere in Figure 3. At first glance, there are clear differences in wages – males have higher wages (this is evident from the size of Q10, Q50 and Q90). Until 2010, real wages grew for both males and females. After 2010, there was a decrease in real wages of Q10 for both males and females (the decrease in real wages for Q10 was more noticeable for females). The median wage for males also decreased slightly, while for females it stagnated. On the other hand, females' Q90 even decreased.

Upper-tail inequality (Q90/Q50) tended to increase in both male and female wages (maximum in 2012), but then, due to a relatively faster growth in median wages, the tendency was to decrease. Lower-tail inequality (Q50/Q10) increased in both cases, again due to a relatively faster median wage growth. This fact is also evidenced by the comparison of average growth rates in Table 2. Thus, the results in the private sphere do not imply the presence of wage polarization, as it is not true that upper-tail inequality increased and lower-tail inequality decreased.

Figure 3. The Czech Republic – gender differences in the private sphere



Note: Top panel includes the development of real wages in CZK through indicators *Q10* (lower decile), *Q50* (median) and *Q90* (upper decile), bottom panel the development of the ratio *Q90/Q50* (upper-tail inequality) and *Q50/Q10* (lower-tail inequality). Source: Average Earnings Information System (2019), authors' calculations

Table 2. Average annual wage growth in the private sphere

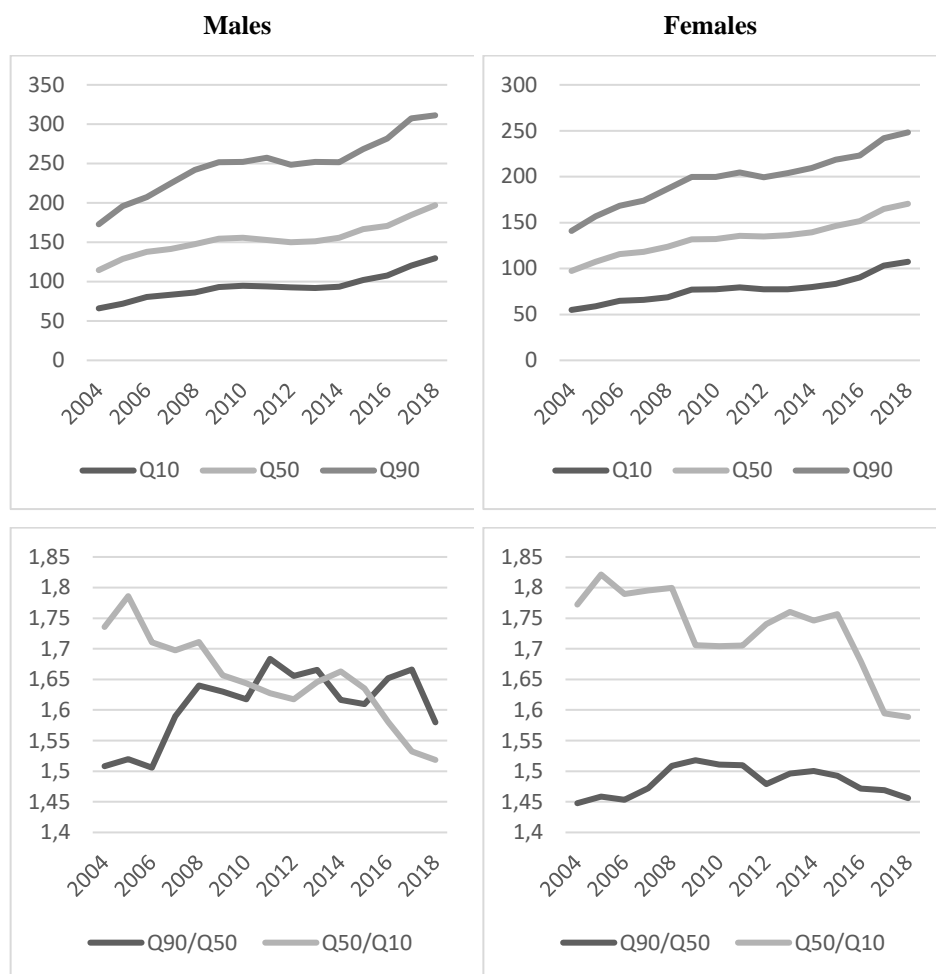
	Males	Females
Q10	3.1 %	4.2 %
Q50	3.9 %	4.3 %
Q90	3.9 %	4.9 %
Q90/Q50	0.0 %	-0.3 %
Q50/Q10	0.8 %	0.0 %

Source: Average Earnings Information System (2019), authors' calculations

Gender differences in the public sphere – descriptive analysis

Figure 4 captures gender differences in the public sphere. In the public sphere, males and females have relatively lower wages than in the private sphere. There are also lower differences between the various wage levels *Q10*, *Q50* and *Q90* (see lower values of the ratios *Q90/Q50* and *Q50/Q10*). The figure again shows that males earn more than females, but at the same time, males have bigger differences in wages *Q10*, *Q50* and *Q90*.

A common trend is a decrease in the lower-tail inequality (a higher decrease in *Q50/Q10* was noticed for males). In both cases, this was due to the relatively faster growth rate of *Q10*, as shown in Table 3. For both males and females, upper-tail inequality increased slightly (the average growth was 0.3 % for males and 0.4 % for females) and lower-tail inequality decreased. This result implies wage polarization.

Figure 4. The Czech Republic – gender differences in the public sphere

Note: Top panel includes the development of real wages in CZK through indicators Q10 (lower decile), Q50 (median) and Q90 (upper decile), bottom panel the development of the ratio Q90/Q50 (upper-tail inequality) and Q50/Q10 (lower-tail inequality). Source: Average Earnings Information System (2019), authors' calculations

Table 3. Average annual wage growth in the public sphere

	Males	Females
Q10	4.6 %	4.6 %
Q50	3.7 %	3.8 %
Q90	4 %	3.8 %
Q90/Q50	0.3 %	0.4 %
Q50/Q10	-0.9 %	-0.7 %

Source: Average Earnings Information System (2019), authors' calculations

Summary of descriptive analysis

In general, the results imply a very slight wage polarization in occupations in the public sphere. This phenomenon has occurred in both male and female occupations. Wage polarization is most evident during 2004–2010, when the upper decile and the lower decile increased relatively faster than the median. The relatively faster increase in the lower decile was not due to a possible effect resulting from the increase in the minimum wage (see Figure 5 in Appendix); from 2006 to 2010, the minimum wage was at the same level, while the lower decile increased by around 20% in both the private and public sphere. If we do not take gender into account, then the results imply reducing wage inequality after 2012.

Our results also show a difference in the remuneration of males and females. Although the development trends of the Q90/Q50 and Q50/Q10 coefficients have similar tendencies, females' wages are relatively lower than males'; this is evident from the size of the coefficients Q10, Q50 and Q90. The Czech Republic does not stand out in this way compared to the countries of Central and Eastern Europe, or compared to the countries of Western Europe, see Fodor and Glass (2018), Pascall and Kwak (2010) and Schäfer and Gottschall (2015). Females' wages in the private sphere grew relatively faster than males' wages. In the public sphere, the dynamics of wage development was similar. For males, the upper-tail inequality in the public sphere and the lower-tail inequality in the private sphere increased (this was due to the decline in real wages of the lower decile after 2010). For females, there has been a clear trend towards reducing wage inequality.

Regression analysis

Wage polarization can be identified with the graphs (as shown above). To determine the factors that affect the formation of wage polarization (or *non*-polarization) it is necessary to employ regression analysis. In this part, we show how selected factors, in particular globalization and technology, affect upper-tail and lower-tail inequality which represent the dependent variables. The results of static panels are presented in Table 4 below. All models are estimated with the GLS estimator; this decision was made according to the Hausman test.

Contrary to expectations, globalization (variable openness) has a statistically significant negative effect on upper-tail inequality and a statistically significant positive effect on lower-tail inequality. This may indicate a situation that globalization in the context of the Czech Republic favours middle-wage workers over high- and low-wage workers. In other words, the country's growing international trade turnover (variable for globalization) contributes to reducing wage inequality. A one percent change in openness will cause the largest decrease in upper-tail inequality in the public sphere (decrease by 0.98 percent), while the impact on the growth of lower-tail inequality is the largest in the private sphere (increase by 0.09 percent). The impact of technology is slightly different – in the public sphere, technology seems to contribute to an increase in upper-tail inequality and a decrease in lower-tail inequality. The results thus imply that a higher share of high-technology products may have contributed to the creation of wage polarization in the public sphere. As should be expected, the minimum wage contributes to the reduction of upper-tail inequality.

Table 4. Estimation of factors affecting upper-tail and lower-tail inequality (RE, GLS estimation)

VARIABLES	Private + public sphere		Private sphere		Public sphere	
	Upper-tail inequality	Lower-tail inequality	Upper-tail inequality	Lower-tail inequality	Upper-tail inequality	Lower-tail inequality
Openness	-0.0542***	0.0635***	-0.0256*	0.0996***	-0.987***	0.0283**
	0.015	0.013	0.014	0.018	0.009	0.058
High-technology products	0.0057	-0.0335**	-0.0239	0.0363***	0.0204**	-0.1043***
	0.011	0.016	0.019	0.008	0.010	0.009
Capital	0.0148**	0.0094	0.0278*	0.0110	0.0285***	0.0145**
	0.006	0.015	0.015	0.011	0.007	0.006
RaD	0.0025	0.0048	0.0109*	0.0148***	0.0002	-0.0054*
	0.004	0.004	0.005	0.004	0.001	0.003
Minimum wage		-0.0304***		-0.0353**		-0.0274***
		0.0111		0.018		0.008
Constant	0.0515	0.1557	-0.1645	0.1539	-0.0957	0.0914
	0.069	0.131	0.189	0.094	0.061	0.056
Wald chi(2)	17.59***	70.18***	7.30	183.32***	817.36***	337.02***
R2 (within)	0.17	0.12	0.00	0.59	0.54	0.68
Observations	364	364	182	182	182	182
No. of regions	28	28	14	14	14	14

*Note: robust standard errors below beta coefficients. All variables are logarithmized. Upper-tail inequality = $\log(Q90/Q50)$, lower-tail inequality = $\log(Q50/Q10)$. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Models include standard robust errors resistant to heteroskedasticity and serial correlation. Source: own calculations.*

For higher robustness of the results, we employ a dynamic panel estimator (system GMM), see Table 5.

All models are statistically significant at the 1% level of significance. In addition, it is also important to check the result of the Arellano-Bond test for serial autocorrelation (H_0 : no autocorrelation). The models are suitable if first-order autocorrelation is present (we reject the null hypothesis) and if second-order autocorrelation is not present.

Table 5. Dynamic estimation of factors affecting upper-tail and lower-tail inequality (system GMM)

VARIABLES	Private + public sphere		Private sphere		Public sphere	
	Upper-tail inequality	Lower-tail inequality	Upper-tail inequality	Lower-tail inequality	Upper-tail inequality	Lower-tail inequality
Y_{t-1}	0.9196***	0.6887***	-0.0504	0.0570	-0.1981***	0.0721
	0.019	0.045	0.038	0.042	0.039	0.057
Openness	-0.0038	0.0462***	-0.0116	0.0839***	-0.1050***	0.2731*
	0.003	0.006	0.016	0.018	0.007	0.015
High-technology products	-0.0145**	0.0039	-0.0195	0.0216	0.0131	-0.1064***
	0.005	0.009	0.016	0.019	0.009	0.0123
Capital	0.0077***	0.0062***	0.0432***	0.0135	0.0238***	0.0289***
	0.002	0.009	0.013	0.011	0.006	0.007
RaD	0.0001	0.0013*	0.0042***	0.0089***	-0.0001	-0.0014
	0.000	0.001	0.000	0.001	0.000	0.001
Minimum wage		-0.0498***		-0.0229		-0.0448***
		0.009		0.019		0.015
Constant	-0.0868***	0.179***	-0.2780*	0.0920	-0.0116	-0.0499
	0.019	0.044	0.142	0.121	0.076	0.098
Wald chi(2)	2742.73***	706.49***	387.50***	340.42***	278.39***	530.28***
AR(1) (p-value)	-3.89 (0.00)	-3.85 (0.00)	-2.82 (0.00)	-2.85 (0.00)	-3.15 (0.00)	-3.31 (0.00)
AR(2) (p-value)	1.62 (0.11)	1.69 (0.09)	-1.06 (0.29)	-2.98 (0.00)	1.03 (0.30)	-1.94 (0.05)
Observations	364	364	169	169	169	169
No. of regions	28	28	14	14	14	14

*Note: robust standard errors below beta coefficients. All variables are logarithmized. Upper-tail inequality = $\log(Q90/Q50)$, lower-tail inequality = $\log(Q50/Q10)$. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Models include standard robust errors resistant to heteroskedasticity and serial correlation.*

Source: own calculations.

The results for all occupations have a similar character as the previous results. Globalization contributes to reducing upper-tail inequality and increasing lower-tail inequality. The percentage range of impacts is smaller compared to previous models. Quantitatively, the largest impact can be seen in the public sphere for globalization (if we do not consider lagged dependent variable). A one percent change in globalization will cause the largest decrease in upper-tail inequality by 0.11 percent, and the largest increase in lower-tail inequality by 0.27 percent. This again may imply that globalization favours middle-wage workers. The Czech Republic focuses on the manufacturing industry which is based on middle-wage and middle-skilled workers; The Czech Republic has the highest share of employees in the industry of all EU countries (Eurofound and European Commission

Joint Research Centre, 2019). The growth in international trade turnover reflects a growing share of exports (from 61.8 to 79%) and imports (from 59.5 to 71.5%) to GDP (OECD, 2021), the explanation lying in the level of export. In the environment of low unemployment, growing exports are subsequently reflected in rising wages for middle-wage and middle-skilled workers, who are paid a wage close to the median. The result is a situation in which globalization (specifically the variable international trade turnover) contributes to reducing upper-tail inequality and increasing lower-tail inequality. It seems that technology contributes to reducing upper-tail inequality and in the public sphere even lower-tail inequality.

Our results are consistent with the literature that examined changes in the structure of employment in the context of job polarization. The contributions of Nchor and Rozmahel (2020) focusing on the comparison of CEE countries and the US, and Martinák (2020) focusing on the V4 countries, do not support the presence of job polarization in the Czech Republic. Polarization in the labor market can be reflected in the polarization of the wage structure; there seems to be no polarization in the labor market and thus no incentives that could lead to wage polarization. As our results show, this may be due to the fact that globalization favours middle-skilled and middle-wage workers, while polarization (both of jobs and wages) would be the opposite.

Conclusion

Globalization has made new technologies more accessible than before, both in terms of cost and in terms of their allocation and ability to move. This results in a relatively rapid transfer not only of what is desirable, but also of what may be undesirable in terms of socio-economic consequences. Disproportionate growth in wage inequality may be undesirable, due to technological changes that are biased towards middle-skilled and middle-paid workers (Autor, Katz and Kearney, 2008; Mazzolari and Ragusa, 2013).

This article deals with the identification of wage polarization (which may be accompanied by an increase in wage inequality) in the context of the Czech Republic during the period 2004 to 2018. The development of the ratios $Q90/Q50$ (upper-tail inequality) and $Q50/Q10$ (lower-tail inequality) implies a very slight wage polarization in occupations within the public sphere (in both male and female occupations), mainly due to the development between 2004 and 2010. In addition to the obvious differences in remunerations, where males earn more than females, our results inform us about the wage dynamics. Females' wages in the private sphere grew relatively faster than males' wages. In the public sphere, the dynamics of wage development was similar.

Unlike empirical studies focused mainly on the United States (Autor, Katz and Kearney, 2006, 2008; Hunt and Nunn, 2019), wage polarization is not associated with a massive increase in wage inequality. The development of wage inequality in the private sphere does not indicate wage polarization. The results imply the pressure to reduce wage inequality rather than increase it significantly. The Czech Republic is considered one of the most egalitarian countries in Europe and the results of this article confirm this fact: the level of income inequality is at a relatively lower level than in other EU countries (Náplava, 2019).

Panel regression analysis identified factors that affect the development of upper-tail and lower-tail inequality. Globalization appears to decrease upper-tail inequality and increase lower-tail inequality. This may imply that globalization favours middle-skilled and middle-paid workers, which probably corresponds to the nature of the Czech economy, which is based on middle-skilled workers with a pro-export focus. The Czech Republic stands out from the countries of Western Europe in terms of the proportion of middle-skilled workers. This fact may be the reason why job polarization does not seem to occur in the context of the Czech Republic, see Nchor and Rozmahel (2020) and Martinák (2020).

The potential for further research can be seen in the attempt to directly link wage polarization and job polarization. Other important wage determinants such as education or the skill level (see Balcar and Gottvald, 2016) play an important role in identifying job polarization and can thus form a bridge to a better understanding of the connection between wage and job polarization.

Funding: This work was supported by Internal grant agency project by Mendel University in Brno [no. PEF_DP_2020018].

Disclosure statement: No potential conflict of interest was reported by the author.

References

- ACEMOGLU, D., AUTOR, D. H. (2011). Skills, tasks and technologies: Implications for employment and earnings. In *Handbook of labor economics* (Vol. 4, pp. 1043-1171). Elsevier. [https://doi.org/10.1016/S0169-7218\(11\)02410-5](https://doi.org/10.1016/S0169-7218(11)02410-5)
- AFXENTIOU, D., KUTASOVIC, P. R. (2011). Empirical evidence on wage polarization: A panel analysis. *The Journal of Business and Economic Studies*, 17(1), 48. Available at: <https://search.proquest.com/docview/865656365?accountid=28016>
- AMOROSO, S., MONCADA-PATERNIO-CASTELLO, P. (2018). Inward greenfield FDI and patterns of job polarization. *Sustainability*, 10(4), 1219. <https://doi.org/10.3390/su10041219>
- ANTONCZYK, D., DELEIRE, T., FITZENGGER, B. (2018). Polarization and rising wage inequality: Comparing the US and Germany. *Econometrics*, 6(2), 20. <https://doi.org/10.3390/econometrics6020020>
- AUTOR, D. H., DORN, D. (2013). The growth of low-skill service jobs and the polarization of the US labor market. *American Economic Review*, 103(5), 1553-97. <https://doi.org/10.1257/aer.103.5.1553>
- AUTOR, D. H., KATZ, L. F., KEARNEY, M. S. (2006). The polarization of the US labor market. *The American economic review*, 96(2), 189-194. Available at: <https://www.jstor.org/stable/30034640>
- AUTOR, D. H., KATZ, L. F., KEARNEY, M. S. (2008). Trends in US wage inequality: Revising the revisionists. *The Review of economics and statistics*, 90(2), 300-323. <https://doi.org/10.1162/rest.90.2.300>

AUTOR, D. H., LEVY, F., MURNANE, R. J. (2003). The skill content of recent technological change: An empirical exploration. *The Quarterly journal of economics*, 118(4), 1279-1333. <https://doi.org/10.1162/003355303322552801>

AVERAGE EARNINGS INFORMATION SYSTEM. (2019). ISPV results - Archive. Available at: <https://www.ispv.cz/en/ispv-results/archive.aspx>

BALCAR, J., GOTTVALLD, J. (2016). Wage determinants and economic crisis 2008-2014: Evidence from the Czech Republic. *Ekonomický časopis*, 64(1), 3-21. ISSN 0013-3035.

BALTAGI, B. (2008). *Econometric analysis of panel data*. John Wiley & Sons.

CENTENO, M., NOVO, Á. A. (2014). When supply meets demand: Wage inequality in Portugal. *IZA Journal of European Labor Studies*, 3(1), 23. <https://doi.org/10.1186/2193-9012-3-23>

CHARNOZ, O., COUDIN, E., GAINI, M. (2011). Wage inequalities in France 1976-2004: a quantile regression analysis. Available at: <http://www.epsilon.insee.fr/jspui/bitstream/1/5813/1/g2011-06.pdf>

CORTES, G. M. (2016). Where have the middle-wage workers gone? A study of polarization using panel data. *Journal of Labor Economics*, 34(1), 63-105. <https://doi.org/10.1086/682289>

COZZI, G., IMPULLITTI, G. (2016). Globalization and wage polarization. *Review of Economics and Statistics*, 98(5), 984-1000. https://doi.org/10.1162/REST_a_00551

CZECH STATISTICAL OFFICE. (2020). Regionální data ve Veřejné databázi. Available at: <https://www.czso.cz/csu/czso/regionalni-data-ve-verejne-databazi>

DUSTMANN, C., LUDSTECK, J., SCHÖNBERG, U. (2009). Revisiting the German wage structure. *The Quarterly journal of economics*, 124(2), 843-881. <https://doi.org/10.1162/qjec.2009.124.2.843>

EUROFOUND AND EUROPEAN COMMISSION JOINT RESEARCH CENTRE. (2019). *European Jobs Monitor 2019: Shifts in the employment structure at regional level*, European Jobs Monitor series, Publications Office of the European Union, Luxembourg.

FERNÁNDEZ-MACÍAS, E. (2012). Job polarization in Europe? Changes in the employment structure and job quality, 1995-2007. *Work and Occupations*, 39(2), 157-182. <https://doi.org/10.1177/0730888411427078>

FIRPO, S., FORTIN, N. M., LEMIEUX, T. (2011). Occupational tasks and changes in the wage structure. *IZA Discussion Papers 5542*. Institute for the Study of Labor (IZA). <https://ssrn.com/abstract=1778886>

FODOR, É., GLASS, C. (2018). Labor market context, economic development, and family policy arrangements: Explaining the gender gap in employment in Central and Eastern Europe. *Social Forces*, 96(3), 1275-1302. <https://doi.org/10.1093/sf/sox080>

GOOS, M., MANNING, A. (2007). Lousy and lovely jobs: The rising polarization of work in Britain. *The review of economics and statistics*, 89(1), 118-133. <https://doi.org/10.1162/rest.89.1.118>

- GOOS, M., MANNING, A., SALOMONS, A. (2014). Explaining job polarization: Routine-biased technological change and offshoring. *American economic review*, 104(8), 2509-26. <https://doi.org/10.1257/aer.104.8.2509>
- HUNT, J., NUNN, R. (2019). Is Employment Polarization Informative About Wage Inequality and Is Employment Really Polarizing? (No. w26064). National Bureau of Economic Research. <https://doi.org/10.3386/w26064>
- LACUESTA, A., IZQUIERDO, M. (2012). The contribution of changes in employment composition and relative returns to the evolution of wage inequality: the case of Spain. *Journal of Population Economics*, 25(2), 511-543. <https://doi.org/10.1007/s00148-011-0371-y>
- MACHIN, S. (2011). Changes in UK wage inequality over the last forty years in Gregg, P., Wadsworth, J., ed., *The Labour Market in Winter-The State of Working Britain*. Oxford University Press, pp. 155–169.
- MARTINÁK, D. (2020). Vplyv technologického pokroku na štruktúru zamestnanosti v krajinách V4. *Politická ekonomie*, 68(1), 42-61. <https://doi.org/10.18267/j.polek.1265>
- MAZZOLARI, F., RAGUSA, G. (2013). Spillovers from high-skill consumption to low-skill labor markets. *Review of Economics and Statistics*, 95(1), 74-86. https://doi.org/10.1162/REST_a_00234
- NÁPLAVA, R. (2019). Changing structure of Employment in Europe: Polarization Issue. *Review of Economic Perspectives*, 19(4), 307-318. <https://doi.org/10.2478/revecp-2019-0016>
- NATICCHIONI, P., RICCI, A., RUSTICHELLI, E. (2008). Wage inequality, employment structure and skill-biased change in Italy. *Labour*, 22, 27-51. <https://doi.org/10.1111/j.1467-9914.2008.00416.x>
- NATICCHIONI, P., RAGUSY, G., MASSARI, R. (2014). Unconditional and conditional wage polarization in Europe. Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2502325
- NCHOR, D., ROZMAHEL, P. (2020). Job Polarization in Europe: Evidence from Central and Eastern European Countries. *DANUBE: Law, Economics and Social Issues Review*, 11(1), 52-74. <https://doi.org/10.2478/danb-2020-0004>
- OECD. (2021). Trade in goods and services (indicator). <https://doi.org/10.1787/0fe445d9-en> (Accessed on 19 April 2021)
- PASCALL, G., KWAK, A. (2010). Gender regimes in transition: gender equality in CEE countries. *Welfare states and gender inequality in Central and Eastern Europe*, Brussels: Etui, 117-50.
- SCHÄFER, A., GOTTSCHALL, K. (2015). From wage regulation to wage gap: how wage-setting institutions and structures shape the gender wage gap across three industries in 24 European countries and Germany. *Cambridge Journal of Economics*, 39(2), 467-496. <https://doi.org/10.1093/cje/bev005>

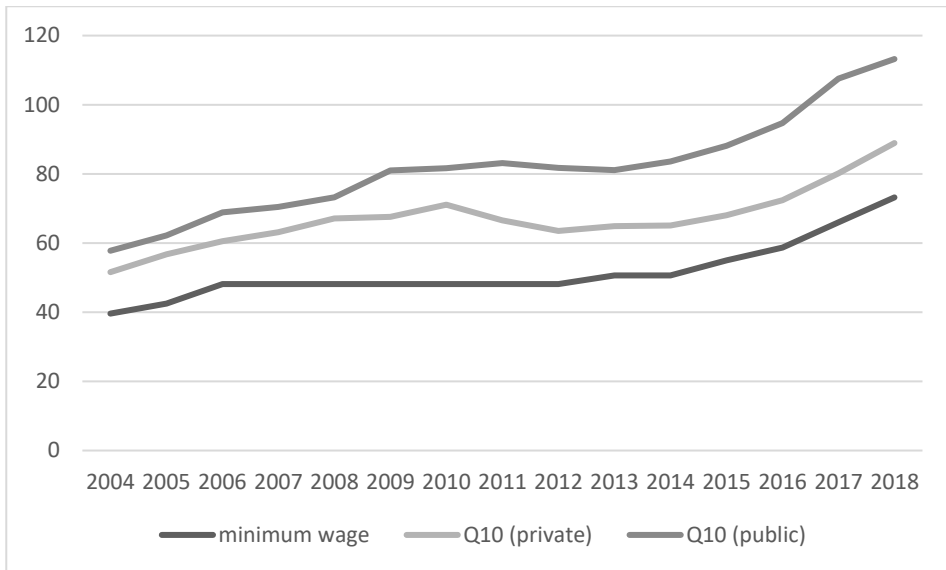
vom LEHN, C. (2019). Labor market polarization, the decline of routine work, and technological change: A quantitative analysis. *Journal of Monetary Economics*, 110, 62-80. <https://doi.org/10.1016/j.jmoneco.2019.01.004>

WANG, W. C. (2009). Information economy and inequality: Wage polarization, unemployment, and occupation transition in Taiwan since 1980. *Journal of Asian Economics*, 20(2), 120-136. <https://doi.org/10.1016/j.asieco.2008.10.004>

WORLDBANK. (2020). Inflation, GDP deflator (annual %) - Czech Republic. Available at: <https://data.worldbank.org/indicator/NY.GDP.DEFL.KD.ZG?locations=CZ&display=graph>

Appendix

Figure 5. Comparison of the minimum wage and lower decile (Q10) in private and public spheres



Note: the development of real wages in CZK. Source: Average Earnings Information System (2019), authors' calculations