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The Magnitude and Causes of Job Polarization

A Local Labor Market Approach

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This paper examines job polarization at the level of local labor markets in Germany over a 30-year period. The major explanation of job polarization is skill biased technological change (SBTC): new technologies are complementary to high paying jobs but substitute workers in routine manual jobs in the middle of the wage distribution, who relocate to low paying service jobs. Several recent papers use regional data to analyze if there is a relation between routine labor and the growth of service jobs, but provide no evidence if the region's labor markets are actually polarized.

I close this gap by first introducing an intuitive and simple index to measure the magnitude of job polarization. Then I use comprehensive data on all German employees subject to social security to calculate this index for 204 local labor markets (LLM) in Western Germany between 1980 and 2010. I find that there are substantial disparities if and how strongly LLM are polarized. About one half of all German LLM exhibit significant job polarization, while some others are even inversely polarized.

In an econometric analysis, I use this measure to examine the relation between the regional economic structure in the beginning of the period and job polarization. The main finding is that the explanation of SBTC does not apply to all regions to the same extend. Urban regions with many export oriented manufacturing industries in 1980 are most likely to polarize, while SBTC does not seem to have led to polarization in rural regions specialized in traditional manufacturing.

JEL-Classification: J31, J24, R23

Keywords: Polarization, Local Labor Markets, Job Tasks, Structural Change, International Trade Exposure

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1 Introduction

The last couple of decades brought rapid changes to industrialized economies. Vast advances in technology changed the way how things are produced and how people interact with each other. While new technologies enhanced the productivity of workers in some jobs, other jobs were replaced by machines and became obsolete. There is a growing fear that this evolution polarizes entire societies. The gap between rich and poor increases in many countries, while the middle class declines. There is a vast literature documenting the increase of wage inequality in several dimensions. In the recent literature, there is also a growing interest in the related phenomenon of job polarization. In this context, polarization means that employment in initially high and low paying occupations grew relative to the middle of the wage distribution. This paper presents an intuitive way to quantify the magnitude of polarization of local or national labor markets. This measure is applied to analyze regional differences in polarization over a 30 year period in Germany.

The term job polarization was coined by Goos/Manning (2007). They build upon the hypothesis of Autor/Levy/Murnane (2003) that technological change is skill biased. That is, technological change is complementary to jobs at the upper end of the wage distribution and erodes demand for routine labor in the middle, but is neutral to nonroutine unskilled labor such as guestkeeping or clerical jobs. When occupations are ranked according to their initial average wage, jobs at both ends will exhibit growth relative to the middling ones. The result is the U-shaped wage/employment profile familiar from most studies on job polarization. Using Data from the United Kingdom, Goos/Manning (2007) find strong support for job polarization and its relation to skill biased technological change (SBTC). Autor/Katz/Kearney (2006) corroborate these findings by presenting empirical evidence for the United States and a brief theoretical model. In a very recent paper, Autor/Dorn (2012) derive an integrated theoretical model on how technological change leads to a decline in routine manual work but an increase in non-routine service occupations. They use data on local labor markets to test their model's implications and find that regions with a high initial share of routine tasks are more prone to adopt information technology and exhibit relocation of routine workers to unskilled service jobs.

Senftleben/Wielandt (2013) draw on this regional approach and analyze whether German local labor markets also exhibit a relocation from routine labor to unskilled services. They find some evidence in support of previous findings, but only for female workers. They point out that generous unemployment benefits hinder the relocation of workers to low paid occupations.

The approach to analyze these patterns at the regional level is extremely innovative. Particularly in Germany, regional mobility is low (Molloy/Smith/Wozniak, 2011) and regions differ substantially in their industrial structure. Regions can thus be regarded as small open economies with equal institutional settings. Variations in job polarization of local labor markets can be used to shed further light on the determinants of this phenomenon. An earlier comparative analysis is presented by Goos/Manning/Salomons (2009) who analyze polarization in 16 countries of the European Union. They find that most of these countries' labor markets are polarized but do not investigate differences between these countries. Another cross-country comparison is the work of Antonczyk/DeLeire/Fitzenberger (2010) who analyze the wage structures of Germany and the US. They relate similarities in polarization but different trends in wage inequality to technology and institutional changes. Both studies have in common that they can only carry out a cursory comparison since they cannot quantify the differences in how strongly the labor markets are actually polarized.

This study contributes to the literature on job polarization in three ways. First, I propose a simple measure on the magnitude of polarization. This polarization index can be calculated for any labor market given that there is comprehensive data on the development of employment in different occupations over time. Second, I conduct the first analysis of polarization itself at the regional level. To this end, I apply this index to quantify polarization in 204 local labor markets in Western Germany between 1980 and 2010. There are huge disparities: while about half of all local labor markets show the familiar U-shaped wage/employment profile, others are not polarized or even exhibit the inverse profile. Third, I use the variation in polarization and the regional economic structure to shed new light on what distinguishes polarized labor markets from others. So far, the

literature focuses on SBTC as the main explanation for polarization. However, local labor markets of the same country differ in how they are affected by SBTC. Many regions that were specialized in traditional manufacturing in the 1980ies experienced a decline of these industries due to rising competition from emerging economies abroad. Oftentimes, such regions did not build up employment in high paying jobs in other industries. Hence, the wage/employment profile is mostly flat rather than U-shaped. Other regions, however underwent a more prototypical structural change towards modern manufacturing and service industries. These regions are more likely to show the familiar U-shaped profile. This paper closes the gap between SBTC and the industry structure and analyzes if there are certain features of the economic structure that are related to job polarization.

The main result of this paper is that in Germany, diversified urban regions with modern export oriented manufacturing industries have the highest polarization indices.

The remainder of this paper is organized as follows: the next section presents the data sources and defines the explanatory variables. Section 3 introduces a simple approach to quantify job polarization at the regional or national level. This measure is used in section 4 to relate the magnitude of polarization to the regional economic structure. Section 5 concludes.

2 Data and Variables

The analysis of job polarization at the regional level requires detailed and complete information of the labor force over a longer period of time. An ideal source for this information is the registry data of the German Federal Employment Agency (BA) that stems from the compulsory notifications to the social security insurance. Specifically, I use the Employment History (BeH) provided by the BA's Institute for Employment Research (IAB). From full sample of this spell-dataset, a cross section of all employees registered as employed on June 30th is drawn. This data covers all employees subject to social security at the cutoff date, which are about 80 percent of the German labor force (Dustmann/Ludsteck/Schönberg, 2009). The majority of workers that are not included in this data set are civil servants and self-employed. The data is very reliable, since it used to

calculate retirement pensions. The major caveat of this data is that wages are censored at the upper earnings limits of the compulsory social security system (e.g. 66,000 Euros in Western Germany, 2010). Following Senfleben/Wielandt (2013), I use an imputation procedure suggested by Gartner (2005) to correct the topcoded values.

Since job polarization is a development over a longer period of time, I focus my analysis on Western Germany, where data is available continuously from 1978 to 2010. In order to relate different patterns of polarization to the industrial structure, I focus on employees in the manufacturing and service sectors and drop apprentices and all employees in the public sector and agriculture and mining. The resulting data set contains between 16,129,486 (1980) and 16,828,903 (2010) observations each year and provides information on daily wage (imputed), occupation, industry, qualification, place of work, as well as some social-demographic information. There is information if a person works full-time, minor part-time (less than 18 hours) or major part-time (between 18 and 39 hours) but not on the exact working hours. I follow Dauth (2012) and estimate full-time equivalents by weighting minor part-time with 16/39 and major part-time with 24/39, respectively.

In the empirical section of this paper, I relate regional differences in a measure of job polarization to other regional characteristics. To this end, it is necessary to aggregate the data to functional local labor markets. The level of 326 counties (Landkreise und kreisfreie Städte – corresponding to NUTS-3 regions of the EU) is not adequate, since counties are administrative entities that have evolved historically but have no economic meaning. A more suitable aggregation are 204 labor market regions of the Gemeinschaftsaufgabe “Verbesserung der regionalen Wirtschaftsstruktur”, the joint effort of the German federal and state governments to align differences in the regional economic structures (Kropp/Schwengler, 2011). This classification bases on commuter flows between municipalities and can thus be regarded as a good approximation of functional labor markets. These regions are available at the Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR) and will henceforth be called local labor markets (LLM).¹ The BBSR also classifies these LLM into urban, middling and rural regions. I

¹The results of this paper do not hinge on this choice. Robustness checks with 325 counties and 108 aggregate labor market regions yield basically the same results and are available upon request from

use this information to construct a dummy variable that takes the value of one if an LLM is urbanized.

For the control variables, several further data sets are used. First, in the literature on job polarization and skill biased technical change, it is argued that manual routine tasks are most likely to be displaced by machines and computers. I replicate the measure for the regional share of routine tasks presented by Senfleben/Wielandt (2013). To this end, I use the 1979 BIBB/IAB Qualification and Career Survey, a survey data set with roughly 30,000 observations. This data set contains, among other, information on the occupation and different activities performed by each individual. The activities are grouped in different task categories following Spitz-Oener (2006). For each individual, the task measure introduced by Antonczyk/Fitzenberger/Sommerfeld (2010) is calculated as the number of activities of a category in relation to all activities performed by the same worker. This task measure can be interpreted as the the percentage of her working time a person spends on performing a task (e.g. routine manual). Next, the average task share is calculated over all workers with the same occupation. Since the BIBB/IAB data uses the same occupational classification as the BeH, the occupational task shares can be merged to the full sample of all employees. Finally, the task share of an LLM can be calculated as the average individual task share weighted by the employment in each occupation. Following this approach, I construct two regional task measures: the share of routine tasks and the share of activities using computers.

Further explanatory variables are the regional shares of workers with specific characteristics in the total labor force. These characteristics are employed in the manufacturing sector (total and subdivided into food products, consumer goods, industrial goods, and capital goods) and university degree. All of these variables are calculated using the BeH.

This data also allows to construct the Krugman (1991) index of industrial specialization $spec_{ij} = \sum_{j'=1, j' \neq j}^N \left| \frac{e_{ij'}}{e_i} - \frac{e_{j'}}{e} \right|$, where e_{ij} is industry j 's employment in region i . This index quantifies how strongly a region is specialized in few industries. If a regions industrial structure matches the structure of the aggregate country, it takes a value of zero and

the author.

becomes larger the more a region is specialized.

Finally, there is a growing literature on how the increasing trade integration in the past decades, viz. the increase of both import competition and export opportunities from developing countries spurred the regional structural change in Germany (cf. Dauth/Suedekum, 2012; Dauth/Findeisen/Suedekum, 2012). To test if there is also an effect on the regional wage/employment structure, I construct measures for the regional trade exposure along the lines of Autor/Dorn/Hanson (2012): $TradeExp_{it} = \sum_j \frac{E_{ijt}}{E_{jt}} \frac{Tradeval_{jt}}{E_{it}}$, where $Tradeval_{jt}$ is the absolute value (in constant 1000 Euros of 2005) of commodities produced by industry j that have either been imported or exported between Germany and the rest of the World in 1980.² E_{ijt}/E_{jt} is region i 's share of national industry employment in j , and E_{it} is total manufacturing employment in period t and region i . This variable can thus be interpreted as how strongly the average worker of an LLM is exposed to import competition or export opportunities.

3 Measuring Polarization of Local Labor Markets

3.1 A Simple Index of Polarization

An intuitive way to compare changes in the wage structure between different countries is introduced by Card/Kramarz/Lemieux (1999). They define skill groups as age-education cells sorted by their mean log wage in the base year. The change in employment rates of these skill groups are plotted against their initial wage ranks. Constructing similar graphs for different countries (USA, Canada, and France) allows them to visualize different patterns of employment changes across countries. Antonczyk/DeLeire/Fitzenberger (2010) adapt this approach to compare changes in wage inequality and polarization between the US and Germany. They find that in both countries, skill groups at the bottom and top of the wage distribution of the base year exhibit higher employment growth rates than skill groups in the middle. Comparing the resulting graphs, they observe “striking similarities [...] between the US and Germany” (p. 28).

²The trade values stem from the *United Nations Commodity Trade Statistics Database*.

While this approach is very useful for a cursory comparison, it does not provide the base for a quantitative analysis. Another approach is introduced by Goos/Manning/Salomons (2009) in order to compare job polarization across 16 European countries. The authors aggregate national employment data to 21 occupations. The occupations are ranked by their mean wage (pooled over all countries) and grouped into the for lowest paying, nine middling and eight highest paying occupations. This allows them to compare changes in employment shares of each group across all countries. They find that in almost all of the 16 countries, the employment shares of the lowest and highest paying occupations increase relative to the middling ones. However, it is difficult to tell if the magnitude of polarization varies between these countries. Yet, quantifying the magnitude could yield valuable information if it is related to structural features of the respective economies.

This paper proposes a simple index of polarization, which is motivated by a graphical illustration used by most recent papers on this subject (e.g. Goos/Manning, 2007; Autor/Dorn, 2012; Senftleben/Wielandt, 2013). First, 313 occupations in the manufacturing and service sector are ranked according to their average log wage and grouped into 100 percentiles. Then, the percentage point change in the employment share of each percentile is plotted against its rank in 1980. While most studies use smoothed visualizations, figure 1 displays the actual data points. It is clearly visible that roughly the occupations in the top third of the 1980 wage distribution grow relative to the other occupations. There is also a noticeable, yet smaller upwards bend at the lower part of the distribution.

The figure also displays the fitted values of a quadratic regression of the change in a wage percentile's relative employment share on its rank, which yields the following results (t-values in parentheses):

$$100 \times \Delta \widehat{EmpShare} = \underset{(0.48)}{0.0845} - \underset{(-1.96)}{0.0158} \times rank(1980) + \underset{(2.72)}{0.0002} \times rank^2(1980)$$

As expected, the regression line is U-shaped and fits the actual data points fairly well ($R^2 = 0.13$). In the first paper on job polarization, Goos/Manning (2007) already use a quadratic regression to show that the distinct U-shape of the regression curve is robust to different data sources and occupational definitions. I suggest to go one step further and

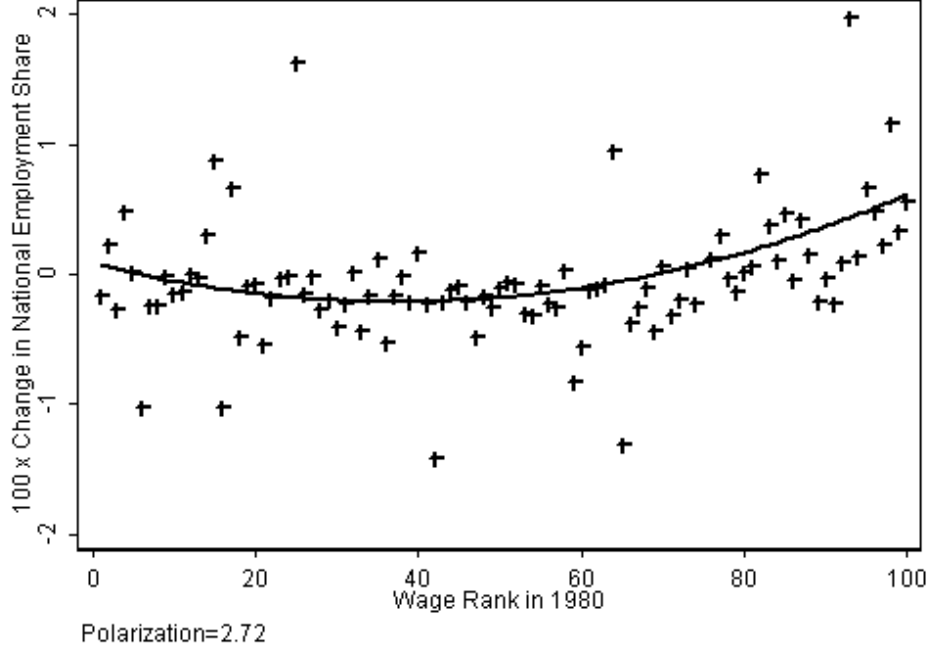


Figure 1: Changes in Employment Shares by Skill Percentile, 1980-2010.

use the curvature of this U as an intuitive measure for the magnitude of polarization. The curvature is defined as the second derivative of the regression equation $\frac{\delta^2(100 \times \widehat{\Delta EmpShare})}{\delta rank(1980)^2} = 2 \times \widehat{\beta}_{rank^2}$. Hence, the curvature of this U only depends on the parameter of the squared term in the regression equation. Yet, this coefficient can be influenced single observations. Consider the case when most of the wage/employment structure of a country is not polarized, except two occupations at both ends of the wage distribution. It appears to be desirable for a polarization measure to take into account how well this U fits to the data. A close alternative to the coefficient of the quadratic term is its t-value:

$$t_{rank^2} = \widehat{\beta}_{rank^2} \div \frac{\widehat{\sigma}}{[SST_{rank^2}(1 - \rho(rank; rank^2)^2)]^{\frac{1}{2}}} = \frac{\widehat{\beta}_{rank^2}}{\widehat{\sigma}} c \equiv PI,$$

where $\widehat{\beta}_{rank^2}$ is the estimated coefficient of the quadratic term, SST_{rank^2} its total sum of squares, $\rho(rank; rank^2)$ its correlation coefficient with the level term, and $\widehat{\sigma}$ the standard error of the regression. Since the variables $rank$ and $rank^2$ do not vary between the countries or regions under analysis ($rank$ is defined as all integers between 1 and 100), the denominator of the last fraction is a constant c . Hence, the t-value depends only on the

curvature of the regression curve ($\widehat{\beta}_{rank^2}$) and its fit to the data ($\widehat{\sigma}$). The advantage of this measure is that it allows a statistical test of polarization: if the wage structure, represented by 100 wage percentiles, is sufficiently polarized then the t-value of the quadratic term should be larger than the critical value of a t-distribution with 100 degrees of freedom, e.g. 1.29 for the ten percent level of significance. In the case of aggregate Germany, the t-value is 2.72, which is larger even than the critical value at the one percent level.

This measure, henceforth called the Polarization Index PI, can be applied to quantify differences in the polarization of the wage structure between countries, or as presented in this paper, to compare regions within the same country.

3.2 Polarization of Local Labor Markets

Figure 3 and figure 4 in the appendix display the distribution of the PI across 204 LLM in Western Germany. There is a substantial variation in the polarization of across these LLM. 97 LLM have a PI larger than 1.29 and can thus be called polarized, while 24 are even polarized more strongly than the aggregate country. Figure 2 displays the polarization profiles of the regions at both ends of the distribution of the PI. The most polarized LLM is Munich, with an PI of 4.24. Munich is the third largest city in Germany with headquarters of numerous large corporations, particularly in the IT, electrical engineering, and vehicle manufacturing sectors. There is a credible explanation for the strong polarization of Munich's labor market: Due to the very modern economic structure, there was a strong growth in high paying jobs such as engineering, management, and R&D occupations, while more traditional manufacturing jobs became less important. At the same time, there has been a rise in service occupations that cater to the growing class of relatively wealthy individuals.

The least polarized LLM is Calw in rural Baden-Württemberg. Despite its location close to the capital of a very wealthy state, Calw's economy is structurally weak. Today, there is some manufacturing of car parts, but at the same time, there has been a decline in the apparel industry and manufacturing of medical devices. It is clearly visible that the development of the wage/employment profile is not polarized. There is no excessive

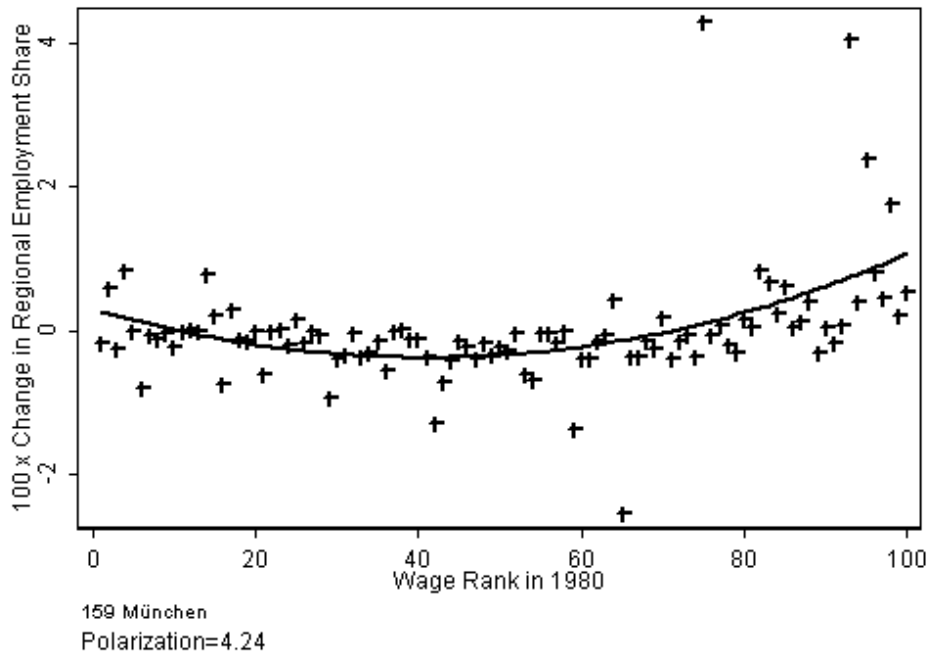
growth at both ends of the wage distribution, while there has been a remarkable decline in mid- and low-paying occupations. The common explanation for job polarization does not seem to hold for this particular region.

At the first glance, it seems like urbanized regions and regions that have undergone a structural change towards modern service and high-tech oriented industries have been more prone to job polarization in the last three decades than rural regions and those that retained a traditional manufacturing base. The remainder of this paper is dedicated to analyze if certain regional characteristics, such as the industrial structure, technical change or the rising trade integration help explain the variation in job polarization across German regions.

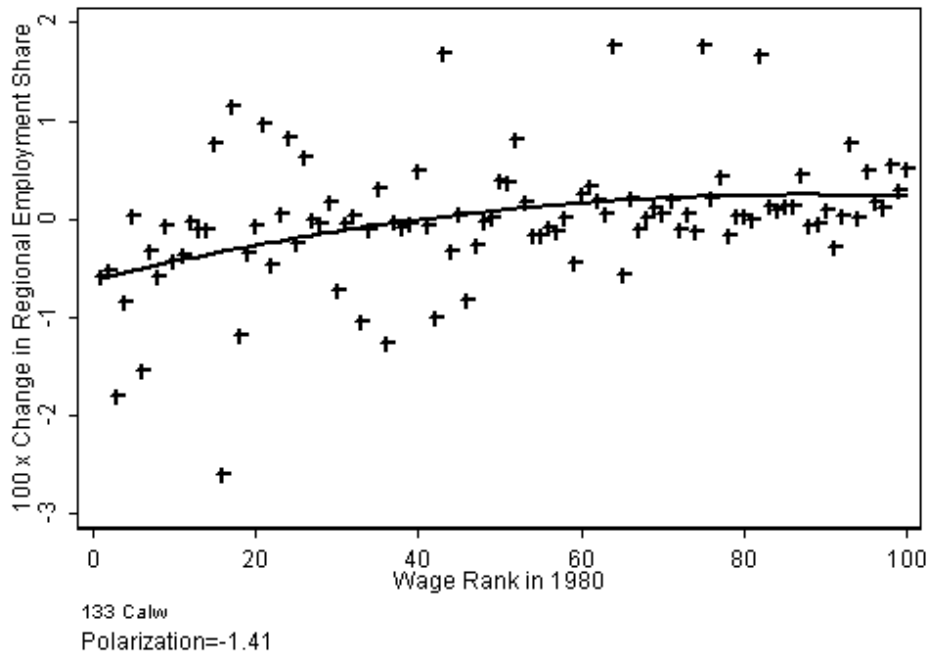
4 Explaining the Differences in Regional Polarization

In order to explain the polarization of the US labor market, Autor/Dorn (2012) derive a theoretical model on how the production factor computer capital is related to abstract labor and routine labor. The model implies that local labor markets with a strong initial specialization in routine tasks will experience a greater adoption of information technology, which is a relative substitute to routine labor. Low skilled workers are thus displaced from routine occupations and relocate to service occupations. They find robust empirical evidence to support this hypothesis. Applying this approach for Germany, Senftleben/Wielandt (2013) find very similar results. Yet, their results seem to stem from female workers alone, while there are no effects for male workers.

A possible explanation for why German results are less robust might be that while both countries have polarized labor markets in general, different mechanisms led to this development. The American economy has seen a steady decline in manufacturing and a rise in service occupations. In Germany, the picture seems to be more differentiated. While manufacturing did decline in this country as well, this trend decelerated after 1995 because of the positive effects of exports to emerging economies in the east (Dauth/Findeisen/Suedekum, 2012). Hence, even though information technology might very well have substituted routine jobs in Germany, workers could have relocated to more



(a) Strongest Polarization



(b) Weakest Polarization

Figure 2: Changes in Employment Shares by Skill Percentile, 1980-2010.

sophisticated manufacturing jobs instead of service jobs.

Table 1: Simple OLS coefficients

	Dependent variable: polarization index 1980-2010			
	(1) coeff.	R ²	(2) coeff.	R ²
% Routine tasks	-0.215*** (0.02)	0.32	-0.214*** (0.03)	0.34
% PC usage	0.885*** (0.06)	0.50	0.875*** (0.06)	0.52
% High skilled	0.478*** (0.04)	0.44	0.481*** (0.05)	0.46
ln Pop. density	0.771*** (0.09)	0.28	0.948*** (0.12)	0.32
Dummy urban=1	1.209*** (0.14)	0.28	1.292*** (0.16)	0.30
Industrial specialization	-2.556** (1.06)	0.06	-2.123* (1.09)	0.12
Imports	-0.028** (0.01)	0.03	-0.028** (0.01)	0.11
Exports	0.050*** (0.01)	0.16	0.047*** (0.01)	0.22
% Manuf.	-0.003 0.01	0.00	-0.006 0.01	0.09

Observations: 204. All covariates are from the initial year 1980. Each coefficient is the result if a simple regression of the dependent variable on one of the covariates. Model (2) includes dummy variables for federal states. Robust standard errors in parentheses. Levels of significance: *** 1 %, ** 5 %, * 10 %.

Table 1 presents a first look at bivariate correlations between the PI and some variables presenting the structure of the LLM in 1980. There is a negative correlation of polarization and the initial share of routine tasks performed in an LLM. This clearly contradicts the findings of Autor/Dorn (2012): regions that were specialized in tasks that were prone to be replaced by computers did not exhibit job polarization over the last three decades. On the contrary, regions that show polarization are those that already relied more heavily on computers in 1980. Polarization is particularly strong in urban regions, regions with a high initial industrial diversity (i.e. low specialization), and in regions with a high initial share of highly qualified employees. The correlations with variables representing the exposure of a region's manufacturing to world imports and exports also add to this picture. Regions that were specialized in manufacturing goods that faced higher competition from abroad experienced less polarization, while the opposite applies to export oriented

regions. Interestingly, the share of employment in the manufacturing sector is not related to polarization at all.

Table 2: Multivariate OLS coefficients

	Dependent variable: polarization index 1980-2010			
	(1)	(3)	(2)	(4)
Dummy urban=1	0.889*** (0.16)	0.704*** (0.18)	0.572*** (0.17)	0.475*** (0.15)
Industrial specialization	0.014 (0.80)	-1.270 (0.97)	-2.310*** (0.84)	-2.867*** (0.76)
% Routine tasks	-0.165*** (0.03)	-0.197*** (0.03)	-0.131*** (0.03)	-0.142*** (0.02)
% Manuf.		0.025** (0.01)	0.009 (0.01)	
Imports			-0.051*** (0.01)	
Exports			0.048*** (0.01)	
% Manuf. food				-0.034 (0.02)
% Manuf. consumer goods				-0.042*** (0.01)
% Manuf. industrial goods				0.022** (0.01)
% Manuf. capital goods				0.051*** (0.01)
Constant	10.115*** (1.44)	11.992*** (1.57)	9.147*** (1.93)	10.369*** (1.29)
R ²	0.428	0.447	0.558	0.639

Observations: 204. All covariates are from the initial year 1980. Robust standard errors in parentheses. Levels of significance: *** 1 %, ** 5 %, * 10 %.

Most of the outcomes remain stable if the above mentioned variables are used jointly in a multivariate regression analysis. The shares of PC usage and of high skilled workers, however, cannot be used jointly with the share of routine tasks since there is a strong negative correlation with both variables that substantially reduces the efficiency of the estimation. Still, the result holds that urbanization is positively related to polarization while the share of routine tasks has a negative sign, even when both variables are considered jointly. Adding the share of employees in manufacturing yields a positive but weakly significant coefficient. This coefficient becomes insignificant again when variables for the exposure to imports and exports are added to the model. Apparently, polariza-

tion depends on which kind of industries are located in a region rather than the scale of manufacturing as a whole.

A similar picture arises when manufacturing is divided into manufacturing of food products, consumer goods (e.g. clothing), industrial goods (e.g. basic chemicals), and capital goods (e.g. machines and vehicles). Since this partition mirrors sectors where Germany is a net importer (consumer goods) and where it is a net exporter (capital goods), I omit the trade variables in this specification. The industries subsumed as manufacturing of consumer goods are mostly traditional industries that steadily declined over the last decades due to the increasing competition by imports from low wage countries. The opposite applies to industries producing industrial and, in particular, capital goods which strongly contribute to Germany's trade surplus and its wealth in general. Apparently, polarization is a phenomenon closely related to structural change. The strong variation of the direction and speed of structural change across German regions (as documented by Dauth/Suedekum, 2012) could also explain the variation in the polarization of local labor markets.

In in the last two specifications, the negative coefficient of industrial specialization becomes significant. Hence, holding constant urbanization and the composition of manufacturing, regions that are specialized in only a small number of industries are less likely to develop a polarized wage structure.

5 Conclusion

This paper examines the variation of job polarization across German local labor markets. This work is complementary to the very recent literature that uses regional heterogeneity to analyze the mechanisms leading to polarization (Autor/Dorn, 2012; Senteleben/Wielandt, 2013). There is an interesting contradiction between the results of these works and the present study: there is strong evidence for the US and somewhat weaker evidence for Germany that employment in low skilled service occupations grew faster in regions with initially high shares of manual routine work. Yet, these local labor markets are much less likely to exhibit polarization in form of a U-shaped wage/employment

profile.

Of course this finding is no evidence against the SBTC hypothesis. What it does show is that the consequences of SBTC depend on a region's economic structure. This fact would stay hidden if national rather than regional polarization is examined. Regions that were specialized in traditional manufacturing industries which required many routine tasks and were prone to be substituted by machines or imports from abroad did not exhibit the familiar wage/employment profile that is associated with job polarization. Low paid jobs rather fell away without systematically being replaced by other occupations. This manifests in form of a plane profile with a possible downward bend at the bottom of the initial wage distribution. On the opposite, urban regions with more modern structures do show the typical U-shaped wage/employment profile. Here, the story of SBTC, that routine jobs were replaced by either high-paying jobs in all sectors or low paying service jobs seems to fit very well.

To what extent do these insights apply to other countries besides Germany? Even though there was a structural change that shifted employment from the manufacturing to the service sector, the German economy still heavily relies on modern and export oriented manufacturing industries. There is no Rust-Belt in Germany: unlike in the US, where manufacturing is negatively related to regional growth in population, employment, and income (cf. Glaeser/Scheinkman/Shleifer, 1995), manufacturing intensive regions in the southern and northwestern parts of Germany are among the most wealthy regions in the country. Hence, it is difficult to tell if US regions are likely behave in a similar way to German regions. The secular decline in US manufacturing and the much less generous social welfare system might have spurred growth of low skilled services that have a smaller significance in Germany. It would be interesting for further research to examine if there is a similar relation between polarization and economic structure in the US and other countries. The index introduced in this study might prove helpful in such an endeavor.

Unfortunately, it is difficult to derive helpful advice for regional policy from the results of this study. Regions with low or negative polarization can be considered as the losers of structural change, where traditional manufacturing strongly declined without being

replaced by more modern industries. Regions that developed more favorably did this at the expense of stronger job polarization. One hope could be that if growth on high paying jobs increases demand for personal services, this in turn might increase wages at the bottom of the skill distribution and thus reduce wage inequality (Autor/Dorn, 2012).

References

Antonczyk, Dirk; DeLeire, Thomas; Fitzenberger, Bernd (2010): Polarization and rising wage inequality: comparing the U.S. and Germany. ZEW Discussion Papers, No. 10-015.

Antonczyk, Dirk; Fitzenberger, Bernd; Sommerfeld, Katrin (2010): Rising wage inequality, the decline of collective bargaining, and the gender wage gap. ZEW Discussion Papers, No. 10-014.

Autor, David H.; Dorn, David (2012): The growth of low skill service jobs and the polarization of the U.S. labor market. *American Economic Review*, forthcoming.

Autor, David H.; Dorn, David; Hanson, Gordon H. (2012): The China syndrome: Local labor market effects of import competition in the United States. *American Economic Review*, forthcoming.

Autor, David H.; Katz, Lawrence F.; Kearney, Melissa S. (2006): The polarization of the U.S. labor market. *American Economic Review*, Vol. 96, No. 2, pp. 189–194.

Autor, David H.; Levy, Frank; Murnane, Richard J. (2003): The skill content of recent technological change: an empirical exploration. *Quarterly Journal of Economics*, Vol. 118, No. 4, pp. 1279–1333.

Card, David; Kramarz, Francis; Lemieux, Thomas (1999): Changes in the relative structure of wages and employment: a comparison of the United States, Canada, and France. *Canadian Journal of Economics*, Vol. 32, No. 4, pp. 843–877.

- Dauth, Wolfgang (2012): Agglomeration and regional employment dynamics. Papers in Regional Science, online first.
- Dauth, Wolfgang; Findeisen, Sebastian; Suedekum, Jens (2012): The rise of the East and the Far East: German labor markets and trade integration. IZA discussion paper, 6685.
- Dauth, Wolfgang; Suedekum, Jens (2012): Profiles of local growth and industrial change * facts and an explanation. IAB Discussion Paper, 20/2012.
- Dustmann, Christian; Ludsteck, Johannes; Schönberg, Uta (2009): Revisiting the German wage structure. Quarterly Journal of Economics, Vol. 124, No. 2, pp. 843–881.
- Gartner, Hermann (2005): The imputation of wages above the contribution limit with the German IAB employment sample. FDZ Methodenreport, 02/2005.
- Glaeser, Edward L.; Scheinkman, José A.; Shleifer, Andrei (1995): Economic growth in a cross-section of cities. Journal of Monetary Economics, Vol. 36, No. 1, pp. 117–143.
- Goos, Maarten; Manning, Alan (2007): Lousy and lovely jobs: the rising polarization of work in Britain. Review of Economics and Statistics, Vol. 89, No. 1, pp. 118–133.
- Goos, Maarten; Manning, Alan; Salomons, Anna (2009): Job polarization in Europe. The American Economic Review Papers and Proceedings, Vol. 99, No. 2, pp. 58–63.
- Kropp, Per; Schwengler, Barbara (2011): Abgrenzung von Arbeitsmarktregionen * ein Methodenvorschlag. Raumforschung und Raumordnung, Vol. 69, No. 1, pp. 45–62.
- Krugman, Paul (1991): Geography and trade. Cambridge: MIT Press.
- Molloy, Raven; Smith, Christopher L.; Wozniak, Abigail K. (2011): Internal Migration in the United States. Journal of Economic Perspectives, Vol. 25, No. 2, pp. 1–42.
- Senftleben, Charlotte; Wielandt, Hanna (2013): The polarization of employment in German local labor markets. Working Paper.

Spitz-Oener, Alexandra (2006): Technical change, job tasks, and rising educational demands: looking outside the wage structure. *Journal of Labor Economics*, Vol. 24, No. 2, pp. 235–270.

Appendix

Table 3: Descriptive statistics for local labor markets in 1980

	All	Rural	Urban
Polarization Index	1.29 (1.16)	0.67 (0.92)	1.88 (1.05)
Dummy urban=1	0.52 (0.50)		
% Routine tasks	56.08 (3.02)	57.48 (2.72)	54.79 (2.69)
% PC usage	4.07 (0.93)	3.54 (0.41)	4.56 (1.00)
% High skilled	3.29 (1.60)	2.46 (0.74)	4.05 (1.79)
Pop. density	279.11 (394.24)	105.06 (27.12)	440.02 (495.38)
Industrial specialization	0.63 (0.11)	0.64 (0.08)	0.61 (0.12)
Imports	29.78 (7.02)	30.67 (7.04)	28.95 (6.92)
Exports	38.78 (9.26)	36.22 (8.64)	41.14 (9.23)
% Manuf.	42.17 (11.46)	39.98 (10.92)	44.19 (11.63)
% Manuf. food	4.01 (2.17)	4.77 (2.22)	3.30 (1.88)
% Manuf. consumer goods	8.28 (6.26)	9.16 (6.48)	7.47 (5.97)
% Manuf. industrial goods	15.71 (9.16)	14.12 (7.26)	17.19 (10.44)
% Manuf. capital goods	14.17 (9.79)	11.93 (9.23)	16.24 (9.88)
Number of local labor markets	204	98	106

Mean values, standard deviations in parentheses.

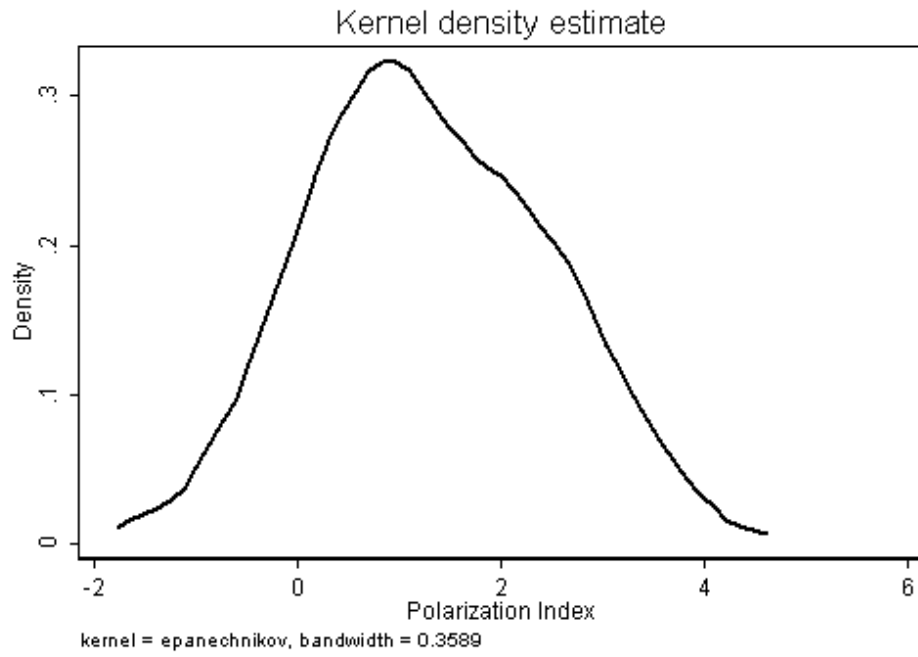


Figure 3: Kernel Density Estimate of the 204 Regional Polarization Indices.

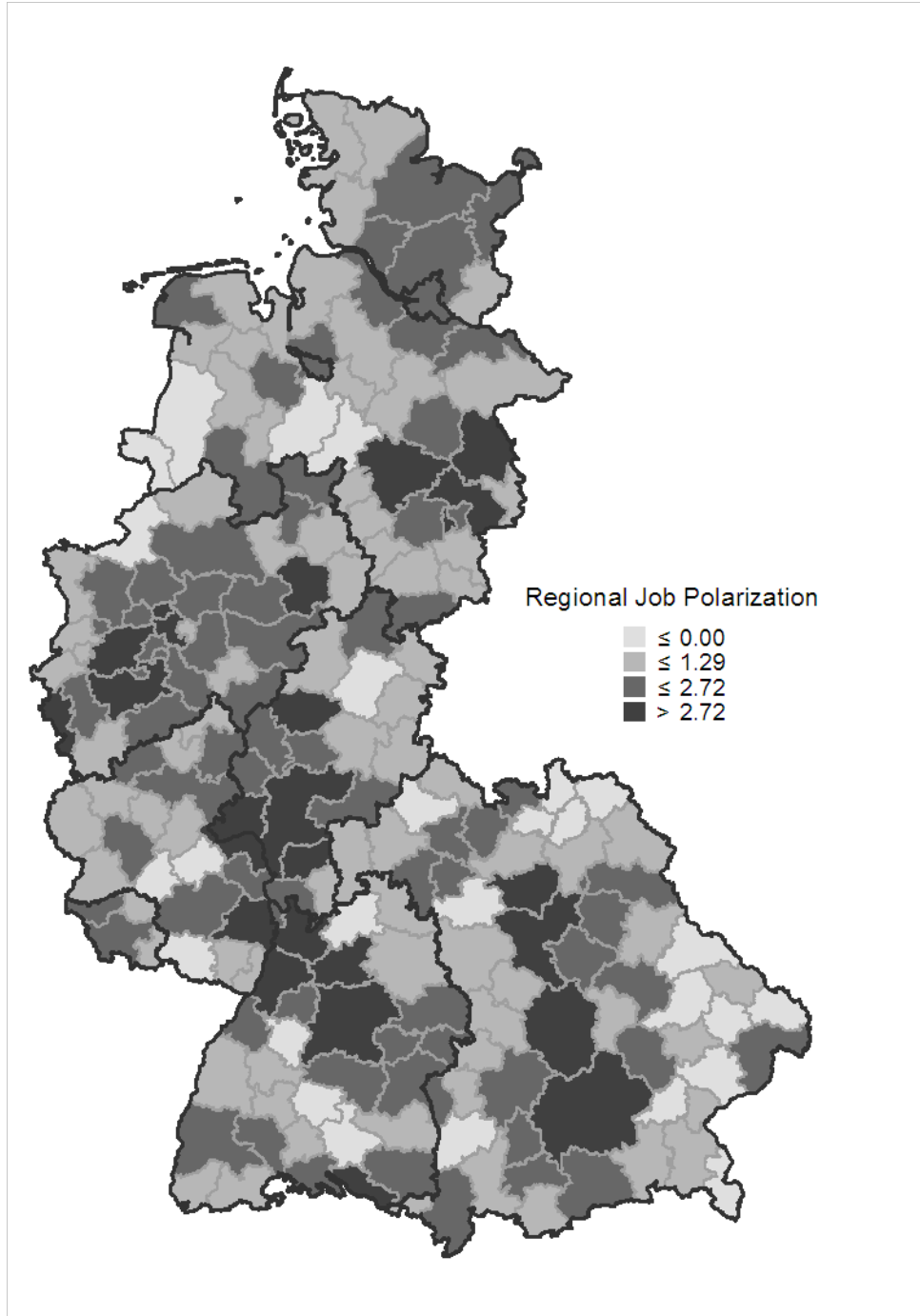


Figure 4: Polarization of 204 Local Labor Markets.