Work in Progress –Please don't quote or circulate

October 2018

Inequality of working hours, income inequality, and the role of collective bargaining in Germany

Stefanie Gerold[1] / Ulrike Stein[2]

Abstract

This paper studies the relation between inequalities in working hours and overall earnings inequality in Germany between 2006 and 2014, and the role of declining collective bargaining coverage. Using data from the German Structure of Earnings Survey (SES), a decomposition of earnings inequality by its factor components reveals that hours inequality and the covariance between wages and hours become more important over time in determining earnings inequality. Decompositions of hours inequality based on reweighting suggest that the decline in collective bargaining coverage is able to explain the rise in hours inequality to some extent. Based on RIF regressions, we show that the presence of collective agreements tends to increase working hours at the bottom of the distribution, and lowers them at the top end of the distribution, while controlling for individual and firm-specific characteristics.

Keywords: Inequality, working hours, collective bargaining, decomposition, counterfactual distribution, unconditional quantile regression, RIF-regressions

JEL Classification: J22, J31, J52, C31, D31

[1] Contact details: Email: stefanie-gerold@boeckler.de, Macroeconomic Policy Institute (IMK), 40476 Düsseldorf.
[2] Contact details: Email: ulrike-stein@boeckler.de, Macroeconomic Policy Institute (IMK), 40476 Düsseldorf, Phone: +492117778339.

1 Introduction

A growing body of literature examines the development of earnings inequality, both across and within countries. This research has mostly focused on the rising dispersion of wages. However, individuals' earnings are by definition the product of hourly wages and the number of hours worked. Earnings inequality thus also depends on the distribution of working hours. Because of the growing share of part-time employment, the dispersion of working hours becomes more important in determining earnings inequality. Hours inequality varies substantially across countries (Blau and Kahn, 2011) and has also developed differently over time. For Germany, Checchi et al. (2016) find that hours inequality has increased during the last decades and is responsible for one third of earnings inequality. Besides the variation in working hours, also the correlation between wages and hours has an impact on earnings inequality. This correlation has increased in most countries over time, which means that the best paid workers also work longer hours than lower-income workers (Salverda and Checchi, 2015). This change in the labour supply elasticity thus had an exacerbating effect on earnings inequality. The question remains how the changes in hours inequality and the wage-hours covariance can be explained.

Checchi et al. (2016) interpret their results as a consequence of weaker union power, which prevented a successful bargaining concerning working hours. However, they only provide descriptive evidence. Previous studies have already examined the link between de-unionisation and wage inequality. As collective bargaining is expected to compress wages, decreasing union power is associated with higher levels of wage inequality (Card et al., 2004; DiNardo et al., 1996; Fortin and Lemieux, 1997). Our hypothesis is that reduced union power has similar effects on the dispersion of hours. This assumption is based on the notion of intensive and extensive margins of labour supply. Powerful unions are expected to prevent employers to adjust employees' working hours according to their demand (intensive margin). Instead, they might aim at expanding the number of jobs (extensive margin), which in turn limits the heterogeneity of hours. However, with decreasing union power, employers have the choice which margin to adjust, which in turn might lead to higher hours inequality (Checchi et al., 2016).

To analyse the link between declining union power and hours inequality, we provide a decomposition analysis of earnings inequality for four different subgroups based on gender and collective agreement coverage. To provide more robust evidence, decompositions based on reweighting (DiNardo et al., 1996) allow us to calculate counterfactual scenarios, taking into account a range of personal and firm-based characteristics. Recentered influence function (RIF) regressions (Firpo et al., 2007) enable us to estimate the impact of collective agreements along the whole distribution of hours. This approach

allows us to test whether the presence of collective agreements tends to increase hours worked at the lower tail of the distribution, and lowers them for higher levels of hours, while controlling for individual and firm-specific characteristics.

By putting the emphasis on hours inequality, we aim at broadening the debate on earnings inequality. As we shift the perspective to hours inequality, the results of this research are expected to provide new policy recommendations to mitigate earnings inequality. Furthermore, by looking at the link between hours inequality and collective bargaining coverage, we investigate whether de-unionisation might affect income inequality through an additional channel, beside the established evidence regarding wage inequality.

2 Literature

A growing body of literature provides empirical evidence on rising income inequality. While most of this research focuses on increasing wage dispersion, only few studies take into account the role of working hours inequality.

Blau and Kahn (2011) were among the first breaking down earnings inequality (measured by the variance of log earnings) into its component parts: the variance of log wages, the variance of log work hours, as well as the covariance of log wages and log work hours. The variation in work hours depends on individuals' labour supply decisions, or constraints in realising their preferred hours. The correlation between wages and hours is a further channel through which working hours can either mitigate or enhance overall earnings inequality. If this term is positive, this implies that the best paid employees work relatively long hours, compared to low-income workers, which exacerbates earnings inequality. The wage-hour covariance can be the result of the labour supply elasticity, the way in which wages influence employer hiring decisions, part-time wage penalties or premiums on overtime hours. Covering eight OECD countries, the authors reveal that hours variation explains on average 36% of earnings variation for men, and 54% for women, with substantial variation between countries. In their inequality report, the OECD (2011) took up this approach, providing a decomposition analysis of earnings inequality for 19 OECD countries. Although wage inequality was found to be the most important factor in determining the levels of earnings inequality in most countries, trends in hours worked seem to have a considerable influence on changes in earnings inequality over time. The authors find that working hours declined especially for the bottom quintile of the earnings distribution, which can be seen as a key factor in the rise of income inequality.

Some recent publications provide more comprehensive analyses by investigating components of earnings inequality over time, and attempt to identify underlying causes of rising hours inequality. A

decomposition analysis on earnings inequality for the US, the UK, Germany, and France by Checchi et al. (2016) reveals that the changes in hours play a particularly important role in Germany. Whereas average hours have declined only slightly between 1991 and 2012, the inequality in working hours has increased considerably in Germany, accounting for a third of earnings inequality in 2012. Also the covariance between wages and hours has changed from negative to a positive. This means that Germany has moved from a situation in which those with the lowest hourly wages spent more hours at work, thus partially offsetting wage inequality, to one where the best-paid workers also put in the longest hours. A within-between decomposition (based on skill levels and gender) reveals that especially low-skilled males and high-skilled females are affected by this changing covariance. Although hours inequality is much higher for women than for men, a relatively small between-group component of hours inequality suggests that female part-time employment can explain hours inequality only to a limited extent. The authors interpret their findings as a result of declining union density, which prevented a successful bargaining concerning working hours. Powerful unions are expected to prevent employers to adjust employees' working hours according to their demand (intensive margin). Instead, they might aim at expanding the number of jobs (extensive margin), which increases their bargaining power. This prevents hours to deviate largely from the legally or contractually specified working hours, which in turn limits the heterogeneity of hours. However, with declining union density it can be assumed that employers have the choice which margin to adjust, which might lead to higher levels of hours inequality (Checchi et al., 2016). The authors underpin their hypothesis by plotting the wage-hour covariance against union density. In a related study, (Salverda and Checchi, 2015) provide a more profound evidence based on a regression analysis. In (pseudo-)longitudinal approach covering 30 countries, the authors find mitigating effects of union density as well as minimum wages on hours inequality. A more recent study by (Biewen and Plötze, 2018) focuses on the role of hours in determining German earnings inequality. In addition to the decomposition of changes in the variance of log hours, their analysis also includes an Oaxaca-Blinder decomposition for within-group and between-group variance of working hours to identify determinants of changes in the hours distribution. For both women and men, strong compositional effects of de-unionisation were found in case of the within-group variance.

While research on hours inequality and its underlying mechanisms is still relatively sparse, a large body of literature has examined the causes for rising wage inequality (for an overview, see Fitzenberger, 2012). A series of studies reveal that the rise in wage inequality can partly be explained by de-unionisation, as collective bargaining compresses the wage distribution (e.g. Card et al., 2004; DiNardo et al., 1996; Fortin and Lemieux, 1997). Most of these studies on Anglo-Saxon countries are based on data of individual union membership. However, as collective bargaining is considerably more important for wage setting than union membership in continental Europe, most studies investigating

the link between wage inequality and union power in Germany rely on linked employer-employee datasets providing information on bargaining coverage (Antonczyk et al., 2010; Dustmann et al., 2014; Gerlach and Stephan, 2006).

Working hours are an integral part of collective agreements in Germany. Many measures are available for internal and external flexibility of working hours.[3] However, the flexibilisation of working time in all dimensions (duration, location and distribution) has increased significantly over time. Since the mid-1980s, opening clauses in collective agreements have successively increased the scope to deviate from the collectively agreed standards within the framework of company agreements. Seifert (2006) points out that the most significant flexibility step concerns the distribution of working time. A good three quarters of all companies with works councils make use of opening clauses (Bispinck, 2005). Berg (2008, 133) concludes that "the benefits to employers of flexible working time take many forms and are generally positive, whereas the implications for employees are more mixed." "Whether employees benefit from flexible working time practices depends a great deal on the extent to which they are part of sectoral agreements and represented by works councils." (Berg, 2008, 149).

This study contributes to the existing literature in two ways. First, by using data from the GSES, we are able to specifically examine the role of collective bargaining in determining hours inequality. In comparison to the GSOEP, the GSES also has the advantage to be mandatory with a much larger sampling size. Focusing on the sampling period 2006 to 2014 allows us to largely cover the service sector, which plays an important role in part-time jobs and thus in the inequality of working hours (compared to Biewen/Plötze (2017) only for 2001-2010). Second, with our quantile regression approach we can identify the impact of collective bargaining not only on measures of aggregate inequality, but along the entire distribution of hours.

[3] For further details on different forms of flexibility, see Seifert (2006).

3 Data

Our analysis is based on data from the Structure of Earnings Survey (SES) for Germany. This linked employer-employee dataset has several advantages. First, compared to the German Socio-Economic Panel (SOEP) used by Checchi et al. (2016), its sampling size is much larger, and participation in the SES is compulsory. Also, it provides data on whether a firm applies collective agreements. As the coverage of the service sector is limited in earlier waves of the GSES, we restrict our sample to the years 2006, 2010 and 2014. This allows for a comparable sample over time which also includes most service industries where part-time contracts are more common.

The SES is a linked employer-employee dataset, which implies that the sample is limited to dependent employees. We further restrict our dataset to workers above the age of 20 years and drop those employees in apprenticeship. Before 2014, only firms with at least 10 employees were included in the SES. Our data includes precise information on the number of employees in the local unit, but only three groups regarding the firm size. To take into account the change in the sampling strategy in 2014, we therefore decided to drop all observations with less than 10 employees in the local unit.

We use anonymised microdata (Scientific Use File) provided by Eurostat. This means that several variables, such as regions or economic activity, are broken down to broader categories. Therefore, this dataset comprises fewer specifications in some cases. However, this does not restrain our analysis.

Our main variables of interest include monthly earnings, hourly wages, working hours, as well as collective bargaining coverage. For monthly earnings, we use data on the gross labour income individuals receive in the reference month. Our working hours variable comprises actual working hours remunerated by the employer in the reference month, including overtime. Here, we exclude extreme observations with working hours of less than 10 and more than 390 per month. As the data is collected on the firm level, the number of hours worked only refers to the respective employment, and does not take into account the hours worked in another job. Based on those two variables, we construct the hourly wage rate of individuals. The variable on collective agreements is provided on the firm level, i.e. this variable has the same specification for all employees within the firm, although not all employees might be paid according to a collective agreement. This dummy variable has the value one if either an industry-wide agreement, a company agreement or an employer/works council agreement applies.

Table 1 *Overview on the firm and personal characteristics*

Variable	
Personal characteristics	
Sex	Male Female
Age	20-29 30-39 40-49 50-59 60+
Education	Lower secondary Upper secondary Tertiary education Education unknown
Occupation	Elementary occupations Managers Professionals Technicians and associate professionals Clerical support workers Service and sales workers Skilled agricultural, forestry and fishery workers Craft and related trades workers Plant and machine operators and assemblers
Type of employment contract	Permanent Temporary
Seniority	0-9 years 10-20 years 21-30 years 31+ years
Firm characteristics	
Collective agreement	No collective agreement Collective agreement
Firm size	<50 50-250 >250
Region	West (HE, RP, SL) North (SH, HH, BR, NS, B) South (BW, BY) East (MV, BR, S, SA, T) Middle (NRW) Mining (in West Germany)
Public/private ownership	Public ownership Private ownership
Industry	Mining & quarrying Manufacturing Energy & water Construction Trade Catering Education Health & social work Other services

3.1 Descriptive analysis

Table 2 provides an overview on how monthly earnings, hourly wages, and weekly working hours developed over the years 2006, 2010 and 2014. The values are also provided separately for men and women, as well as for employment relations with and without collective agreements, respectively. We can observe an increase in both overall earnings inequality and wage inequality as represented by several inequality measures. However, wage inequality remained rather constant between 2010 and 2014, and it increased much stronger for men compared to women.

Regarding weekly hours worked, mean hours declined by 1.5 hours between 2006 and 2014, while the median number of hours worked remained rather constant in the period under consideration. This indicates that changes in hours worked have developed differently over the hours distribution. While the 90/50 ratio remained unchanged over time, the 50/10 ratio has increased over time. This indicates that the increasing hours inequality is mostly due to the increase in the dispersion at the lower part of the hours distribution. These developments also become apparent in the histograms and kernel density plots in Figure 1, showing that the lower tails of the distribution become fatter over time, while the peak around full-time hours becomes lower.

Looking at the difference between employment relations with and without collective agreements reveals that in almost all dimensions, the group of employees not covered excert higher inequality measures compared to those covered. This is also reflected by the kernel density plots in Figure 1, suggesting that employment relationships at the lower tail of the hours distribution, and for weekly hours higher than 40 hours are more prevalent among uncovered employment relationships, whereas the densities around full-time working hours are higher for covered relationships.

Table 2: *Comparative statistics and inequality measures*

		All			Male			Female		
Labour earnings	Unit	2006	2010	2014	2006	2010	2014	2006	2010	2014
Mean	Euro	2,534	2,592	2,722	3,040	3,139	3,314	1,893	1,929	2,060
Median	Euro	2,326	2,326	2,439	2,726	2,771	2,928	1,769	1,753	1,854
Inequality measures										
Gini	Index	0.334	0.361	0.376	0.295	0.326	0.339	0.343	0.363	0.379
MLD	Index	0.247	0.283	0.316	0.190	0.232	0.266	0.259	0.282	0.313
Theil	Index	0.199	0.231	0.247	0.159	0.192	0.207	0.201	0.224	0.244
$Theil_2$	Index	0.231	0.277	0.286	0.192	0.234	0.240	0.209	0.248	0.264
Decile ratios										
DR 90/10		6.8	11.1	11.3	3.8	4.8	7.3	8.5	8.8	9.5
DR 90/50		1.9	2.0	2.1	1.8	2.0	2.0	1.9	2.0	2.1
DR 50/10		3.6	5.5	5.5	2.1	2.4	3.7	4.5	4.4	4.6

Wages	Unit	2006	2010	2014	2006	2010	2014	2006	2010	2014
Mean	Euro	16.80	17.55	18.40	18.76	19.66	20.65	14.32	15.01	15.89
Median	Euro	14.89	15.30	15.81	16.39	16.85	17.43	13.27	13.71	14.38
Inequality measures										
Gini	Index	0.272	0.286	0.287	0.277	0.295	0.299	0.242	0.252	0.253
MLD	Index	0.124	0.136	0.134	0.128	0.144	0.145	0.099	0.106	0.103
Theil	Index	0.129	0.144	0.144	0.135	0.152	0.155	0.098	0.107	0.108
$Theil_2$	Index	0.168	0.190	0.189	0.177	0.202	0.203	0.113	0.129	0.129
Decile ratios										
DR 90/10		3.4	3.6	3.5	3.4	3.8	3.8	3.0	3.1	3.0
DR 90/50		1.8	1.9	1.9	1.9	2.0	2.0	1.7	1.7	1.7
DR 50/10		1.9	1.9	1.8	1.8	1.9	1.9	1.8	1.8	1.7

		All			Male			Female		
Weekly hours	Unit	2006	2010	2014	2006	2010	2014	2006	2010	2014
Mean	Euro	33.6	32.5	32.1	37.0	36.0	35.7	29.3	28.3	28.1
Median	Euro	38.4	38.0	38.0	38.9	38.7	38.9	35.0	30.6	30.4
Inequality measures										
Gini	Index	0.160	0.176	0.188	0.103	0.117	0.127	0.215	0.230	0.238
MLD	Index	0.091	0.103	0.124	0.054	0.067	0.088	0.122	0.131	0.149
Theil	Index	0.063	0.073	0.084	0.036	0.045	0.055	0.091	0.099	0.109
$Theil_2$	Index	0.051	0.059	0.067	0.028	0.034	0.041	0.076	0.085	0.092
Decile ratios										
DR 90/10		2.7	3.3	3.9	1.5	2.1	2.4	4.0	4.0	4.2
DR 90/50		1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.3	1.3
DR 50/10		2.6	3.1	3.7	1.3	1.9	2.2	3.5	3.1	3.2

Source: SES, own calculations.

Table 2: *continued*

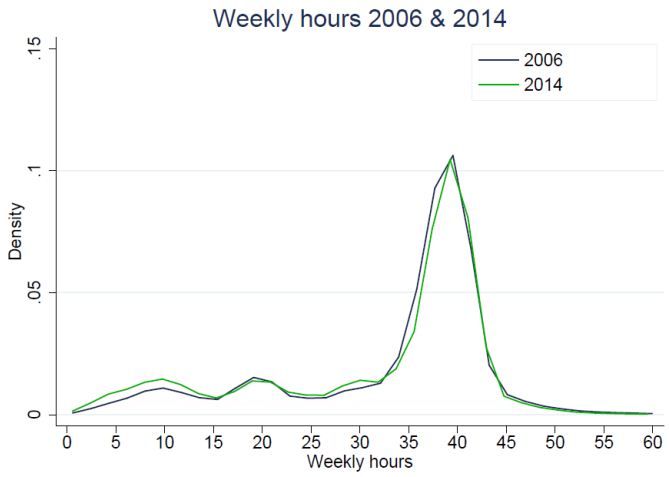
		All			Collective agreement			No collective agreement		
Labour earnings	Unit	2006	2010	2014	2006	2010	2014	2006	2010	2014
Mean	Euro	2,534	2,592	2,722	2,746	2,764	3,030	2,263	2,380	2,398
Median	Euro	2,326	2,326	2,439	2,565	2,555	2,771	2,009	2,069	2,100
Inequality measures										
Gini	Index	0.334	0.361	0.376	0.300	0.339	0.343	0.371	0.384	0.403
MLD	Index	0.247	0.283	0.316	0.196	0.253	0.259	0.302	0.314	0.361
Theil	Index	0.199	0.231	0.247	0.160	0.202	0.206	0.248	0.265	0.287
$Theil_2$	Index	0.231	0.277	0.286	0.177	0.227	0.233	0.314	0.349	0.346
Decile ratios										
DR 90/10		6.8	11.1	11.3	4.5	7.0	7.2	10.2	10.9	11.3
DR 90/50		1.9	2.0	2.1	1.8	1.9	1.9	2.0	2.1	2.2
DR 50/10		3.6	5.5	5.5	2.5	3.7	3.7	5.0	5.2	5.3

		All			Collective agreement			No collective agreement		
Wages	Unit	2006	2010	2014	2006	2010	2014	2006	2010	2014
Mean	Euro	16.80	17.55	18.40	18.44	19.18	20.61	14.71	15.57	16.09
Median	Euro	14.89	15.30	15.81	16.82	17.31	18.35	12.41	12.92	13.32
Inequality measures										
Gini	Index	0.272	0.286	0.287	0.244	0.262	0.263	0.289	0.300	0.294
MLD	Index	0.124	0.136	0.134	0.101	0.116	0.113	0.138	0.149	0.140
Theil	Index	0.129	0.144	0.144	0.104	0.119	0.120	0.154	0.167	0.159
$Theil_2$	Index	0.168	0.190	0.189	0.128	0.147	0.151	0.224	0.249	0.227
Decile ratios										
DR 90/10		3.4	3.6	3.5	3.0	3.5	3.4	3.3	3.5	3.4
DR 90/50		1.8	1.9	1.9	1.7	1.8	1.8	2.0	2.0	2.0
DR 50/10		1.9	1.9	1.8	1.8	1.9	1.9	1.7	1.7	1.7

		All			Collective agreement			No collective agreement		
Weekly hours	Unit	2006	2010	2014	2006	2010	2014	2006	2010	2014
Mean	Euro	33.6	32.5	32.1	33.5	31.8	32.3	33.7	33.4	32.0
Median	Euro	38.4	38.0	38.0	37.5	37.3	37.5	38.9	38.7	38.9
Inequality measures										
Gini	Index	0.160	0.176	0.188	0.145	0.175	0.169	0.177	0.175	0.205
MLD	Index	0.091	0.103	0.124	0.072	0.096	0.099	0.114	0.112	0.150
Theil	Index	0.063	0.073	0.084	0.052	0.069	0.068	0.078	0.077	0.101
$Theil_2$	Index	0.051	0.059	0.067	0.042	0.057	0.055	0.062	0.061	0.080
Decile ratios										
DR 90/10		2.7	3.3	3.9	2.1	2.9	2.9	3.7	3.6	4.1
DR 90/50		1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
DR 50/10		2.6	3.1	3.7	2.0	2.7	2.7	3.4	3.4	3.9

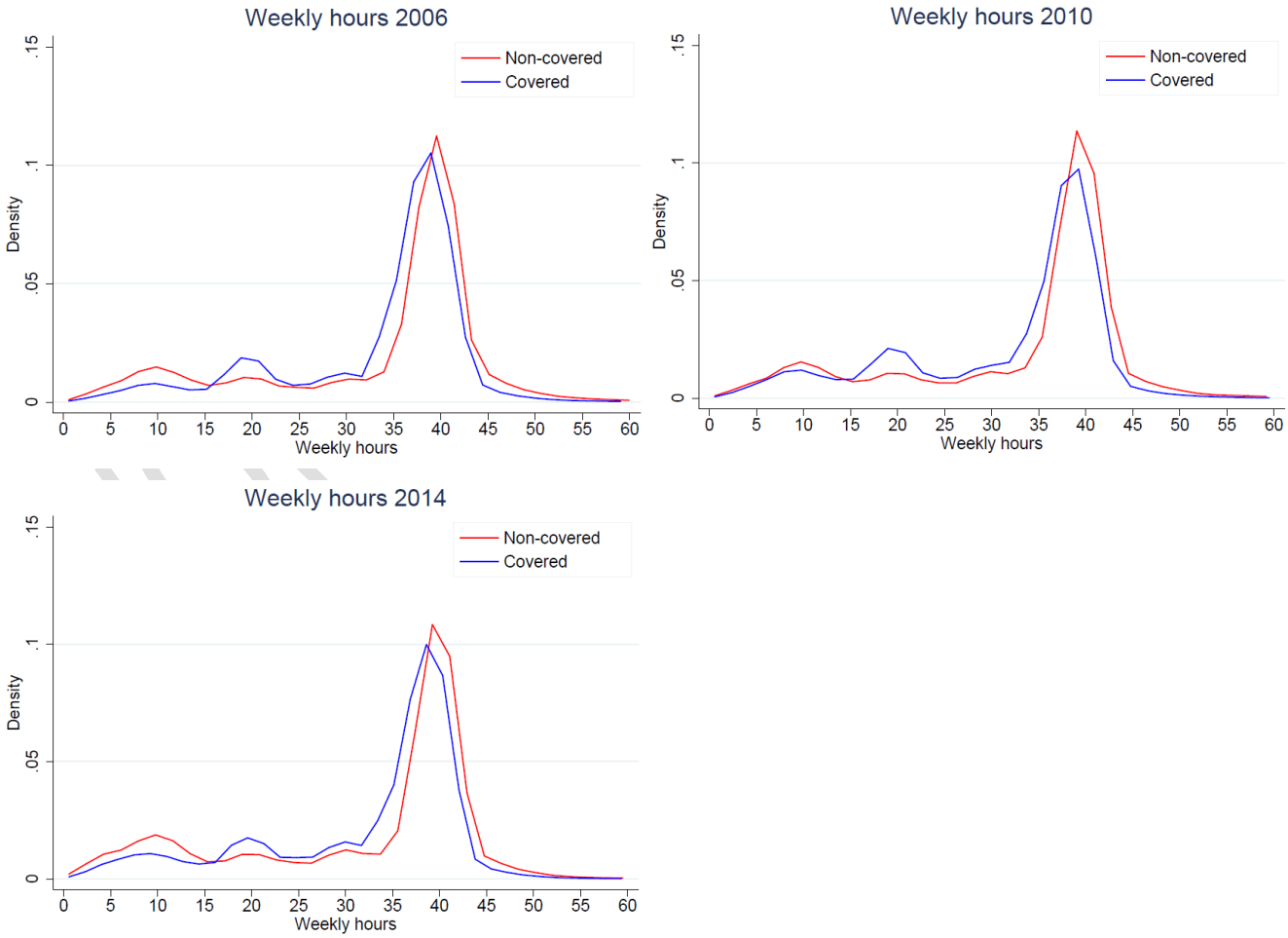
Source: SES, own calculations.

Figure 1: *Kernel density plot on weekly hours, 2006 and 2014*



Source: SES, own calculations.

Figure 2: *Kernel density plot on weekly hours for employment relationships covered and non-covered by collective agreement*



Source: SES, own calculations.

During the period under consideration, the share of collective bargaining decreased notably (Table 3). Between 2006 and 2014, the share of employment relationships covered by a collective agreement declined from 56.17% to 51.22%.

Table 3: *Share of employment relationships with collective agreement*

Year	No collective agreement	Collective agreement
2006	43.83	56.17
2010	44.96	55.04
2014	48.78	51.22

Source: SES, own calculations.

When we split the sample into four groups according to weekly working hours (Table 4), we see that there was an increase in the share of employees working between 2 and 15 hours, and between 15 and 34 hours. On the other hand, the share employees working full-time (34-42 hours) and long hours (more than 42 hours) decreased between 2006 and 2014. This also suggests that the rising hours dispersion is due to an expansion of employment relations at the lower tail of the hours distribution. At the same time, we can observe that the shares of employees working very short or very long hours is much higher in firms where no collective agreement is applied.

Table 4: *Development of weekly working hours according to four groups*

2006 Weekly hours	No collective agreement	Collective agreement	Total
2-15	13.9	7.3	10.2
15-34	14.4	20.6	17.9
34-42	61.3	67.5	64.8
42+	10.3	4.6	7.1
Total	100.0	100.0	100.0

2010 Weekly hours	No collective agreement	Collective agreement	Total
2-15	13.9	11.2	12.4
15-34	15.8	24.5	20.6
34-42	62.2	60.6	61.3
42+	8.2	3.7	5.7
Total	100.0	100.0	100.0

2014 Weekly hours	No collective agreement	Collective agreement	Total
2-15	18.2	10.9	14.5
15-34	16.3	22.7	19.5
34-42	58.1	62.6	60.4
42+	7.4	3.8	5.5
Total	100.0	100.0	100.0

Note: Numbers refer to the proportion of employment relationships in a specific year according to four different hour groups.
Source: SES, own calculations.

4 Decomposition of earnings inequality

In a first step, we provide a decomposition of earnings inequality by factor components. To do this, we chose the mean log deviation (MLD). This inequality measure, also called Theil's L index, belongs to the general entropy (GE) family. For the MLD, the parameter α = 0, which means that this GE indicator is mainly sensitive to changes in the bottom of the distribution. As the distribution of hours mainly changed in the lower tail of the distribution, the MLD seems to be a feasible indicator. Moreover, it is possible to decompose the MLD in an additive way (Duro and Esteban, 1998). This allows us to identify the effects of wage inequality, hours inequality, and a component capturing the correlation between hours and wages.

Following Checchi et al. (2016) earnings inequality (I_y) can be written as the sum of wage inequality (I_w), inequality of hours worked (I_h) and a term ρ that captures the correlation between hours and wages.

$$I_y = I_w + I_h + \ln\left(1 + \frac{cov}{\bar{w}\bar{h}}\right) = I_w + I_h + \rho$$

In Table 5, we report these components of earnings inequality in terms of MLD for the years 2006, 2010 and 2014. As already described before (Table 2), both earnings inequality and hours inequality increased steadily over the observed time period. However, wage inequality only increased between 2006 and 2010. The term ρ is positive throughout all years, suggesting a positive correlation between hours and wages, and thus enhancing earnings inequality additionally. Looking at the components' relative contributions to earnings inequality reveals that the role of wage inequality becomes less important in determining earnings inequality. In contrast, both the relative contributions of hours inequality and of ρ increase over time. This implies that these components became more important in explaining earnings inequality.

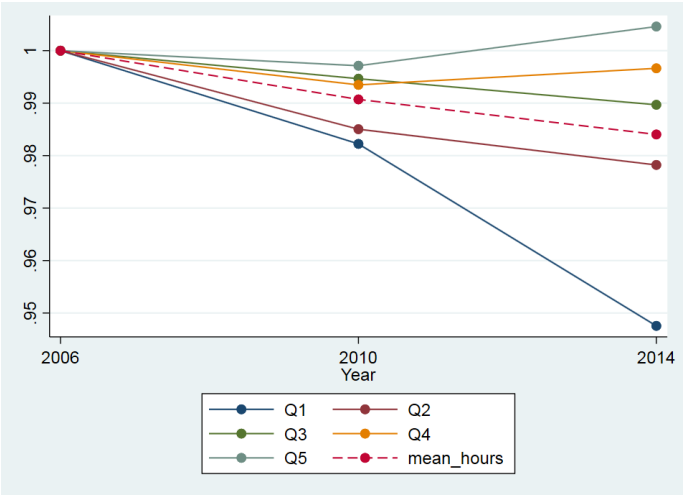
Table 5: *Decomposition of earnings inequality: absolute and relative contributions*

	2006	2010	2014
Earnings	0.247	0.283	0.316
Wages	0.124	0.136	0.134
	(0.50)	*(0.48)*	*(0.42)*
Hours	0.091	0.103	0.124
	(0.37)	*(0.36)*	*(0.39)*
ρ	0.033	0.044	0.058
	(0.13)	*(0.16)*	*(0.18)*

Note: Inequality in earnings, wages and hours is measured by the MLD. ρ denotes the correlation term. Numbers in brackets refer to the relative contributions of the different components to earnings inequality.
Source: SES, own calculations.

The increasing value of *p* over time suggests that employees with lower wages also work fewer hours compared to well-paid employees, thus enhancing inequality in addition. When we split our sample into quintiles according to the ln of hourly wages, we see that working hours developed differently for different wage groups. Plotting the mean working hours for each quintile over time reveals a general decline in average working hours, which is reflected by the dashed line. However, whereas working hours increased slightly for the best paid workers (5th quintile), hours declined most considerably for lower income groups, especially for the first quintile.

Figure 2: *Normalised mean ln weekly hours for wage quintiles*[4]



4.1 Decomposition for different population subgroups

Table 4 showed that employment relationships differ according to whether they are covered by collective agreements, and according to gender. As a consequence, it makes sense to include group differences into the analysis in order to determine whether the development in earnings inequality is due to changes in the structure of employment relationships that have changed overall earnings inequality or whether it is due to changes in inequality within the different groups that caused the change in overall earnings inequality. Splitting the sample into *j* different groups the inequality measure MLD of earnings can then be decomposed into two components: between-group inequality (*B*) and within-group inequality (*W*):

[4] First, observations were split into quintiles based on ln hourly wages. For each wage quintile, the means of ln monthly working hours were calculated for the years 2006, 2010 and 2014. The means are normalised to 1 in 2006.

$$\boldsymbol{MLD} = \frac{\mathbf{1}}{\boldsymbol{n}}\sum_{i=1}^{n} \boldsymbol{ln}\left(\frac{\overline{\boldsymbol{y}}}{\boldsymbol{y}_i}\right) = \sum_{j=1}^{J} \boldsymbol{p}_j \boldsymbol{l}\,\boldsymbol{n}\left(\frac{\overline{\boldsymbol{y}}}{\boldsymbol{y}_j}\right) + \sum_{j=1}^{J} \boldsymbol{p}_j\, \boldsymbol{MLD}_j.$$

Combining this decomposition with the previous decomposition gives a nested decomposition (Checchi at al. 2016) where earnings inequality can be written as the sum of between-group inequality and within-group inequality of wages, hours and the correlation between hours and wages respectively:

$$I_y = B_w + B_h + B_\rho + W_w + W_h + W_\rho$$

Table 6 reports the results of a subgroup decomposition for four different groups according to gender and bargaining coverage. Inequality in earnings and hours, as well as the covariance between wages and hours, are always higher for women. For men, however, wage inequality is higher. We also see that regardless of gender, inequalities are lower for those groups of employees who are employed based on a collective agreement. Between 2006 and 2014, earnings inequality increased for all subgroups. Regarding wage inequality, we can only observe an increase for all subgroups between 2006 and 2010. In contrast, hours inequality increased for some subgroups between 2006 and 2010 and in all subgroups between 2010 and 2014.

Table 6: *Decomposition of earnings inequality for four population subgroups*

2006		**Earnings**	**Wages**	**Hours**	***ρ***	**Popul. share**
Male	**Non-covered**	0.237	0.145	0.072	0.021	0.25
	Covered	0.145	0.104	0.039	0.002	0.31
Female	**Non-covered**	0.310	0.104	0.151	0.054	0.19
	Covered	0.206	0.080	0.100	0.026	0.25
2010						
Male	**Non-covered**	0.258	0.157	0.074	0.027	0.26
	Covered	0.202	0.123	0.061	0.018	0.29
Female	**Non-covered**	0.311	0.110	0.146	0.056	0.19
	Covered	0.252	0.090	0.120	0.042	0.26
2014						
Male	**Non-covered**	0.308	0.152	0.111	0.046	0.27
	Covered	0.209	0.122	0.064	0.023	0.26
Female	**Non-covered**	0.354	0.105	0.179	0.070	0.22
	Covered	0.258	0.086	0.122	0.050	0.25

Source: SES, own calculations.

Table 7 presents the results of the nested decomposition for the years 2006, 2010 and 2014. The largest share of all inequality dimensions are attributable to within-group differences. In the case of hours inequality, this means that, say, female part-time employment only accounts for a small part of hours dispersion.

Table 7: *Decomposition of earnings inequality for four population subgroups*

2006	Earnings	Wages	Hours	ρ
Total	0.247	0.124	0.091	0.033
	(100.0)	*(50.1)*	*(36.6)*	*(13.3)*
Within	0.214	0.108	0.084	0.022
	(86.8)	*(43.8)*	*(33.9)*	*(9.1)*
Between	0.033	0.016	0.007	0.010
	(13.2)	*(6.3)*	*(2.7)*	*(4.2)*
2010				
Total	0.283	0.136	0.103	0.044
	(100.0)	*(48.0)*	*(36.5)*	*(15.6)*
Within	0.250	0.121	0.096	0.034
	(88.4)	*(42.6)*	*(33.9)*	*(12.0)*
Between	0.033	0.015	0.007	0.010
	(11.6)	*(5.4)*	*(2.6)*	*(3.6)*
2014				
Total	0.316	0.134	0.124	0.058
	(100.0)	*(42.4)*	*(39.2)*	*(18.5)*
Within	0.280	0.117	0.116	0.046
	(88.6)	*(37.1)*	*(36.9)*	*(14.7)*
Between	0.036	0.017	0.007	0.012
	(11.4)	*(5.3)*	*(2.3)*	*(3.8)*

Source: SES, own calculations.

This subgroup decomposition suggests that the decline in collective agreements might indeed have an effect on increasing (hours) inequality. However, looking at between- and within-group effects has several limitations. First, these four groups might also be different in terms of their distribution of other characteristics, such as age, education, industry etc. Accounting for all these covariates would make the number of groups very large. Moreover, this approach does not allow for identifying the effects of each covariate's specific contribution, i.e. to perform a detailed decomposition. Another drawback refers to the fact that it is not possible to apply this approach to several other inequality measures such as interquartile ranges or the probability density function. This makes it impossible to look at changes at different points in the distribution. In order assess the effect of collective agreements on hours inequality, we now turn to more advanced decomposition methods, including reweighing and quantile regressions.

5 Reweighting approach

The reweighting approach goes back to DiNardo et al. (1996) (DFL in the following), who propose a simple strategy to arrive at counterfactual distributions. The underlying idea is to replace the marginal distribution of X for group A with the marginal distribution of X for group B using a reweighting factor ψ(X). The DFL reweighting method can be understood in analogy to the propensity score reweighting method commonly used in the treatment effects literature (Hirano et al., 2003). Applying DFL reweighting to changes of inequality over time implies that time is seen as state variable, or as treatment. To assess the impact of a set of covariates on changes in the distribution over time, this approach relies on constructing a counterfactual state of the world where these specific covariates remained fixed in time. To construct the counterfactual distribution of hours (or wages) that would prevail for workers in group A if they had the characteristics of group B, we can use the following reweighting factor $\psi(X) = \frac{dF_{X_B}(X)}{dF_{X_A}(X)}$.

Using Bayes' rule, this ratio of two multivariate marginal distribution functions can be simplified to

$$P(X|D_B = 1) = \frac{\Pr(D_B = 1|X) \cdot dF(X)}{\int_X \Pr(D_B = 1|X) \cdot dF(X)} = \frac{\Pr(D_B = 1|X)}{\Pr(D_B = 1)}$$

in the case of $D_B = 1$, and a similar expression for $D_B = 0$. As $dF_{X_B}(X) = \Pr(X|D_B = 1)$, the reweighting factor that keeps all conditioning variables as in period 0 can be written as

$$\psi(X) = \frac{(\Pr(X|D_B = 1)}{(\Pr(X|D_B = 0)} = \frac{\Pr(D_B = 1|X)\,/\Pr(D_B = 1)}{\Pr(D_B = 0|X)\,/\Pr(D_B = 0)}.$$

In practice, we follow the approach of DFL who suggest running a logit or probit model for the probability of belonging to group B, $\Pr(D_B = 1|X)$, and compute the reweighting factor by using this predicted probability, as well as the predicted probability of belonging to group A, $1 - \Pr(D_B = 1|X)$, and the sample proportions in group B and A:

$$\hat{\psi}(X) = \frac{\widehat{\Pr}(D_B = 1|X)\,/\widehat{\Pr}(D_B = 1)}{\widehat{\Pr}(D_B = 0|X)\,/\widehat{\Pr}(D_B = 0)}$$

Although DFL focus on the estimation of counterfactual densities using kernel density methods, various distributional statistics can be computed using the reweighting factor, either based on the counterfactual density or the counterfactual distribution. The DFL reweighting approach allows us to quantify the extent to which changes in the distribution are due to changes in the characteristics of the workforce (composition effect), and an "unexplained" effect. It thus represents an extension of the

standard Oaxaca-Blinder decomposition on the difference in mean outcomes for two groups (Blinder, 1973; Oaxaca, 1973). In terms of changes in the distribution, we can write down the overall difference of some distributional statistic *v* between two groups as:

$$\Delta_O^v = v(F_B) - v(F_A) = v_B - v_A.$$

Given that the distribution of covariates X is different across groups, we can decompose this equation into two parts: $\Delta_O^v = (v_B - v_C) + (v_C - v_A) = \Delta_S^v + \Delta_X^v,$

where v_c refers to the counterfactual situation, Δ_S^v represents the unexplained component, and Δ_X^v the composition effect.

In our analysis, the two groups A and B correspond to the years 2006 and 2014, respectively. In a first step, we construct a counterfactual density of working hours that would have prevailed in 2014 if all observed characteristics would have remained at their 2006 level. The results are presented in table 8, panel A1. Most of the changes in hours inequality can be traced back to the composition effect, i.e. the changes in covariates. As we are specifically interested in the contribution of the declining coverage of collective bargaining on hours inequality, in a second step we construct another counterfactual density, only holding collective bargaining coverage constant at its 2006 level (Table 8, panel A2). As we only hold one covariate constant, the composition effect becomes much smaller. However, in case of almost all inequality measures, it remains positive, suggesting that if collective bargaining coverage would have remained stable over time, inequality in working hours would have been lower in 2014.

Table 8: *Decomposition of inequality of log hours, DFL reweighting*

Inequality measure	**Standard Deviation**	**90-10**	**90-50**	**50-10**	**95-5**	**95-50**	**50-5**	**Gini**	**MLD**	**Theil**	**Theil2**
A. Overall hours inequality											
A1. All covariates in 2014 reweighted to 2006											
Unadjusted change (2014 – 2006)	0.090	0.356	0.001	0.356	0.216	-0.020	0.236	0.016	0.008	0.006	0.005
Composition effect	0.057	0.254	0.000	0.254	0.192	-0.005	0.198	0.013	0.004	0.004	0.003
	(62.8)	*(71.2)*	*(0.0)*	*(71.4)*	*(89.2)*	*(27.0)*	*(83.9)*	*(79.1)*	*(58.8)*	*(63.6)*	*(67.2)*
Unexplained effect	0.034	0.103	0.001	0.102	0.023	-0.015	0.038	0.003	0.003	0.002	0.002
	(37.2)	*(28.8)*	*(100.0)*	*(28.6)*	*(10.8)*	*(73.0)*	*(16.1)*	*(20.9)*	*(41.2)*	*(36.4)*	*(32.8)*
A2. Bargaining coverage in 2014 reweighted to its 2006 level											
Unadjusted change (2014 – 2006)	0.090	0.356	0.001	0.356	0.216	-0.020	0.236	0.016	0.008	0.006	0.005
Composition effect	0.002	0.022	0.000	0.022	0.025	-0.005	0.031	0.001	0.000	0.000	0.000
	(2.0)	*(6.2)*	*(0.0)*	*(6.2)*	*(11.8)*	*(27.0)*	*(13.1)*	*(6.5)*	*(0.7)*	*(2.2)*	*(3.2)*
Unexplained effect	0.088	0.334	0.001	0.334	0.190	-0.015	0.205	0.015	0.008	0.006	0.005
	(98.0)	*(93.8)*	*(100.0)*	*(93.8)*	*(88.2)*	*(73.0)*	*(86.9)*	*(93.5)*	*(99.3)*	*(97.8)*	*(96.8)*

Note: Numbers refer to percentage changes in decile ratios. Unadjusted change refers to the change in the decile ratios between 2006 and 2014. The composition effect indicates the difference between 2006 and the reweighted distribution in 2014. The unexplained effect refers to the difference between the counterfactual distribution in 2014 and the observed distribution in 2014. Numbers in brackets indicate the relative contribution of each effect on the unadjusted change.

6 Unconditional quantile regression

Another approach to assess the impact of covariates on the distribution of independent variables are *unconditional quantile regressions* (UCQ) (Firpo et al., 2009). Quantile regressions are a useful tool when we assume that the effects of an independent variable varies along the distribution of the dependent variable. In contrast to OLS, which estimates the effect of *y* on the mean of *x*, quantile regressions allow for analysing the effect along the whole distribution of *y*.

Conventional quantile regression defines quantiles conditional on the control variables (Koenker, 2005). Such *conditional quantile regressions* (CQR) thus redefine the quantiles. With regard to our case, a CQR would estimate how collective agreements affect working hours at different points of the conditional hours distribution, i.e. for employees with different values of working hours but similar covariate values. However, as we are interested on whether collective agreements compress the distribution of working hours, the application of unconditional quantile regressions is more appropriate. UQR enables us to investigate the effects of a treatment variable on the unconditional (marginal) distribution of the outcome variable. This means that the quantiles are defined before the regression, regardless of the covariates to be included in the model (Killewald and Bearak, 2014).

This approach has been introduced by (Firpo et al., 2009), who propose regressions based on the recentred influence function (RIF). The influence function $IF(Y; v, F_Y)$ measures the influence of an individual observation on the distributional statistic of interest $v(F_Y)$, such as quantiles, the variance or Gini. If we add the statistic $v(F_Y)$ back to the influence function, we receive the recentered influence function $RIF(y; v) = v(F_Y) + IF(y; v)$, with its expectation equal to $v(F_Y)$. The RIF regression model then corresponds to the conditional expectation of the $RIF(Y; v, F_Y)$ modelled as a function of the explanatory variables, $E[RIF(Y; v, F_Y)\ |X] = m_\tau(X)$. RIF-regressions are based on OLS, but with the dependent variable being replaced by the RIF of the statistic of interest. Instead of estimating the marginal effect of *x* on the mean of *y*, this approach estimates the impact of a small change in *x* on any distributional statistic of *y*.

In the case of quantiles as our distributional statistic, the influence function for the τ-th quantile is $IF(Y; q_\tau, F_Y)$, which is equal to $(\tau - \mathbb{1}\{Y \leq q_\tau\})/f_Y(q_\tau)$. $RIF(Y; q_\tau, F_Y)$ is thus equal to $q_\tau + IF(Y; q_\tau, F_Y)$. Its conditional expectation $E[RIF(Y; q_\tau, F_Y)\ |X] = m_\tau(X)$ is equivalent to unconditional quantile regression, as the average derivative of the UQR, $E[m'_\tau(X)]$, equals the marginal effect on

the unconditional quantile of a slight shift in the distribution of control variables, holding everything else constant.[5]

UQR has recently been applied to evaluating the impact of minimum wages on the earnings distribution (Aeberhardt et al., 2016), or the distributive effects of education on earnings in Argentina (Alejo et al., 2014). As RIF regressions do not allow for clustering standard errors, inference is usually conducted by bootstrapping.

In the following, we present the results of an UQR analysis for various quantiles of log working hours. Table 9 provides the results of a standard OLS regression together with the RIF-coefficients of various quantiles for 2014. The effect of collective agreements on hours worked is heterogenous across the distribution of hours. While the coefficients of the collective agreement are positive for lower hours, the decline and become negative at higher quantiles. While the OLS coefficient represents the mean effect on log hours, the five quantiles analysed correspond to weekly hours of approximately 10, 20, 30, 40, and 48 hours, respectively.

These findings suggest that the presence of collective agreements tend to increase working hours at the bottom of the distribution, and decreases them at the top of the distribution, while controlling for personal and firm characteristics. These findings suggest that the presence of collective agreements indeed have a mitigating effect on hours inequality, which supports our hypothesis.

[5] For our analysis, we use the user-written command `rifreg` in Stata provided by Firpo et al.

Table 9: *OLS and Unconditional Quantile Regression Coefficients on Log Hours for 2014.*

	OLS	10 hours	20 hours	30 hours	40 hours	48 hours
Collective agreement	0.022	0.140	0.026	0.008	-0.031	-0.042
	(0.005)***	(0.027)***	(0.002)***	(0.002)***	(0.000)***	(0.003)***
Female	-0.181	-0.135	-0.131	-0.273	-0.028	-0.073
	(0.007)***	(0.024)***	(0.002)***	(0.003)***	(0.000)***	(0.003)***
Age 30-39	0.063	0.283	0.052	-0.001	0.003	0.015
	(0.011)***	(0.043)***	(0.003)***	(0.003)	(0.000)***	(0.005)***
Age 40-49	0.003	0.172	0.006	-0.072	-0.001	0.030
	(0.010)	(0.027)***	(0.003)*	(0.004)***	(0.000)***	(0.005)***
Age 50-59	-0.010	0.105	-0.004	-0.072	-0.003	0.036
	(0.009)	(0.019)***	(0.003)	(0.004)***	(0.000)***	(0.005)***
Age >60	-0.301	-0.634	-0.298	-0.336	-0.018	-0.002
	(0.010)***	(0.106)***	(0.005)***	(0.005)***	(0.001)***	(0.005)
High-school	-0.022	-0.121	-0.026	-0.002	-0.000	-0.001
	(0.006)***	(0.026)***	(0.003)***	(0.003)	(0.000)	(0.005)
Tertiary education	-0.039	-0.231	-0.041	-0.000	0.011	-0.004
	(0.013)***	(0.042)***	(0.004)***	(0.004)	(0.001)***	(0.005)
Managers	0.785	2.044	0.690	0.673	0.056	-0.003
	(0.012)***	(0.330)***	(0.008)***	(0.008)***	(0.001)***	(0.011)
Professionals	0.728	1.993	0.649	0.592	0.047	-0.011
	(0.014)***	(0.323)***	(0.007)***	(0.007)***	(0.001)***	(0.005)**
Techn./professionals	0.671	1.794	0.599	0.560	0.030	0.006
	(0.012)***	(0.292)***	(0.007)***	(0.006)***	(0.000)***	(0.004)
Clerical support workers	0.650	1.814	0.584	0.508	0.024	-0.007
	(0.011)***	(0.293)***	(0.007)***	(0.006)***	(0.000)***	(0.004)
Service / sales workers	0.448	1.395	0.419	0.311	0.010	-0.010
	(0.012)***	(0.228)***	(0.006)***	(0.005)***	(0.000)***	(0.004)***
Skilled agric., forestry, fishery workers	0.621	1.635	0.544	0.516	0.028	0.023
	(0.031)***	(0.268)***	(0.021)***	(0.018)***	(0.003)***	(0.029)
Craft / trades workers	0.681	1.833	0.599	0.563	0.030	0.087
	(0.011)***	(0.297)***	(0.007)***	(0.006)***	(0.001)***	(0.008)***
Plant/machine operators	0.626	1.657	0.525	0.496	0.034	0.292
	(0.012)***	(0.266)***	(0.007)***	(0.006)***	(0.000)***	(0.012)***
Temporary contract	-0.055	-0.093	-0.041	-0.078	-0.006	0.009
	(0.012)***	(0.017)***	(0.003)***	(0.003)***	(0.000)***	(0.004)**
Seniority 10-20	0.105	0.329	0.092	0.069	-0.003	-0.005
	(0.004)***	(0.052)***	(0.003)***	(0.002)***	(0.000)***	(0.004)
Seniority 20-30	0.134	0.444	0.113	0.096	-0.006	-0.030
	(0.006)***	(0.071)***	(0.003)***	(0.003)***	(0.000)***	(0.005)***
Seniority >30	0.194	0.706	0.149	0.123	-0.005	-0.025
	(0.012)***	(0.108)***	(0.004)***	(0.004)***	(0.000)***	(0.006)***
Firm size 50-250	0.135	0.388	0.115	0.112	0.005	0.012
	(0.006)***	(0.062)***	(0.003)***	(0.003)***	(0.000)***	(0.004)***
Firm size >250	0.097	0.325	0.093	0.090	-0.007	-0.025
	(0.007)***	(0.052)***	(0.003)***	(0.003)***	(0.000)***	(0.004)***
NRW	-0.039	-0.121	-0.045	-0.038	0.001	0.001
	(0.010)***	(0.023)***	(0.004)***	(0.003)***	(0.000)***	(0.004)
West	-0.036	-0.101	-0.041	-0.042	0.003	-0.007
	(0.008)***	(0.019)***	(0.003)***	(0.003)***	(0.000)***	(0.004)
South	-0.046	-0.145	-0.040	-0.040	0.004	-0.008
	(0.008)***	(0.022)***	(0.002)***	(0.003)***	(0.000)***	(0.004)**
East	0.097	0.206	0.107	0.133	0.028	-0.038
	(0.007)***	(0.037)***	(0.002)***	(0.003)***	(0.000)***	(0.004)***
Mining West G.	0.193	0.104	0.204	0.211	0.074	0.728
	(0.047)***	(0.040)***	(0.026)***	(0.026)***	(0.004)***	(0.069)***
Public ownership	-0.008	-0.064	-0.034	-0.023	0.005	0.004
	(0.010)	(0.014)***	(0.004)***	(0.003)***	(0.000)***	(0.004)
Missing information on ownership	-0.022	-0.037	-0.016	-0.012	-0.001	-0.004
	(0.008)***	(0.008)***	(0.002)***	(0.002)***	(0.000)**	(0.005)

Mining & quarrying	-0.040	0.012	-0.121	-0.107	-0.016	-0.095
	(0.046)	(0.034)	(0.025)***	(0.025)***	(0.003)***	(0.026)***
Manufacturing	0.082	0.195	0.075	0.089	0.007	-0.051
	(0.006)***	(0.030)***	(0.003)***	(0.002)***	(0.000)***	(0.005)***
Energy & water	0.122	0.301	0.086	0.097	-0.006	0.053
	(0.010)***	(0.049)***	(0.004)***	(0.005)***	(0.001)***	(0.011)***
Construction	0.147	0.273	0.105	0.103	0.043	0.026
	(0.008)***	(0.046)***	(0.004)***	(0.004)***	(0.001)***	(0.011)**
Trade	0.044	0.164	0.031	0.014	0.005	-0.032
	(0.007)***	(0.028)***	(0.003)***	(0.003)***	(0.000)***	(0.005)***
Catering	-0.091	-0.160	-0.074	-0.058	-0.004	-0.050
	(0.014)***	(0.039)***	(0.006)***	(0.005)***	(0.001)***	(0.004)***
Education	-0.127	-0.313	-0.070	-0.150	0.003	-0.009
	(0.028)***	(0.046)***	(0.005)***	(0.005)***	(0.001)***	(0.004)**
Health & social work	-0.019	0.047	-0.020	-0.072	-0.010	-0.013
	(0.008)**	(0.019)**	(0.004)***	(0.004)***	(0.000)***	(0.004)***
Constant	4.242	1.925	3.966	4.550	5.176	5.407
	(0.014)***	(0.303)***	(0.007)***	(0.006)***	(0.001)***	(0.009)***
R^2	0.30	0.18	0.25	0.28	0.21	0.02
N			723,565			

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

*Note: Bootstrapped standard errors (100 repetitions) are in parentheses. Statistical significance levels: * p<0.1; ** p<0.05; *** p<0.01. The base group is made up of male employees without collective agreement, between 20 and 29 years old, with secondary education, in the service sector, with a permanent contract, a tenure up to 10 years, in Northern Germany, and in a mainly privately own firm with 10 to 50 employees.*
Source: SES, own calculations.

7 Discussion and Conclusion

This paper analyses the role of hours inequalities in determining overall earnings inequality. Using data from the German Structure of Earnings Survey (SES) for 2006, 2010 and 2014 reveals that both hours inequality and the correlation between hours and wages rises during the observed period, and becomes more important in explaining overall earnings inequality. At the same time, the share of earnings inequality that can be explained by wage inequality declined from 50% to 42%. Decomposing earnings inequality for four population groups (based on gender and collective bargaining coverage) further reveals that inequalities are higher for women and uncovered employees. To provide more robust evidence on the effect of declining bargaining coverage on hours inequality, decompositions based on reweighting allow us to calculate counterfactual scenarios. Holding collective bargaining coverage at its 2006 levels suggests that hours inequality would have increased less strongly than we can observe. Our hypothesis that collective bargaining might provide a tool to curb the rising dispersion in working hours is also supported by a RIF-regression analysis. The coefficients on our collective agreement variable are positive at the lower end of the hours distribution, and turn negative for higher amounts of hours. Overall, our results suggest that union presence is not only able to compress wage inequality, as shown by previous research, but might also reduce hours inequality. As the dispersion of hours has been shown to become more important in determining earnings inequality in Germany, these insights are of increasing relevance.

8 References

Aeberhardt, R., Givord, P., and Marbot, C. (2016). Spillover effect of the Minimum Wage in France: An UnconditionalQuantile Regression (Center for Research in Economics and Statistics).

Alejo, J., Gabrielli, M.F., and Sosa-Escudero, W. (2014). The Distributive Effects of Education: An Unconditional Quantile Regression Approach. Rev. Anal. Econ. – Econ. Anal. Rev. *29*, 53–76.

Antonczyk, D., Fitzenberger, B., and Sommerfeld, K. (2010). Rising wage inequality, the decline of collective bargaining, and the gender wage gap. Labour Econ. *17*, 835–847.

Berg, P. (2008). Working Time Flexibility in the German Employment Relations System: Implications for Germany and Lessons for the United States. Ind. Beziehungen - Z. Fuer Arb. Organ. Manag. - Ger. J. Ind. Relat. *15*, 111–132.

Biewen, M., and Plötze, D. (2018). The Role of Hours Changes for the Increase in German Earnings Inequality (Institute for the Study of Labor (IZA)).

Bispinck, R. (2005). Betriebsräte, Arbeitsbedingungen und Tarifpolitik. WSI-Mitteilungen *6*, 301–307.

Blau, F.D., and Kahn, L.M. (2011). Inequality and Earnings Distribution. In The Oxford Handbook of Economic Inequality, B. Nolan, W. Salverda, and T.M. Smeeding, eds. (Oxford University Press), pp. 177–203.

Blinder, A.S. (1973). Wage Discrimination: Reduced Form and Structural Estimates. J. Hum. Resour. *8*, 436–455.

Card, D., Lemieux, T., and Riddell, W.C. (2004). Unions and wage inequality. J. Labor Res. *25*, 519–559.

Checchi, D., García-Peñalosa, C., and Vivian, L. (2016). Are changes in the dispersion of hours worked a cause of increased earnings inequality? IZA J. Eur. Labor Stud. *5*.

DiNardo, J., Fortin, N.M., and Lemieux, T. (1996). Labor Market Institutions and the Distribution of Wages, 1973-1992: A Semiparametric Approach. Econometrica *64*, 1001–1044.

Dustmann, C., Fitzenberger, B., Schönberg, U., and Spitz-Oener, A. (2014). From Sick Man of Europe to Economic Superstar: Germany's Resurgent Economy. J. Econ. Perspect. *28*, 167–188.

Firpo, S., Fortin, N., and Lemieux, T. (2007). Decomposing Wage Distributions using Recentered Influence Functions Regressions. Mimeo Univ. Br. Columbia.

Firpo, S., Fortin, N.M., and Lemieux, T. (2009). Unconditional Quantile Regressions. Econometrica *77*, 953–973.

Fitzenberger, B. (2012). Expertise zur Entwicklung der Lohnungleichheit in Deutschland (Arbeitspapier, Sachverständigenrat zur Begutachtung der Gesamtwirtschaftlichen Entwicklung).

Fortin, N.M., and Lemieux, T. (1997). Institutional changes and rising wage inequality: is there a linkage? J. Econ. Perspect. *11*, 75–96.

Gerlach, K., and Stephan, G. (2006). Bargaining Regimes and Wage Dispersion. Jahrb. Für Natl. Stat. J. Econ. Stat. *226*, 629–645.

Hirano, K., Imbens, G.W., and Ridder, G. (2003). Efficient Estimation of Average Treatment Effects Using the Estimated Propensity Score. Econometrica *71*, 1161–1189.

Killewald, A., and Bearak, J. (2014). Is the Motherhood Penalty Larger for Low-Wage Women? A Comment on Quantile Regression. Am. Sociol. Rev. *79*, 350–357.

Koenker, R. (2005). Quantile regression (Cambridge ; New York: Cambridge University Press).

Oaxaca, R. (1973). Male-Female Wage Differentials in Urban Labor Markets. Int. Econ. Rev. *14*, 693–709.

OECD (2011). Divided We Stand. Why Inequality Keeps Rising (OECD Publishing).

Salverda, W., and Checchi, D. (2015). Labor Market Institutions and the Dispersion of Wage Earnings. In Handbook of Income Distribution, A.B. Atkinson, and F. Bourguignon, eds. (Elsevier), pp. 1535–1727.

Seifert, H. (2006). Was hat die Flexibilisierung des Arbeitsmarktes gebracht? WSI-Mitteilungen *11*, 601–608.