German labor unions: Shaping occupational trends and earnings across routine jobs

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Abstract: This paper uses individual data from the German Socio-Economic Panel (SOEP) to examine occupational trends and earnings returns to routine jobs over the period 1985-2019. Initially, we observe a significant decline in the returns to routine task intensity (RTI), suggesting a reduced demand for routine jobs. However, once unionized workers are taken into account, this decline is reversed and becomes positive and highly significant. This highlights the role of unions in mitigating wage declines in routine occupations, consistent with results of Parolin (2021) for the U.S. labor market. Interestingly, controlling for unionization eliminates the statistical significance of the linear time trend, suggesting that unionized workers are increasingly specializing in non-routine occupations. Moreover, we find that demand for unionized workers does not decline significantly, as in the case of non-unionized workers.

Keywords: labor unions, routine occupation, automation
JEL Classification: J23, J31, J51

1 Introduction

In the last four decades, wage polarization has been significantly increasing in all developed countries (Autor, Katz, and Kearney 2008; Goldin and Katz 2009; Acemoglu and Restrepo 2019; Dustmann, Ludsteck, and Schönberg 2009). Labor market scholars suspect that new technologies could be one of the major driving factors behind unfavorable changes in earning distribution. A very influential argument was made that technologies have a skills-biased effect on labor demand (Tinbergen 1974). Katz and Murphy (1992) observed that despite the increase in the supply of more educated workers the education (wage) premium increased. This well-documented fact was caused by steadily rising labor demand that is biased toward highly educated labor. However, this framework could not explain why low and high-paid service occupations experienced large employment and earning growth at the expense of middle-pay occupations (Goos and Manning 2007). The second flaw of this model lies in the fact that it is not able to explain why wages of low-educated workers fall (not stagnate) substantially (Autor 2022). Later, scholars introduced a concept of task-routines (Autor, Levy, and Murnane 2003; Acemoglu and Autor 2011; Acemoglu and Restrepo 2018) that could account for wage polarization better. Based on the conceptualization of the production process to a set of tasks, that could be either performed by the technology (machines, robots, or AI) - routine tasks, and those that require a higher level of creativity or are performed in a non-controlled environment - non-routine technology could directly complement those, that are non-routine and directly replace those that are routine. Since the most routine occupations are in the middle of the income distribution, these occupations are directly replaced by machines, causing a decline in employment shares. Workers from these high routine-task intensive occupations from the middle of the income distribution tend to move to the lower-paid occupations, where they exert downward pressure on wages (Acemoglu and Autor 2011). In Germany, Dustmann, Ludsteck, and Schönberg (2009) documented that since 1980 wage growth at the top of the wage distribution experienced the largest growth and the middle-tier group of workers experienced slower growth than the bottom of the wage distribution. A similar but more pronounced trend was documented for the U.S. (Autor and Dorn 2013).

In addition to the technology-based explanation, another strand of the literature sees institutional changes as a key driver of wage polarization, such as a secular decline in union density and the minimum wage (Fortin and Lemieux 1997), or changes in the composition of the labor force (Lemieux 2006), or an increase in foreign competition (Feenstra and Hanson 1999; Autor, Dorn, and Hanson 2013). Empirical studies documenting that the impact of technology on wages and employment depends on these institutional changes are numerous. In Germany, Fitzenberger, Kohn, and Wang (2006) documented that the strong deunion- ization that began in the 1990s contributed significantly to the increase in wage inequality at the bottom of the income distribution. Fitzenberger, Kohn, and Lembcke (2013) further add evidence that

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higher union coverage reduces wage dispersion by increasing wages at the bottom of the income distribution and reducing wages of those at the top of the income distribution. In the U.S. labor market, Parolin (2021) examined the relationship between trends in the earnings returns to occupational routine task intensities, given changes in union densities. He found that if union coverage had remained stable, the polarization of earnings driven by highly routine occupations would not have occurred. Despite of moderating effect of labor market institutions, Kostøl and Svarstad (2023) showed that the moderating effect of trade unions has bi-directional causation. On the one hand, workers who specialize in more routine occupations enjoy higher union premiums compared to non-routine workers, which consequently positively contribute to technological change.

To investigate how earning and employment trends differ across unionized workers who are employed across different routine task intensities occupations (RTI), I will make use of the German Socio-Economic Panel (SOEP) from 1985-1993 (West Germany) and 1993-2019 (East and West Germany) to study the wage premium (1990-2019) and employment trends (1985- 2019) across routine and non-routine occupation. I borrowed the proposed hypothesis from Parolin (2021) and investigated whether trade union membership inhibits declining earning returns to an occupation's RTI, and whether this higher earning potentially has a declining effect on the employment of higher RTI occupations. The main findings of the paper can be summarized as follows. I found a declining trend in the return to routine jobs, and unions appear to mitigate this decline, although their impact is not economically significant. I also document a declining trend in the employment of routine jobs, and it appears that unions play a moderating role in slowing this decline.

After I decompose the employment trends into manufacturing, mining, and all other non-manufacturing sectors, I document a rising number of routine occupations in manufacturing and a declining number of routine occupations in manufacturing. On the one hand, I observe a significant moderating effect of organized workers in the non-manufacturing sector, but surprisingly, the same effect is absent in the manufacturing sectors.

The rest of the paper is structured as follows. Section 2 describes the methods and data used in the paper. Section 3 discusses the main results, and section 4 concludes.

2 Empirical specification and data

The German Socio-Economic Panel (SOEP) created by Goebel et al. (2019) is a longitudinal survey of approximately 15,000 private households in West Germany from 1984 to 2021 and East Germany from 1990 to 2021 (release 2023). Since the union membership was asked for the first time in 1985 and 2019. I restrict my analysis to this period. To estimate the earning returns across different routine task intensities, I follow the specification from Goos, Manning, and Salomons (2014) and Parolin (2021) by estimating the trend in the returns to an occupation's RTI:

$$log\big(real\ wage_{j,i,s,t}\big) = \beta_1 RTI_j + \beta_2\big(RTI_j \cdot Year_t\big) + \beta_3 X_j + \gamma_i + \gamma_s + \gamma_t + \varepsilon_{j,i,s,t} \quad (1)$$

The $log\big(real\ wage_{j,i,s,t}\big)$ of occupation *j*, in industry *i*, federal state *s*, and time *t* start to be recorded in 1990. I deflated them to the year 2015 by making use of the Consumer Price Index (CPI) obtained from the Federal Statistical Office of Germany (2023). To complement data on Routine Task Intensities (RTI) of occupations later rescaled from 0 (non-routine) to 1 (routine) computed by Tijdens (2023) for ISCO-08, I created consistent occupational groups that were translated from ISCO-88 COM to ISCO-08 by using correspondence tables provided by the International Labor Organization (ILO) by keeping only unique matches across both classifications. The main variable of interest is the β_2 coefficient, which accounts for interacted $Year_t$ and RTI_j. If the estimate of β_2 is positive and significant, this must imply that the earnings returns to higher RTI are increasing over time, independent of composition effects (Parolin 2021). To account for the composition effect, I add the variables that could influence the labor supply, namely the education, age, age squared, sex, and migration background of an individual all composed to vector X_j. Moreover, the model takes into account unobservable fixed effects: γ_i, γ_s, γ_t on the level of industry, federal state, and year respectively, that are correlated with our dependent variables and should eliminate different institutions, or sectoral specific shocks. Subsequently, I extend the model (1) by adding trend of earning return to unionized workers:

$$\log\big(real\ wage_{j,i,s,t}\big) = \beta_1 RTI_j + \beta_2\big(RTI_j \cdot Year_t\big) + \beta_3 X_j + \beta_4\big(RTI_j \cdot Year_t \cdot Union_j\big) + \gamma_i + \gamma_s + \gamma_t + \varepsilon_{j,i,s,t} \quad (2)$$

A positive and significant slope, β_4, would suggest that union coverage is associated with more favorable earnings returns to an occupation's RTI over time. To test whether higher union coverage leads to accelerated declines in occupations at greater risk of automation, I estimate the same specification as Parolin (2021):

$$\log\big(RTI_j\big) = \beta_1 Year_t + \beta_2 Union_j + \beta_3\big(RTI_j \cdot Year_t \cdot Union_j\big) + \gamma_i + \gamma_s + \varepsilon_{j,i,s,t} \quad (3)$$

All composition controls and fixed effects are the same as in the previous models. I exclude the year fixed effect γ_t because I include a time trend estimate, β_1, in the main specification. A negative and significant estimate of the time trend would imply that high RTI occupations are declining over time, presumably because negative labor demand is shifting to routine occupations. Since I am most interested in the moderating effect of unions, the significant and positive estimate will suggest that unionized workers tend to be less exposed to negative labor demand shifts over time.

3 Results

Table 1 shows the results of the (1) and (2) models. The interaction term of RTI and the linear time trend is negative and statistically significant in the first and second columns, indicating that returns to RTI have declined on average. Interestingly, after I include the interaction with unionized workers, the estimate is positive and highly significant, suggesting that unions do indeed play a moderating role in the downward pressure on wages in more routine occupations. Similar results were obtained for the US labor market in Parolin (2021). Notably, the introduction of controls for unionized workers in column (2) eliminates the statistical significance of the linear time trend. The estimate for the union parameter (- 0.99 (0.56)) suggests that unionized workers, on average, tend to specialize in more non- routine occupations. Strikingly, the demand for unionized workers tends to increase over time, captured by a positive estimate for different time trends for unionized workers in table1. These results contrast with those of Parolin (2021), who found a modest negative impact of unions on wages in the U.S labor market.

Finally, I estimate the model (3) within the subset of manufacturing, mining, and transportation (hereafter manufacturing) and all other agricultural and service industries (hereafter non-manufacturing) in order to clarify whether specific subsets of industries are driving the overarching trend of declining demand for routine occupations attributed to unions. The results of this exercise are presented in table 3. On the one hand, the linear trend estimates consistently show a decline in the prevalence of routine occupations over time in non-manufacturing industries. On the other hand, an increasing demand for more routine occupations is observed in the subset of manufacturing industries. While unions exert a more pronounced restraining influence in non-manufacturing, their statistical significance diminishes in manufacturing, possibly due to greater heterogeneity among manufacturing firms.

4 Conclusions

This paper examined occupational trends and the earning returns to routine occupations in the German labor market between 1985 and 2019, and the role of unionized workers. First, we observed a significant decline in the returns to RTI over time, suggesting a declining demand for routine occupations.

However, an important finding emerged when we introduced unionized workers into the equation. The decline in returns to RTI was not only reversed but turned positive and highly significant. This result underscores the moderating role that unions play in mitigating downward pressure on wages in routine occupations. This finding is consistent with the research of Parolin (2021), who found similar trends in the U.S. labor market.

In addition, this paper revealed that the statistical significance of the linear time trend disappeared when controlling for unionized workers. The results suggest that unionized workers tended to specialize in non-routine occupations and, remarkably, the demand for unionized workers appeared to increase over time.

These results diverge from the previous results of Parolin (2021), who found that unions had a modest positive impact on wages but noted that this effect was offset by a reduction in the employment share of routine occupations.

After splitting our analysis into manufacturing and non-manufacturing industries. We found different trends. Routine occupations showed a steady decline over time in non- manufacturing industries, while the opposite trend was observed in manufacturing. Unions exerted a stronger restraining influence in non-manufacturing, but their statistical significance diminished in manufacturing, possibly due to the greater heterogeneity among firms in this sector.

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References

Acemoglu, Daron, & Autor, David. (2011). *Skills, tasks and technologies: Implications for employment and earnings*. In Handbook of labor economics (Vol. 4, pp. 1043–1171). Elsevier.

Acemoglu, Daron, & Restrepo, Pascual. (2018). *The race between man and machine: Implications of technology for growth, factor shares, and employment.* American Economic Review, 108(6), 1488–1542.

Acemoglu, Daron, & Restrepo, Pascual. (2019). *Automation and new tasks: How technology displaces and reinstates labor.* Journal of Economic Perspectives, 33(2), 3–30.

Autor, David. (2022). *The labor market impacts of technological change: From unbridled enthusiasm to qualified optimism to vast uncertainty.* Technical report. National Bureau of Economic Research.

Autor, David H., & Dorn, David. (2013). *The growth of low-skill service jobs and the polarization of the US labor market.* American Economic Review, 103(5), 1553–1597.

Autor, David H., Dorn, David, & Hanson, Gordon H. (2013). *The China syndrome: Local labor market effects of importcompetition in the United States*. American Economic Review, 103(6), 2121–2168.

Autor, David H., Katz, Lawrence F., & Kearney, Melissa S. (2008). *Trends in US wage inequality: Revising the revisionists.* The Review of Economics and Statistics, 90(2), 300–323.

Autor, David H., Levy, Frank, & Murnane, Richard J. (2003). *The skill content of recent technological change: An empirical exploration*. The Quarterly Journal of Economics, 118(4), 1279–1333.

Dustmann, Christian, Ludsteck, Johannes, & Schönberg, Uta. (2009). *Revisiting the German wage structure.* The Quarterly Journal of Economics, 124(2), 843–881.

Feenstra, Robert C., & Hanson, Gordon H. (1999). *The impact of outsourcing and high-technology capital on wages: Estimates for the United States, 1979–1990*. The Quarterly Journal of Economics, 114(3), 907–940.

Fitzenberger, Bernd, Kohn, Karsten, & Lembcke, Alexander C. (2013). *Union density and varieties of coverage: The anatomy of union wage effects in Germany*. ILR Review, 66(1), 169–197.

Fitzenberger, Bernd, Kohn, Karsten, & Wang, Qingwei. (2006). *The erosion of union membership in Germany: Determinants, densities, decompositions.*

Fortin, Nicole M., & Lemieux, Thomas. (1997). *Institutional changes and rising wage inequality: Is there a linkage?* Journal of Economic Perspectives, 11(2), 75–96.

Goebel, Jan, Grabka, Markus M., Liebig, Stefan, Kroh, Martin, Richter, David, Schröder, Carsten, & Schupp, Jürgen.(2019). *The German socio-economic panel (SOEP)*. Jahrbücher für Nationalökonomie und Statistik, 239(2), 345–360.

Goldin, Claudia, & Katz, Lawrence F. (2009). *The race between education and technology: The evolution of US educational wage differentials, 1890 to 2005.*

Goos, Maarten, & Manning, Alan. (2007). *Lousy and lovely jobs: The rising polarization of work in Britain.* The Review of Economics and Statistics, 89(1), 118–133.

Goos, Maarten, Manning, Alan, & Salomons, Anna. (2014). *Explaining job polarization: Routine-biased technological change and offshoring.* American Economic Review, 104(8), 2509–2526.

Katz, Lawrence F., & Murphy, Kevin M. (1992). *Changes in relative wages, 1963–1987: Supply and demand factors*. The Quarterly Journal of Economics, 107(1), 35–78.

Kostøl, Fredrik B., & Svarstad, Elin. (2023). *Trade Unions and the Process of Technological Change. Labour Economics*, 84, 102386.

Lemieux, Thomas. (2006). *Increasing residual wage inequality: Composition effects, noisy data, or rising demand for skill?* American Economic Review, 96(3), 461–498.

Mihaylov, Emil, & Tijdens, Kea Gartje. (2019). *Measuring the routine and non-routine task content of 427 four-digit ISCO-08 occupations.*

Parolin, Zachary. (2021). *Automation, occupational earnings trends, and the moderating role of organized labor*. Social Forces, 99(3), 921–946.

Tijdens, Kea. (2023). *WISCO Occupations ISCO08 5dgt 55languages 4000titles with mapping surveycodings 20230425.*

Tinbergen, Jan. (1974). *Substitution of graduate by other labor*. Kyklos: International Review for Social Sciences.

5 Appendix

Table 1 Trends of real wages and routine occupations interacted with trade union membership in Germany, 1990-2019.

	Δlog(Real Wages$_{jsit}$)	
	(1)	(2)
RTI$_j$	11.474***	11.474***
	(0.781)	(2.501)
RTI$_j$ ×Year	-0.005***	-0.005***
	(0.001)	(0.001)
RTI$_j$ × Union × Year		0.000***
		(0.000)
Adj. R^2	0.41	0.41
Observations	114,263	36,649

Note: Real wages, trade union membership, and all demographic variables come from SOEP database created by Goebel et al. (2019). The Routine Task Intensity (RTI) scores are from Mihaylov and Tijdens (2019) estimate for ISCO-08 occupation and are rescaled between 0 (non-routine occupation) and 100 (routine occupation). Wages are winsorized at 1 and 99 percentile. Estimates control for age, age squared, education, gender. Fixed effects are defined at the level of 2-digit NACE industries and 16 federal states. Standard errors are clustered at the federal state level, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

Table 2 Trends of routine task intensity score and trade union membership in Germany, 1985-2019.

	ΔRTIj	
	(1)	(2)
Year(linear)	-0.0001***	0.0002
	(0.0000)	(.0001)
Union		-0.9928*
		(0.5641)
Union × Year (linear)		0.0005*
		(0.0002)
Adj. R^2	0.22	0.22
Observations	190,049	61,299

Note: Trade union membership and all demographic variables come from SOEP database created by Goebel et al. (2019). The Routine Task Intensity (RTI) scores are from Mihaylov and Tijdens (2019) estimate for ISCO-08 occupation and are rescaled between 0 (non-routine occupation) and 100 (routine occupation). Wages are winsorized at 1 and 99 percentile. Estimates control for age, age squared, education, gender. Fixed effects are defined at the level of 2-digit NACE industries and 16 federal states. Standard errors are clustered at the federal state level, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$

Table 3 Non-manufacturing and manufacturing trends of routine task intensity score and trade union membership in Germany, 1985-2019.

	Δ RTIj			
	Non-manufacturing		Manufacturing, mining	
	(1)	(2)	(3)	(4)
Year(linear)	-.0004***	-.0003***	0.0007***	0.0016***
	(0.0001)	(0.0001)	(0.0001)	(0.0002)
Union		-1.5060***		-0.3025
		(0.6656)		(1.0100)
Union ×Year (linear)		0.0007***		0.0001
		(0.0003)		(0.0005)
Adj. R^2	0.27	0.27	0.13	0.13
Observations	137,842	43,991	52,207	17,308

Note: Trade union membership and all demographic variables come from SOEP database created by Goebel et al. (2019). The Routine Task Intensity (RTI) scores are from Mihaylov and Tijdens (2019) estimate for ISCO-08 occupation and are rescaled between 0 (non-routine occupation) and 100 (routine occupation). Wages are winsorized at 1 and 99 percentile. Estimates control for age, age squared, education, gender. Fixed effects are defined at the level of 2-digit NACE industries and 16 federal states. Standard errors are robust to HAC, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$.

97