International Trade and Labor Market Outcomes

Evidence from German Micro-Level Data

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Introduction

What is the impact of globalization on labor market outcomes? This classical question dates back at least to the seminal work by Stolper and Samuelson (1941), who analyzed labor market consequences of trade liberalizations in a Hecksher-Ohlin (HO) framework. According to the Stolper-Samuelson-Theorem, trade increases the real return to the factor of production that is relatively abundant in each country and lowers the real return to the other factor. For developed economies – which are typically rich in skilled labor – trade is therefore expected to increase the wage of skilled workers relative to unskilled workers, thus leading to a rise in wage inequality. At the same time, the opposite is expected to happen in developing economies. The latter prediction, however, has often been found to be at odds with the empirical evidence: a number of studies documented rising wage inequality in developing economies during periods of increased globalization (Goldberg and Pavcnik (2007), Topalova (2007), Hanson and Harrison (1999)). For quite some time, the economic literature therefore failed to uncover an important contribution of globalization to wage inequality. As a consequence, changes in the labor market structure were primarily attributed to other factors, such as technological changes, and the impact of international trade on the former was considered to be very modest.

Recently, this view has been challenged. The development of new theoretical frameworks and the availability of new datasets have renewed the interest in studying labor market consequences of globalization. In particular the seminal work by Melitz (2003), which stresses the role of firm heterogeneity in a model of international trade, has triggered a new strand of research that provides new insights into the effects of trade on labor market outcomes (e.g. Egger and Kreickemeier (2009), Davis and Harrigan (2011),

Helpman et al. (2010), Felbermayr et al. (2014)). The availability of detailed firm-level or even matched employer-employee datasets has further stimulated economic research in this field. Moreover, the increasing integration of developing economies (China in particular) into the world market during the last decades has further increased the interest in studying the effects of trade with low-income countries on advanced economies' labor markets (see e.g. Autor et al. (2013), Autor et al. (2016), Pierce and Schott (2016) for the U.S. and Dauth et al. (2014) for Germany).

This dissertation contributes to this literature. In the following three chapters, I analyze different dimensions of how international trade affects labor market outcomes. All three parts are empirical contributions that are based on detailed German establishment or linked employer-employee data. An analysis of the German economy is of particular interest, since it is not only the largest European economy, but also generally known for its trade openness.[1] In the first chapter, I start from a very broad perspective and investigate the most important drivers of the recent rise in German wage inequality. I consider a wide range of individual- as well as establishment-level characteristics and, among them, the export status of a firm is of particular interest. In the second chapter, I focus on the endogenous adjustment of labor market institutions as a reaction to increased trade exposure. More specifically, I analyze to what extent German firms change their collective bargaining regime as a response to low-wage country import competition. In the last chapter, I focus on individual employment stability and investigate how this is shaped by the global activity of the employer. In the following, I briefly summarize each chapter and stress its contribution to the literature. All three parts of this dissertation are self-contained empirical essays and represent independent pieces of research, such that they can be read independently.

The first chapter, which is joint work with Gabriel Felbermayr and Daniel Baumgarten, focusses on the rise in German wage inequality from 1996 to 2010 and quantifies important drivers of this development. Recent contributions, such as Barth et al. (2014) for the U.S. and Card et al. (2013) for Germany, have stressed the importance of firm-level pay effects

[1] According to WTO International Trade Statistics 2015, Germany was ranked as the third largest exporter as well as importer in world merchandise trade for the year 2014 (after China and the U.S.).

for the rise in wage dispersion. Most of the existing literature, however, is silent about the true underlying sources of these effects. We build on this research and consider a rich set of individual-level characteristics as well as important establishment-level variables and pin down their relative importance for the increase in German wage inequality. We pay special attention to a plants' technology, its collective bargaining regime and its export status. The inclusion of the latter is motivated by recent trade theories, which analyze the link between international trade and wage inequality in a setting with heterogeneous firms and labor market imperfections. The underlying idea is that the exporter wage premium, the wage differential between workers employed at exporting firms and the ones employed at non-exporting firms, is a key transmission channel from trade to wage inequality (Helpman et al. (2010), Egger and Kreickemeier (2012), Felbermayr et al. (2014), Baumgarten (2013)).

For our analysis we use detailed linked employer-employee data for the German manufacturing sector, which is provided by the Institute for Employment Research (IAB)[2] and employ a state-of-the-art decomposition technique based on recentered influence function (RIF) regressions (Firpo et al. (2009)). This allows us to quantify the relative contribution of each single factor to the rise in wage inequality, conditional on all other variables, in a unified framework. Moreover, it enables us to distinguish between compositional changes and changes in the conditional wage structure for each single variable, thus allowing for so called detailed decompositions. We contribute to the literature by providing thorough evidence on the contribution of each variable to the rise in wage dispersion. Moreover – and different to most existing evidence so far – our results can be considered as particularly robust, since they do not depent on the sequential ordering of the decomposition process.

Our main results can be summarized as follows: changes in the skill- and occupation related wage structure are important sources of increased wage dispersion in the German manufacturing sector between 1996 and 2010. With respect to establishment-level characteristics, the decline in collective bargaining coverage, which is primarily due to a decline

[2]We use the cross-sectional version of the linked employer-employee LIAB dataset (version QM 9310).

in industry-wide collective contracts, is by far the most important driver of increased wage inequality. Plants' technology as well as its export status are found to play only a minor role for the increase in wage dispersion.

The second chapter, which is joint work with Daniel Baumgarten, builds upon the previous results and focusses on the decline in sector-wide collective bargaining agreements in the German manufacturing industry. Given that in Germany the decision of collective bargaining coverage is essentially at the discretion of the firm (see e.g. Dustmann et al. (2014)), we investigate to what extent increased import competition from China and Eastern Europe, which we refer to as *"the East"*, has induced German firms to leave centralized wage agreements. In doing so, we shed light on an indirect, albeit important link between international trade and labor market outcomes that has been neglected in the existing literature. Moreover, we stress the endogeneity of labor market institutions, another aspect that has received little attention in theoretical trade frameworks so far.

We argue that an increase in import penetration from low wage countries is likely to induce some German firms to opt out of collective wage agreements, both because less productive firms find it increasingly difficult to pay union wages and because workers are more willing to accept an opting-out decision if their employers face a credible threat of going bankrupt or downsize production. In order to run our analysis, we combine data from the IAB Establishment Panel for the German manufacturing sector with detailed bilateral trade information provided by the CEPII.[3] We exploit variation in trade flows between Germany and the East at the industry level and relate them to changes in the bargaining regime at the establishments. To identify a causal relationship, we apply the intrumental variable strategy pioneered by Autor et al. (2013) and instrument trade flows between Germany and the East by trade flows between the East and other high-income countries.

We find that an increase in import competition from China and Eastern Europe in the period from 1996 to 2008 induces German firms to leave collective bargaining regimes. In terms of magnitude we conclude that the increase in import exposure explains about

[3] `http://www.cepii.fr/CEPII/en/cepii/cepii.asp`

22 percent of the overall decline in sector-level bargaining regimes in the German manufacturing sector. Digging deeper into the analysis of heterogeneous effects reveals that it is indeed especially the smaller, less productive firms that are most strongly affected by an increase in import penetration. Overall, our results imply that labor market institutions not only shape comparative advantage (e.g. Egger et al. (2015b)), and hence trade patterns, but are themselves endogenous with respect to international trade. Moreover, the decline in collective bargaining seems to constitute one potentially important channel linking international trade and labor market outcomes – and one that is likely to have long-term consequences.

In the final chapter I focus on the impact of a plants' international trade activity on individual employment stability. I use a duration model and relate individual employment durations to specific employer characteristics, where the import and export activity of the establishment are the variables of main interest. My focus is on job spells that end in unemployment, since they are most likely reflecting involuntary job dismissals (Hirsch (2016)) and induce particularly high welfare losses. This is because periods of unemployment not only affect workers' future wage profiles (Arulampalam (2001)) and risks of repeated unemployment spells (Gregg (2001)), but also induce search costs and welfare losses due to idle production factors. To the extent that the global engagement of a firm affects individual employment stability, this is one channel through which international trade impacts individual income (risks). My analysis therefore can be considered as complementing the literature that focusses on wage differentials between trading and non-trading firms (e.g. Schank et al. (2007), Baumgarten (2013)). To the best of my knowledge, it provides the first empirical evidence on individual employment stability with respect to the global engagement of firms.

The data I use for this analysis is again a linked employer-employee dataset, the longitudinal version of the LIAB[4], which contains yearly plant-level information from the IAB Establishment Panel and information on all workers that were employed for at least

[4]The longitudinal version of the linked employer-employee LIAB dataset is also provided by the Institute for Employment Research (version LM 9310) and differs in its construction from the cross-sectional version employed in the analysis for Chapter 1.

one day at the surveyed establishments. It allows me to follow individual workers over time and to account for a rich set of establishment level characteristics.

From a theoretical point of view, the predictions on how a firms' engagement in international trade should affect individual employment stability are ambiguous. On the one hand, exporting firms could offer more stable employment relationships than non-exporting firms since they can diversify their risks by selling to different markets. On the other hand, exporters could also provide riskier jobs if exporting is inherently a more volatile activity than selling to the domestic market (e.g. due to exchange rate risks or higher foreign demand uncertainty). Predictions with respect to the import activity of a firm are similarly ambiguous.

My main results can be summarized as follows: Conditional on a rich set of individual and establishment level controls, exporting establishments provide a stability premium – meaning that involuntary job separations are less likely. This is in line with the idea that exporting helps firms to diversify their risks across markets, thus allowing them to offer more stable job relationships. Once I control for unobserved establishment level heterogeneity, I find a (weakly) negative relationship between employment stability and export intensity, which however is only driven by few establishments that realize more than half of their total sales in foreign markets. Consistent with previous findings (Vannoorenberghe (2012), Kurz and Senses (2016)) my results therefore suggest a non-monotonic relationship between exporting and employment stability, according to which low and medium (high) levels of export activity are found to lead to fewer (more) involuntary job separations. Throughout my analysis, I find employment at importing establishments to be riskier, beeing thus associated with lower levels of employment stability than employment at non-importing plants. This is consistent with an explanation that stresses higher labor demand elasticities at importing plants due to a higher substitutability between foreign and domestic labor as a reaction to domestic wage increases.

Chapter 1

Dissecting Between-Plant and Within-Plant Wage Dispersion*

*This chapter is based on joint work with Daniel Baumgarten and Gabriel Felbermayr. It is a revised version of the Ifo Working Paper No. 216, "Dissecting Between-Plant and Within-Plant Wage Dispersion - Evidence from Germany", 2016.

1.1 Introduction

Wage inequality has been on the rise in most (industrialized) countries in the last few decades and recent research has pointed to the growing importance of workplace heterogeneity for this development: a large fraction of the increase in overall wage inequality is due to increased wage dispersion between as opposed to within firms or establishments. While this trend is shared by many countries, the sources of this increase are still underexplored.[1]

In this chapter, we pin down the role of important establishment and worker characteristics for the increase in overall wage inequality. For this purpose, we use detailed linked employer-employee data of the German manufacturing sector, covering the years 1996 to 2010. In addition to personal characteristics such as age, education, occupation and nationality, we evaluate the contribution of explicit establishment characteristics such as a plant's collective bargaining regime, its technological status and its export behavior.[2] Since the effect of exporting is assumed to be strongest and most direct for the manufacturing sector, we restrict our analysis to this sector only. Disentangling the role of each single variable to the rise in wage dispersion, taking other variables explicitly into account, requires a rich and comprehensive framework. To this end we apply a state-of-the-art decomposition method which is based on recentered influence function (RIF) regressions (Firpo et al. (2009)). This approach allows us to implement a detailed decomposition with respect to each variable and has the advantage of being path-independent.

We contribute to the existing literature by quantifying the relative importance of a large set of characteristics to the rise in wage inequality using a considerably rich and comprehensive framework. As a further central contribution we separately perform a detailed decomposition of changes in between-establishment and within-establishment wage dispersion, thus shedding light on the (possible divergent) sources of these two impor-

[1] Davis and Haltiwanger (1991), Dunne et al. (2004), and more recently Barth et al. (2014), Handwerker and Spletzer (2015), and Song et al. (2015) provide evidence for the US; Faggio et al. (2010) for the UK; Card et al. (2013) for Germany; and Helpman et al. (2016) for Brazil. In contrast, the between-firm component seems to be less important in Sweden (Akerman et al. (2013)).

[2] We also account for regional as well as industry characteristics. Note that we consider a sample of male workers only in order to be comparable with previous research.

tant subcomponents of wage inequality. We find that the decline in collective bargaining coverage as well as changes in the skill- and occupation-related wage structure are main sources of increased overall wage dispersion. Regional employment shifts, differences between collectively covered and uncovered plants and increased sorting play a key role for changes in between-establishment wage dispersion, while the technology intensity of a plant is the most important driver of within-plant wage inequality.

Germany is an interesting point in case, as it has long been known for a rather stable wage distribution, but recently experienced a strong increase in wage inequality. In fact, the German wage structure shares many of the developments observed in the US, although inequality at the bottom of the wage distribution started to rise only in the 1990s, one decade later than in the US (Dustmann et al. (2009)). Previous research has already hinted at some important sources of rising (West-)German wage inequality. In their seminal contribution, Dustmann et al. (2009) stress the importance of changes in workforce composition (in line with Lemieux (2006)) and the decline in collective bargaining.[3] In addition, they provide indicative evidence that technological change has played a role for the widening of the wage distribution at the top. In line with most traditional studies, Dustmann et al. (2009) mostly rely on plain individual-level data, the bargaining status of the plant being the only establishment-level characteristic considered. Building upon these results, Antonczyk et al. (2010) use a sequential decomposition analysis based on quantile regressions in order to investigate the increase in German wage inequality between 2001 and 2006. Using linked employer-employee data, they explicitly account for a number of personal as well as firm characteristics and also analyze the importance of collective bargaining institutions for changes in wage dispersion. According to their analysis, changes in collective bargaining play a significant, however minor role for the development of wage inequality. They assign the largest contribution to wage differences within and between industries. Although the braod scope of their paper is close to our analysis (at least to the first part), their results depend on the sequential ordering of their

[3]In subsequent research, Dustmann et al. (2014) also point to greater wage flexibility within the covered sector, which they attribute to an increased use of "opening clauses" in industry-level collective agreements.

decomposition excercise.

More recent research puts special emphasis on the firm or establishment component of wage dispersion. Most notably, Card et al. (2013) use (West-)German linked employer-employee data and document that about 60 percent of the increase in cross-sectional wage dispersion are due to establishment effects and the covariance between establishment and person effects. The exploration of the underlying sources of this growing importance of establishment-level pay is still in its infancy, however. Also, it is unclear to what extent increased between-establishment wage dispersion is linked to the drivers of aggregate wage inequality highlighted in the previous literature. Card et al. (2013) provide tentative evidence that the decline in collective bargaining discussed above has likely contributed to this development, yet they do not explore the quantitative importance of this channel.

Other research has focused on selected alternative (potential) drivers. Goldschmidt and Schmieder (2015) analyse the importance of domestic (on-site) outsourcing of food, cleaning, security and logistics services and find that this channel can account for around 9 percent of the increase in German wage inequality since the 1980s. Turning to international evidence, Handwerker and Spletzer (2015), having in mind a similar hypothesis as Goldschmidt and Schmieder (2015), analyse whether an increasing concentration of occupations at establishments has played a role. They find that this channel can only account for a small amount of the increase in (between-establishment) wage dispersion in the US. Other firm or establishment characteristics that have been found to be relevant – either for changes in overall wage inequality or for changes in between-establishment heterogeneity – are the industry of the workplace (Antonczyk et al. (2010); Barth et al. (2014)) and the export status of the plant (Helpman et al. (2016); Baumgarten (2013); Egger et al. (2013)).[4]

In this study, we adopt a more agnostic approach. Instead of pursuing one specific hypothesis, we account for a whole set of potential driving factors and quantify their

[4]The focus on the export status is motivated by recent trade theories, which analyse the link between international trade and wage inequality in a setting with heterogenous firms and labour market imperfections (e.g. Helpman et al. (2010); Egger and Kreickemeier (2012); Felbermayr et al. (2014)). In these models, the exporter wage premium, the wage differential between workers employed at exporters and the ones employed at non-exporters, is the key transmission channel from trade to wage inequality.

respective contributions to the increase in overall as well as in between- and within-establishment wage dispersion. Moreover, we disentangle the contributions of various factors to rising inequality, both through compositional changes and changes in the conditional wage structure. We employ a considerably richer framework than the existing literature and jointly account for a host of personal characteristics (age, education, occupation, and nationality) and a rich set of establishment characteristics (collective bargaining coverage, technological status, export behavior, industry, and region).

Our main findings are as follows. First, we confirm that the strong decline in collective bargaining, even conditional on an abundant set of control variables, is indeed a major source of the rise in wage dispersion and explains about a quarter of the observed increase in wage inequality in German manufacturing over the period 1996–2010. We find this effect to be disproportionately strong in the eastern region of Germany. Furthermore, we show that this decline has affected wage dispersion in very specific ways. It is a primary source of increasing between-plant wage dispersion, indicating that wage differences between covered and uncovered plants have increased over time. Moreover, it has affected lower-tail as opposed to upper-tail wage inequality, and its inequality-increasing effect is mostly concentrated in the first (1996–2003) rather than the second (2003–2010) half of the period of analysis.

Second, employment shifts towards more highly skilled workers and, even more so, changes in the skill-related wage structure, particularly in the high-to-medium skill wage gap, have also played important roles. They contributed to both within-plant and between-plant wage dispersion. Interestingly, we find that the skill-related wage structure effect is quantitatively even more important for between-plant than for within-plant wage inequality, reflecting that a major part of changes in the skill-wage gaps has arisen from increasing between-establishment wage differentials. We put this finding down to increased assortative matching along the skill dimension and provide supporting evidence in this respect.

Third, the technology intensity and the export status of the establishment are generally of little quantitative importance for the increase in overall wage dispersion over the full

period of analysis. We do find, however, a sizable technology-related wage structure effect for western Germany, indicating that the reward to a plants technology differs substantially between East- and West-Germany. Both establishment characteristics do matter for subcompents of wage dispersion and subperiods, respectively.

Fourth, shifts in the regional structure of employment also contributed to increased (between-establishment) wage dispersion. This captures the relative increase in manufacturing employment experienced by East Germany over the period of analysis.

The remainder of the chapter is organized as follows. In Section 2, we describe the linked employer-employee data used for our analysis. In Section 3, we briefly discuss the key developments in the German wage structure. Section 4 explains the decomposition analysis. We present a first descriptive overview of changes in the composition of workers and establishments as well as changes in the wage structure associated with worker and establishment characteristics, the ingredients to our decomposition analysis, in Section 5. In Section 6, we provide a detailed discussion of our decomposition results. Section 7 concludes.

1.2 Data

We base our analysis on the German LIAB data, which is a linked employer-employee data set provided by the Institute for Employment Research (IAB) in Nuremberg.[5] It combines the IAB Establishment Panel with social security data on all workers who were employed in one of the establishments as of the 30th of June of a given year.

The IAB Establishment Panel is a stratified sample of all establishments that employ at least one worker subject to social security. The strata variables are defined over regions, industries and size classes. Appropriate weights, which are inverse to the sampling probability, are provided to assure the representativeness of the results. The IAB Establishment Panel started in 1993 with West-German establishments, while East-German plants have been included from 1996 onwards. Although participation in the IAB Es-

[5]More specifically, we use the cross-sectional version of the linked employer-employee LIAB dataset (version QM 9310).

tablishment Panel is voluntary, the response rate is very high (up to 80 percent). The survey is very detailed and covers many different topics. For our analysis, information regarding the share of exports in total sales, investment in communication technology, the plant's technology status, and information related to the wage bargaining regime are most important. This information is surveyed in every year.[6]

The employee data stem from social security registrations by the employer that are mandated by law. Hence, only workers covered by social security are included in the Employment Statistics. Civil servants and self-employed are not registered. It still covers, however, about 80 percent of the German workforce. These compulsory social security records contain personal information such as gender, citizenship, the level of education, the year of birth, detailed information about the occupation (on a three-digit level), and the (top-coded) daily wage.

Similar to previous research (e.g. Dustmann et al. (2009), Card et al. (2013)) we limit our attention to full-time jobs held by men in the age of 18–65 years. We exclude marginal jobs that are subject to reduced social security contributions as well as workers that undergo training. For workers who hold multiple jobs, we only keep the highest paying one. We exclude observations that are reported to have an (implausibly) low daily wage of less than ten euros. Furthermore, we restrict our analysis to manufacturing since the effect of exporting on wages is assumed to be strongest and most direct in this sector and information about the establishments' exports are patchy for other sectors.[7] Our period of analysis covers the years from 1996 to 2010 and our main specifications are based on the reunified Germany.[8] Taking these restrictions into account we end up with 558,152 (388,621) workers and 1,524 (2,836) establishments in 1996 (2010). It is worth noting that our sample restrictions may lead to an underestimation of the overall level and growth of wage inequality among German male workers in the manufacturing sector.

[6]Further establishment variables, such as the industry affiliation on a three-digit level and regional information, are provided from the Establishment History Panel.

[7]Moreover, we do not consider those establishments, where the reporting unit in the Establishment Panel has changed over time. This is due to the fact that such a change in the reporting unit might not be accompanied by a corresponding change in the workforce data, since the establishment id stays the same.

[8]In order to be comparable to previous research, we briefly discuss the results of our main analysis on a sample for West-Germany as well.

However, since we cannot control for hours worked, such restrictions are needed to avoid measurement error.

An important caveat of the data is the censoring of wages at the annual social security maximum. In our sample, between 9 and 14 percent of the wage observations are censored in every year. To address this problem, we follow Dustmann et al. (2009) and impute the missing upper tail of the wage distribution using a series of Tobit regressions.[9] Using the estimated parameters from these models, we replace each censored wage value with a random draw from the upper tail of the appropriate conditional wage distribution. All wage information is converted into constant year-2000 euros by deflating them with the Consumer Price Index as provided by the German Federal Statistical Office. Table A.1.1 in the Appendix shows summary statistics of our main variables.

1.3 Trends in German Wage Inequality

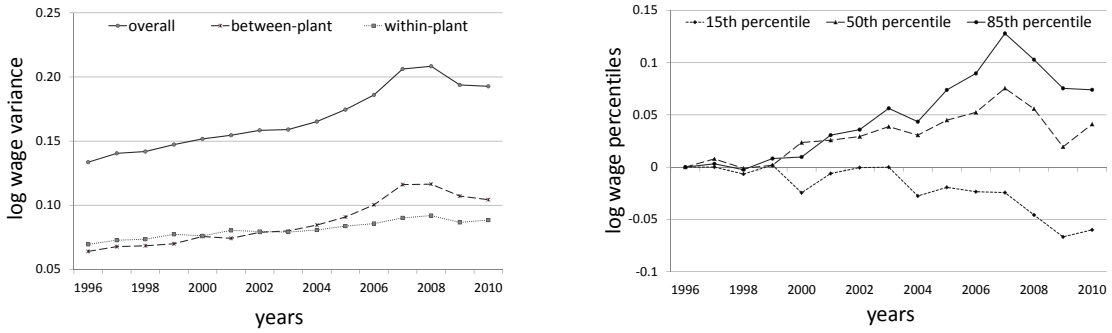
Panel (A) of Figure 1.1 displays the evolution of the variance of log real wages in the manufacturing sector as a measure of overall wage inequality. It can be seen that wage inequality has been rising up to pre-crisis year 2008 before declining slightly during the main crisis year 2009 and remaining at this level in 2010. In terms of magnitude, the increase between 1996 and 2010 amounts to about 44 percent of the initial value, which is substantial.

The figure also shows the development of between- and within-establishment wage dispersion. The variance has the attractive property that the between- and the within-component add up to the total, fulfilling the criterion of an additively separable inequality measure (Shorrocks (1980)). Technically, this can be formalized as follows:

$$\underbrace{\frac{1}{N_t}\sum_i (w_{it}-\bar{w}_t)^2}_{\text{overall variance}} = \underbrace{\frac{1}{N_t}\sum_j N_{jt}\,(\bar{w}_{jt}-\bar{w}_t)^2}_{\text{between-plant variance}} + \underbrace{\frac{1}{N_t}\sum_j\sum_{i\in j}(w_{it}-\bar{w}_{jt})^2}_{\text{within-plant variance}},$$

[9] We run a series of Tobit regressions for each year, education-group and region (east/west). The explanatory variables are the ones that we also use in our analysis: five age-group dummies, industry and federal-states dummies, occupation dummies as well as indicator variables for export behavior, the investment in technology of plants and the collective bargaining status.

where workers are indexed by i and plants by j. N_t and N_{jt} denote the overall number of workers and the number or workers in plant j at time t, respectively. In addition, w_{it} denotes the log wage of individual i, $\bar{w}_{jt}$ the mean log wage within plant j, and $\bar{w}_t$ the overall mean log wage at time t.



(A) Different Inequality Measures **(B)** Wage Growth at Percentiles

Figure 1.1
Evolution of Wage Dispersion

Notes: Figure (A) shows the evolution of overall, between-plant and within-plant wage variance. We construct the measure of between-plant (within-plant) variance by using yearly regressions of log real individual wages on a full set of establishment fixed effects. We then take the variance of predicted (residual) wages as a measure of between-plant (within-plant) inequality. Figure (B) shows indexed log real wage growth of the 15th, 50th and 85th percentile. Since at most 14 percent of wage observations are censored in each year, the 85th wage percentile is not affected. Both Figures are based on LIAB data and refer to the manufacturing sector. The sample corresponds to full-time male workers between 18 and 65 years of age.

While in 1996, the within-establishment component was slightly larger than the between-establishment component, accounting for 52 percent of overall wage inequality, between-establishment wage dispersion has grown considerably faster, accounting for 54 percent of the level of wage inequality in 2010 and for about two thirds of the increase in wage inequality over the period of analysis. This is in line with findings of the related literature, which also stresses the growing importance of between-establishment wage dispersion.

While the variance is a good and frequently used summary measure of overall wage dispersion, it does not allow one to analyse changes at different parts of the wage distribution. Therefore, Panel (B) of Figure 1.1 shows changes in log real wages over time at different percentiles of the earnings distribution (normalized to the year 1996). Up to

the year 2007 workers at the median and at the 85th percentile have realized real wage gains, while workers at the 15th percentile have faced moderate declines in real wages.[10] During the three most recent years of our sample (2007-2010) all workers up to the 85th percentile have realized real wage losses. If we consider the 85-50 and 50-15 log wage differential as measures of upper-tail and lower-tail wage inequality, it becomes apparent that most of the overall increase in wage inequality is due to changes in the lower part of the earnings distribution.

1.4 Empirical Approach and Methodology

In order to quantify the economic impact of (changes in) certain covariates on (changes in) the distribution of wages, our empirical approach has to meet different requirements: Firstly, it needs to allow us to "go beyond the mean", meaning that we need to estimate the effects not simply on the mean but on the whole distribution of our dependent variable of interest. Secondly, we need to account for several covariates in a comprehensive framework. This is simply because we are interested in the *conditional effects* of our covariates and, in addition to that, we want to evaluate the relative impact of each covariate with respect to the other included factors. Thirdly, for each single covariate we want to distinguish between a composition effect, which is linked to changes in the distribution of this factor, and a wage structure effect that reflect changes in the conditional wage distribution over time. The latter two requirements are usually referred to as allowing for a *detailed decomposition*.

A decomposition method which can be applied beyond the mean and allows for a detailed decomposition with respect to each single covariate in a unified framework is the so called RIF regression approach, which is based on recentered influence function (RIF) regressions and was introduced by Firpo et al. (2009). A simple intuition for this methodology is that it can be regarded as a generalization of a standard Oaxaca-Blinder decomposition technique (Oaxaca (1973); Blinder (1973)) from the mean to other distributional statistics. A key advantage of this RIF regression approach is related to

[10] Note that the characteristics of a worker at each percentile might have changed over time.

its linearization. It makes the procedure computationally relatively simple and, even more importantly, the resulting decomposition path-independent. This latter property implies that we do not have to take a stand on the sequential ordering of covariates in the decomposition process, which generally matters for the decomposition results.[11] In the following, we sketch the key mechanisms underlying our approach.[12]

1.4.1 RIF-Regression Approach

A RIF-regression is similar to a standard regression with the exception that the dependent variable Y is replaced by the recentered influence function of the statistic of interest. Consider $IF(y;\upsilon)$, the influence function corresponding to an observed wage y for the distributional statistic $\upsilon(F_Y)$ of interest (e.g., a quantile, the variance, the gini coefficient). The recentered influence function is defined as $RIF(y;\upsilon) = \upsilon(F_Y) + IF(y;\upsilon)$ so that it aggregates back to the statistic of interest: $\int RIF(y;\upsilon)\cdot dF(y) = \upsilon(F_Y)$. In non-technical terms, the influence function represents the contribution of a given observation to the distributional statistic of interest.

Assuming that the conditional expectation of $RIF(y;\upsilon)$ can be modeled as a linear function of the explanatory variables,

$$E[RIF(y;\upsilon)|X] = X\gamma + \epsilon,$$

the corresponding parameters γ can be estimated by OLS. Applying this approach to quantiles, the RIF regression corresponds to an unconditional quantile regression, which allows one to estimate the marginal effect of any explanatory variable, say, the share of workers covered by collective bargaining, on the τth quantile of the wage distribution. Different from a standard conditional quantile regression, which only captures within-group (or residual) wage effects of the covariates, the unconditional quantile regression captures both within-group and between-group effects. For example, in the case of collective bar-

[11] Alternative approaches that also allow for detailed decompositions generally do not share the property of path-independence, often face non-monotonicity problems and are computationally more cumbersome (see e.g. Chernozhukov et al. (2013), DiNardo et al. (1996), Melly (2005)).

[12] This section is very much based on Firpo et al. (2013) and Fortin et al. (2011). We refer the interested reader to these original contributions for a more extensive description of the empirical approach.

gaining, the (typically negative) within-group effect on wage inequality stems from the fact that within the covered sector, wages (among comparable workers) tend to be more compressed than in the non-covered sector. On the other hand, the (typically positive) between-group effects results from covered workers usually earning a higher conditional mean wage than non-covered workers. As this example illustrates, the within-group and the between-group effects may go into different directions, and one or the other may dominate at different points of the wage distribution. The RIF coefficients as such, however, do not allow one to disentangle the within-group and the between-group component so that we will resort to auxiliary evidence in cases where this distinction is of interest.

Due to the linearization, it is straightforward to apply the standard Blinder-Oaxaca decomposition to the RIF regression. Thus, if one is interested in decomposing changes in the distributional parameter $\upsilon(F_Y)$ between two different time periods ($t = 0$ and $t = 1$), the decomposition reads as

$$\hat{\Delta}_O^{\upsilon} = \underbrace{\overline{X}_1 \left(\hat{\gamma}_1^{\upsilon} - \hat{\gamma}_0^{\upsilon}\right)}_{\text{wage structure effect}} + \underbrace{\left(\overline{X}_1 - \overline{X}_0\right) \hat{\gamma}_0^{\upsilon}}_{\text{composition effect}} \tag{1.1}$$

where $\hat{\Delta}_O^{\upsilon}$ denotes the overall change in the statistic υ. The first term on the right-hand side denotes the wage structure effect, $\hat{\Delta}_S^{\upsilon}$, which is obtained by holding the distribution of covariates constant and only modifying the conditional wage structure (represented by the RIF coefficients). The second term denotes the composition effect, $\hat{\Delta}_X^{\upsilon}$, which is obtained by holding the conditional wage structure (RIF coefficients) constant and varying the distribution of covarriates according to the observed changes between $t = 0$ and $t = 1$.

As Fortin et al. (2011) explain, there may be a bias in the decomposition because the linear specification used in the regression is only a local approximation that does not generally hold for larger changes in the covariates. In particular, the RIF coefficients might change if the distribution of the covariates changes even though the true wage structure remains the same. To circumvent this problem, Fortin et al. (2011) propose to combine the RIF regressions with a reweighting approach, where the counterfactual $\hat{\gamma}_{01}^{\upsilon}$ coefficients are obtained from a RIF regression on the period 0 sample reweighted to

mimic the period 1 sample (such that $plim(\overline{X}_{01}) = plim(\overline{X}_1)$). Taken this adjustment into account, the pure wage structure effect[13] amounts to

$$\overline{X}_1 \left(\hat{\gamma}_1^v - \hat{\gamma}_{01}^v\right)$$

and the pure composition effect[14] to

$$\left(\overline{X}_{01} - \overline{X}_0\right) \hat{\gamma}_0^v.$$

Just like in the standard Blinder-Oaxaca decomposition, it is possible to obtain the detailed elements of the wage structure and the composition effects which are attributable to different subsets of the vector of explanatory variables, X. However, in case of the wage structure effect, the detailed elements are not unique and, for categorical variables, depend on the choice of the base category which has to be taken into account when interpreting the results. It is important to stress that the decomposition method, similar to alternative decomposition approaches used in the literature (e.g. DiNardo et al. (1996); Fairlie (2005); Mata and Machado (2005)), relies on the assumption of the invariance of the conditional distribution and therefore ignores general equilibrium effects. For our analysis this implies, e.g., that the collective bargaining wage premium is assumed to be independent of collective bargaining coverage. Moreover, the decomposition takes all covariates are exogenously given and not themselves determined by the same factors that also raise wage inequality. This however implies that a "causal" interpretation of the estimated effects is not possible.

We apply this approach to quantify the contribution of our explanatory factors to changes in the wage distribution between 1996 and 2010. These factors cover the per-

[13] The "naive" wage structure effect can be devided into the pure wage structure effect and the reweighting error. See Fortin et al. (2011) for details.

[14] The "naive" composition effect can be divided into a pure composition effect and a component measuring the specification error. The specification error captures the difference between the composition effect estimated using a non-parametric reweighthing approach and the linear approximation obtained using the RIF-regression.

sonal characteristics education (four categories)[15], age (five categories)[16], nationality (two categories)[17], and dummies for more than 300 different occupations. Moreover, we consider a dummy variable that indicates the export status of an establishment, two dummy variables capturing the bargaining regime of the establishment (sector-level and firm-level agreement, respectively, where no collective bargaining agreement is the base category) and two dummy variables that equal one if the plant has invested in communication or information technology and if the (self-assessed) technology status of the plant is above average compared to other establishments in the same industry, respectively. Finally, we include a full set of two-digit industry dummies to capture sectoral shifts during our period under study and include an indicator variable for the former eastern region of Germany.[18]

We apply the decomposition method to changes in overall wage distribution as well as to changes in between- and within-establishment wage dispersion. For statistical inference, we rely on a bootstrap (200 replications) of the whole decomposition. To account for the correlation of wages within industries, a block bootstrap procedure is applied where all observations within an industry are resampled.

1.5 Evidence on Changes in Workforce Composition and the Wage Structure

Before discussing the detailed decomposition results of changes in wage dispersion, we provide descriptive evidence on changes in the composition of workers and establishments as well as changes in the wage structure related to worker and establishment characteristics. These basically constitute the ingredients, albeit in an unconditional and simplified way, to our decomposition analysis where we quantify their respective contributions to

[15] 1) Low: no vocational training, no high school. 2) Medium: high school and/or vocational training. 3) High: university or technical college. The fourth category consists of observations with missing educational information.

[16] 1) 18-25 years. 2) 26-35 years. 3) 36-45 years. 4) 46-55 years. 5) 56-65 years.

[17] German versus not-German.

[18] We choose our base category to be a worker employed at a non-exporting establishment, which is not covered by a collective bargaining agreement and which has not invested into information communication technology and who is employed in west Germany. Regarding the remaining categorial variables, we choose the modal categories in 1996 to be our base categories. These are medium skilled workers, in the age of 26 to 35, metalworkers in the manufacture of machinery and equipment industry.

the increase in wage inequality.

1.5.1 Changes in the Composition of Workers and Establishments

The first two columns of Table 1.1 illustrate the composition of workers according to various individual and establishment characteristics for the years 1996 and 2010. In terms of sociodemographic characteristics, there is a visible trend towards more highly skilled and, even more so, older workers. The share of workers with university education in our sample increased from 8 percent in 1996 to 10 percent in 2010.[19] Also, the share of workers in the age group 46–55 (56–65) increased from 22 percent (9 percent) to 33 percent (13 percent). In contrast, there is a decline in the share of foreign workers. It has to be noted, however, that in the present data, workers are classified as foreigners/natives based on their nationality. Since the German nationality law was reformed during our sample period, making it easier to obtain German citizenship, this decline most likely reflects changes in citizenship rather than a decline in the number of migrant workers.

Regarding establishment characteristics, the share of workers employed at exporters increased from 68 percent to 76 percent, reflecting the substantial increase in trade openness experienced by Germany over the period of analysis and, more generally, underscoring the importance of exporting establishments in the German manufacturing employment structure. In contrast, the employment share of high-technology plants (no matter whether defined according to investments in communication and information technology or according to the subjective assessment of the plant's technology status) remained fairly stable. This might be due to the fact that a lot of investments in technology already took place before the mid 1990s when our period of analysis starts.

[19] In addition, the share of workers with missing education information also increased. According to their (unconditional) mean wages, this group seems to resemble most closely the group of low-skilled workers (which decreased by an amount similar to the increase of the missings), suggesting that particularly the share of medium-skilled workers declined.

TABLE 1.1
Worker Shares, Within Group Wage Dispersion and Mean Values

	Worker Share		Within Group Wage Dispersion and Mean Values											
			Overall Wages				**Between-Plant Wages**				**Within-Plant Wages**			
	1996	2010	1996		2010		1996		2010		1996		2010	
Worker-Level Characteristics			mean	sd	mean	sd	mean	sd	mean	sd	mean	sd	mean	sd
education: missing	0.04	0.08	4.30	0.44	4.26	0.45	4.36	0.32	4.30	0.36	-0.05	0.26	-0.05	0.36
education: low	0.16	0.12	4.34	0.24	4.36	0.29	4.49	0.18	4.50	0.26	-0.14	0.18	-0.14	0.20
education: medium	0.73	0.70	4.47	0.34	4.49	0.38	4.48	0.25	4.51	0.31	0.00	0.24	-0.02	0.26
education: high	0.08	0.10	4.99	0.38	5.11	0.45	4.65	0.26	4.74	0.30	0.35	0.32	0.37	0.38
age: 18-25	0.07	0.06	4.21	0.27	4.17	0.34	4.41	0.26	4.42	0.35	-0.20	0.20	-0.24	0.22
age: 26-35	0.32	0.18	4.42	0.30	4.40	0.38	4.47	0.25	4.48	0.34	-0.04	0.21	-0.08	0.23
age: 36-45	0.29	0.30	4.53	0.37	4.56	0.43	4.50	0.25	4.53	0.31	0.03	0.26	0.03	0.30
age: 46-55	0.22	0.33	4.58	0.39	4.58	0.45	4.52	0.26	4.54	0.31	0.06	0.29	0.05	0.31
age: 56-65	0.09	0.13	4.59	0.41	4.54	0.45	4.51	0.25	4.51	0.32	0.08	0.31	0.03	0.31
foreign citizenship (yes)	0.10	0.08	4.39	0.28	4.44	0.35	4.51	0.21	4.54	0.28	-0.11	0.21	-0.10	0.24
foreign citizenship (no)	0.90	0.92	4.50	0.37	4.52	0.45	4.49	0.26	4.51	0.33	0.01	0.27	0.01	0.30
Establishment-Level Characteristics														
exporter (yes)	0.68	0.76	4.55	0.35	4.67	0.43	4.55	0.21	4.58	0.28	0.00	0.28	0.00	0.31
exporter (no)	0.32	0.24	4.35	0.36	4.44	0.47	4.35	0.28	4.31	0.35	0.00	0.23	0.00	0.26
investment in ICT (yes)	0.62	0.59	4.53	0.37	4.59	0.43	4.53	0.24	4.59	0.29	0.00	0.28	0.00	0.31
investment in ICT (no)	0.38	0.41	4.42	0.35	4.40	0.43	4.42	0.25	4.40	0.33	0.00	0.24	0.00	0.27
high technological status (yes)	0.20	0.16	4.51	0.38	4.56	0.45	4.51	0.27	4.56	0.33	0.00	0.27	0.00	0.31
high technological status (no)	0.80	0.84	4.48	0.36	4.51	0.44	4.48	0.25	4.50	0.32	0.00	0.26	0.00	0.30
collective agreement firm-level (yes)	0.10	0.12	4.39	0.35	4.57	0.39	4.39	0.24	4.57	0.26	0.00	0.26	0.00	0.29
collective agreement firm-level (no)	0.90	0.88	4.50	0.37	4.51	0.44	4.50	0.25	4.51	0.33	0.00	0.26	0.00	0.30
collective agreement sector-level (yes)	0.78	0.53	4.53	0.34	4.64	0.40	4.53	0.21	4.64	0.26	0.00	0.27	0.00	0.31
collective agreement sector-level (no)	0.22	0.47	4.33	0.39	4.37	0.43	4.33	0.30	4.37	0.32	0.00	0.25	0.00	0.29
east Germany (yes)	0.11	0.14	4.13	0.37	4.15	0.42	4.13	0.28	4.15	0.33	0.00	0.24	0.00	0.26
east Germany (no)	0.89	0.86	4.53	0.34	4.57	0.41	4.53	0.21	4.57	0.28	0.00	0.27	0.00	0.30

Notes: Analysis based on LIAB data, manufacturing sector. Sample includes full-time male workers between 18 and 65 years of age. Education groups are defined as: 1) low: no vocational training, no high-school; 2) medium: high school and/or vocational training; 3) high: university or technical college. The fourth category consists of observations with missing educational information. Sampling weights are employed. We construct the measure of between-plant (within-plant) variance by using yearly regressions of log individual wages on a full set of establishment fixed effects. We then take the variance of predicted (residual) wages as a measure of between-plant (within-plant) inequality.

The most drastic change in terms of establishment characteristics, however, relates to changes in collective bargaining coverage rates. In Germany the recognition of trade unions regarding collective bargaining purposes is at the discretion of the firm. Once a firm has recognized a union, collective bargaining outcomes apply de facto to all workers in that firm, regardless of whether they are union members or not (for a discussion see e.g. Dustmann et al. (2009) and Fitzenberger et al. (2013)). Such collective agreements are either formed at the firm or at the regional-industry level. Firms that once have recognized a collective contract, however, can later decide to opt at their own discretion. Table 1.1 shows that the share of workers covered by a sector-level bargaining agreement declined by 25 percentage points (from 78 percent to 53 percent), which was hardly offset by the small increase in the share of workers covered by firm-level bargaining agreements.[20] Note that, since we are considering an unbalanced panel of establishments, this decline comes about by both previously covered establishments leaving collective bargaining and entering (young) plants being less likely to follow a collective agreement.

In addition, the regional structure of manufacturing employment changed slightly, with an increasing share of workers employed in eastern Germany (up from 11 to 14 percent).[21]

1.5.2 Changes in the Wage Structure

Intra-Group Wage Dispersion The second part of Table 1.1 displays the structure and development of intra-group wage dispersion, where these groups are again formed according to varying worker and establishment characteristics.

It portrays two main findings. First, intra-group wage dispersion differs substantially across groups. At the individual- level, it increases in the workers' skill level and age, and it is larger for natives than for foreigners. At the establishment-level, it is, not surprisingly, substantially larger among establishments not covered by collective bargaining agreements

[20] A similar pattern emerges when considering the fraction of establishments instead of workers. Thus, this decline is not (primarily) driven by covered and uncovered establishments growing at different rates.

[21] We find a similar employment pattern using a representative 2 percent sample of all employment biographies, the SIAB data, which is also provided by the IAB. Accoding to the SIAB, manufacturing employment in eastern Germany increased from 10 to 12 percent between 1996 and 2010 (see Table A.1.2).

than among covered ones as well as slightly larger among exporters, eastern German establishments, and high-technology plants than among their respective counterparts. Thus, most of the compositional changes outlined in the previous subsection entail a relative shift towards groups with larger within-group wage dispersion, suggesting that there should be a substantial contribution of composition effects to the increase in wage inequality.[22]

Second, in all groups, with no single execption, intra-group wage dispersion increased markedly over the period of analysis. Thus, in addition to composition effects, wage structure effects have also played a role. The magnitude of this increase again differs across groups, sometimes reenforcing initial differences in intra-group wage dispersion (e.g. in the case of education where it increased the most for the high-skilled) and sometimes dampening them (e.g. in the case of collective bargaining where intra-group wage dispersion increased more among covered than among uncovered workers).

We also display the structure and development of between- and within-establishment wage dispersion by subgroup.[23] Generally, the relative importance of both subcomponents of wage inequality differs quite substantially across subgroups. For example, the larger intra-group wage dispersion of more highly skilled and older workers is mostly driven by the within-establishment component. Relatedly, and on top of this, those groups that have high levels of intra-group wage dispersion in one subcomponent of wage inequality are not necessarily the ones that also have high levels of intra-group wage dispersion in the other subcomponent. In particular, there is smaller between-establishment, but larger within-establishment wage dispersion among establishments covered by a collective bargaining agreement than among uncovered ones. The same goes for exporting versus non-exporting establishments while the opposite holds true for establishments in eastern versus western Germany.

[22] In fact, the only exception is the slight decrease in the share of workers employed at high-technology establishments.

[23] Note, however, that between-establishment and within-establishment wage dispersion do not have to add up to the total for every single subgroup as they are still based on the establishment-mean wages and within-establishment wage residuals that we calculated for the entire sample. The covariance between these two terms will be zero if subgroups are formed according to establishment-level characteristics – where the mean within-group wage residual is always zero by construction – but will generally not be equal to zero if subgroups are formed according to individual characteristics.

Over time, the between-establishment component has grown more strongly for most subgroups, the exception being high-skilled workers and establishments with either a firm-level or no collective agreement.

Mean Wage Gaps Between Groups The overall wage structure is not only shaped by wage dispersion within groups but also by (mean) wage gaps between groups. Note that these mean differences matter for both the composition effect and the wage structure effect of the decomposition analysis. To the extent that between-group wage differentials change, they will contribute to the wage structure effect. On the other hand, to the extent that there are compositional shifts towards groups whose (initial) group-mean wages are relatively far from (close to) the grand mean, these will contribute to greater (lower) wage inequality via the composition effect.

Table 1.1 also shows (unconditional) mean wages by subgroups. A strong increase in the high-to-medium skill wage gap as well as in the collective bargaining wage premium can be observed. Again, we also show separately the structure and development of between- and within-establishment mean wages.[24] Interestingly, we see that, in the skill dimension, about two thirds in the increase in the high-to-medium skill wage gap are due to the between-establishment component, providing some tentative evidence that skill-related sorting has become more important over time.

1.6 Decomposition Results

We now turn to our detailed decomposition results based on RIF regressions and first discuss our findings for overall wage inequality. Our main specifications generally refer to the reunified Germany, but we briefly review the main results for a sample of West-Germany as well. We then turn to our separate decomposition results for between- and within-establishment wage dispersion and in further extensions, explore differences between lower-tail and upper-tail wage dispersion as well as changes over time.

[24] Due to the aforementioned reason that mean within-establishment wage residuals are zero by construction at the establishment level, this distinction is only interesting for groupings defined according to individual-level as opposed to establishment-level characteristics.

1.6.1 Baseline Decomposition of Overall Wage Inequality

The results of our baseline decomposition of changes in the log wage variance between 1996 and 2010 are presented in Table 1.2, where the values represent log percentage points and generally give the joint contribution of groups of (dummy) variables belonging to the explanatory factors listed in the left column of the table. In addition to composition and wage structure effects, we also report the specification and reweighting errors for each decomposition.

Looking first at the total composition and wage structure effects, respectively, reveals that both contribute equally to the increase in wage dispersion over the sample period. Among the different factors, compositional changes associated with collective bargaining coverage contribute the most to the increase in wage dispersion. This reflects the strong decline in (particularly sector-level) collective bargaining coverage rates discussed in the previous section. This decline supposes a relative shift towards the group of (uncovered) workers which is characterized by both higher intra-group wage dispersion and group-mean wages that are relatively far from the grand mean. The contribution of the bargaining-related composition effect amounts to 1.55 log percentage points, which corresponds to 26 percent of the total increase and almost half of the total composition effect, respectively.[25]

Among the remaining composition effects, shifts in the education and age profile of workers and in the regional structure of employment have played important roles for the increase in wage dispersion. These compositional shifts are associated with an increase in inequality of 0.50 (education), 0.71 (age), and 0.53 (region) log percentage points, respectively. As far as the education and age-related composition effect are concerned, they capture the relative shifts towards higher-educated and older workers, i.e. groups that are characterized by a greater within-group wage dispersion (see also, e.g., Lemieux (2006) and Dustmann et al. (2009)). The region-related composition effect captures the relative increase in employment experienced by eastern Germany over the period of analysis (from 11 percent of total manufacturing employment in 1996 to 14 percent in 2010 in our

[25]The magnitude of this effect is not easily comparable to previous findings by e.g. Dustmann et al. (2009) or Antonczyk et al. (2010), since they have focussed on different time periods, and - more importantly - on West-Germany only. We briefly discuss our decomposition results for the former west of Germany at a later stage of this section.

Table 1.2
Baseline Results: Decomposition of Overall Variance, 1996-2010

Observed Change	5.92***	
	[0.77]	
	Composition	**Wage-Structure**
Export	-0.10	-1.31
	[0.07]	[1.01]
Collective Bargaining	1.55***	0.61
	[0.30]	[0.88]
Technology	-0.02	-0.20
	[0.04]	[0.62]
Occupation	0.22	2.42
	[0.23]	[2.01]
Education	0.50***	2.03***
	[0.14]	[0.39]
Age	0.71***	-0.37
	[0.09]	[0.07]
Foreign	0.03*	0.08
	[0.02]	[0.09]
East	0.53***	0.24
	[0.14]	[0.28]
Industry	0.00	0.15
	[0.12]	[3.97]
Constant		0.15
		[4.41]
Reweighting error		-0.31
		[0.20]
Specification error		-0.62
		[0.34]
Total	3.43***	3.42***
	[0.52]	[0.60]

Notes: Decomposition is based on LIAB data, manufacturing sector. Sample includes full-time male workers between 18 and 65 years of age. Table contains bootstraped standard errors in parenthesis (200 replications of the entire procedure and clustered at the industry level). Asteriks indicate statistical significance at the 1%(***), 5%(**) or 10% (*) level. To account for the rather low level of degrees of freedom, statistical inference is based on the Student's t-distribution with 14-1=13 degrees of freedom rather then the standard normal distribution.

sample). Given that there is a pronounced East-West gap in wages, this relative increase of eastern German employment supposes a relative shift towards the group whose (mean) wages are relatively far from the grand mean, implying greater dispersion. In contrast, the remaining composition effects, including the ones relating to the establishments' export and technology status, are small in magnitude and/or insignificant.

Turning to the wage structure effects, the ones associated with education and occupation of workers are the quantitavely most important ones, although only the former is statistically significant. Recall that the wage structure effects capture both a between component, that is changes in wage differentials between groups (e.g. education groups, occupations), and a within component, that is changes in wage dispersion within groups (compared to the base group). In the case of education, both of these components are at work and contribute to greater wage dispersion. On the one hand, wage dispersion among high-skilled (and low-skilled) workers increased relative to wage dispersion among medium-skilled workers, our base group. On the other hand, the skill wage premium particularly for university graduates increased markedly over the period of analysis. While the unconditional mean wage gaps discussed in the previous section already provided some suggestive evidence in this respect, the same pattern carries through using standard Micerian wage regressions. Figure 1.2 plots the wage differentials between the low- and medium-skilled (left y-axis) and the medium- and high-skilled (right y-axis) over time, where the shown coefficients are based on yearly regressions of log wages on education and age dummies, as well as on sector and region indicators. While the relative skill premium between low- and medium skilled workers remained relatively stable over time, the premium of high-skilled wokers increased substantially, in particular during the second half of our period of observation.

With respect to the occupation wage structure effect, we also find an inequality increasing contribution which is particularly strong at the upper part of the wage distribution. Figure 1.3 illustrates this finding by showing changes in smoothed wages between 1996 and 2010 for each occupation-skill percentile. It can be seen that those occupations ranked above the median-skill percentile realized increasing wage growths, while those occupa-

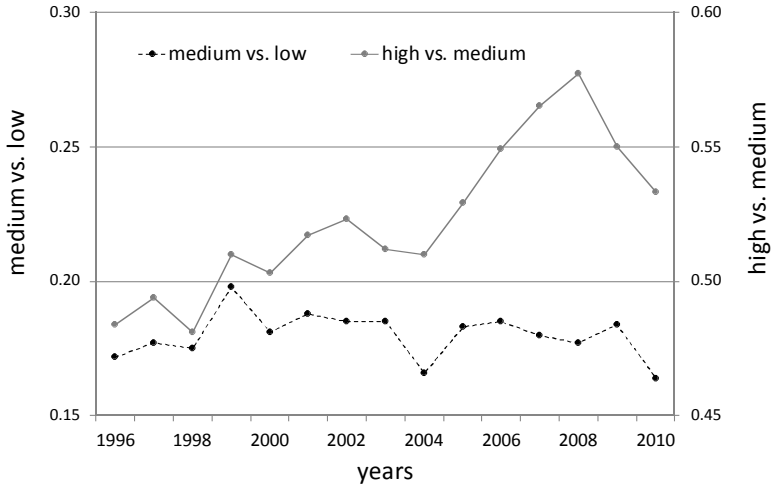


Figure 1.2
Skill Premia

Notes: Figure 1.2 shows relative skill premia of medium versus low (left axis) and high versus medium (right axis) educated workers. The results are based on yearly regressions of imputed (log) wages on indicator variables for four education-, five age-, 16 region- and 23 sector-groups. Regressions are based on the LIAB data, manufacturing sector. The sample corresponds to full-time male workers between 18 and 65 years of age.

tions ranked below the median only show very moderate wage increases: a pattern which leads to an overall increase in wage inequality.

Coming back to the remaining wage structure effects, only the one related to collective bargaining coverage contributes in a quantitative important way to greater wage dispersion, although its contribution is not statistically significant. The positive point estimate reflects both a (slightly) rising collective bargaining wage premium over the period of analysis as well as rising wage dispersion among covered relative to not covered workers. The latter development has also been highlighted by Dustmann et al. (2014) and is related to an increasing flexibility within collective agreements. Interestingly, we even find the wage structure effect related to exporting to be inequality-reducing, albeit again not significant.[26] The other wage structure effects are not important determinants of greater

[26]This result stands in contrast to the one obtained by Baumgarten (2013) who explicitly analyses the contribution of establishment-level exporting to wage inequality and finds that the increase in the exporter wage premium has contributed, albeit not very strongly, to increasing wage inequality. Apart from a different sampling period – the analysis of Baumgarten (2013) ends in 2007, that is before the exporter wage premium decreased during the Great Recession (see Dauth et al. (2015)) – the main difference is that he focused only on the between component of the wage structure effect, i.e. a greater difference between exporters and non-exporters, and not on the within-component, i.e. the relatively

wage dispersion.

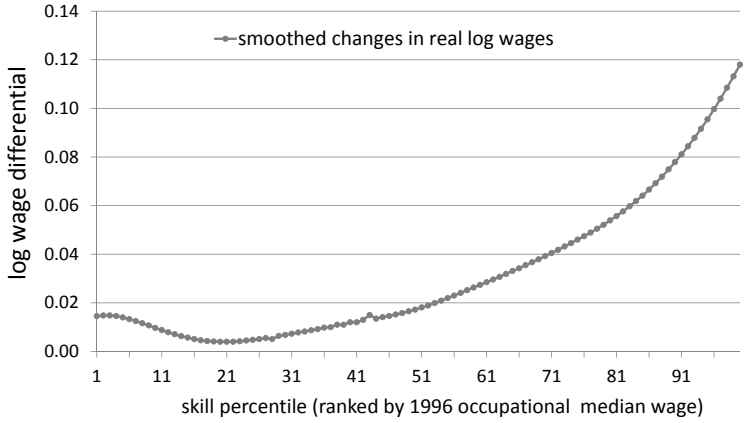


FIGURE 1.3
Wage Differentials by Skill Percentile, 1996-2010

Notes: Figure 1.3 shows changes in smoothed wages, 1996-2010. It is constructed by sorting three-digit-occupations according to their median wages in 1996 (employment weighted) and then grouped into 100 equally sized groups. We employ a smoothed regression with bandwith 0.8. The analysis is based on LIAB data, manufacturing sector. The sample corresponds to full-time male workers between 18 and 65 years of age.

Baseline Decomposition for West-Germany Columns 1 and 2 of Table A.1.3 in the Appendix show the baseline decomposition results for a sample of West-Germany. The following two aspects should be pointed out: First, the composition effect related to the decline in collective bargaining coverage is sizeably smaller and amounts to 0.68 log percentage points only, indicating that changes in the collective bargaining structure affected the increase in wage inequality in the eastern part of Germany disproportionately strong. For West-Germany, the composition effects related to the decline in collective bargaining coverage is roughly as important as the impact of compositional changes related to the education and age structure of the workforce.[27] Second, the wage structure effect

smaller increase in wage dispersion among exporters than among non-exporters. The results of our analysis suggest that the negative within component of the wage structure effect exceeds the positive between component.

[27] The magnitude of the bargaining related composition effect is of similar size to the one obtained by Dustmann et al. (2009) who, however, did not control for any other factors except for age and education and consider the years 1995–2004. Antonczyk et al. (2010) estimate a smaller contribution of deunionization to rising wage inequality. Their analysis also accounts for other explanatory factors

related to the technology intensity of an establishment is found to have a statistically significant and economically large impact on increasing wage inequality (amounting to 1.23 log percentage points). This captures both, that the technology premium increased substantially in West-Germany between 1996 and 2010 and that wage dispersion among workers employed at high technology firms inreased strongly.

Summing up, the decomposition analysis shows that the main sources of the increase in overall wage dispersion, as measured by the log wage variance in the German manufacturing sector over the period 1996 to 2010, are changes in the education and occupation-related wage structures as well as changes in the composition of collective bargaining coverage. The latter effect is disproportionately strong in East-Germany.

1.6.2 Decomposition of Between- and Within-Plant Inequality

We now separately decompose changes in between-plant and within-plant wage dispersion. For this purpose, we apply the same decomposition technique to changes in the variance of predicted wages and wage residuals, respectively, of a regression of log individual wages on a full set of establishment fixed effects. At first sight, a natural expectation could be that establishment characteristics, with their composition and wage structure effects, should be the main drivers of between-establishment wage dispersion while individual characteristics should be the main drivers of within-establishment wage dispersion. However, that does not need to be the case. To the extent that individual characteristics also matter for between-establishment wage inequality, this suggests that workers with different characteristics are unevenly distributed across establishments, providing (indirect) evidence for assortative matching. Indeed, previous research has already shown the growing importance of assortative matching, as measured by the correlation between individual and establishment effects, for wage inequality (Card et al. (2013)). On the other hand, to the extent that establishment characteristics matter for within-establishment wage dispersion, this suggests that these characteristics affect individual workers' wages unevenly.

such as the industry and the size of the firm. Note, however, that the analysis by Antonczyk et al. (2010) is based on a much shorter period (2001–2006) and does not capture the full decline in collective bargaining coverage rates.

TABLE 1.3
Decomposition of Between-Plant and Within-Plant Variance, 1996-2010

	Between-Plant Variance		**Within-Plant Variance**	
Observed Change	4.03***		1.89***	
	[0.56]		[0.20]	
	Composition	**Wage-Structure**	**Composition**	**Wage-Structure**
Export	-0.23**	0.45	0.13**	-0.75*
	[0.09]	[0.74]	[0.06]	[0.42]
Collective Bargaining	1.85***	1.37	-0.27***	-0.19
	[0.26]	[0.95]	[0.08]	[0.38]
Technology	-0.02	-1.00	-0.01	0.82***
	[0.03]	[0.62]	[0.01]	[0.27]
Occupation	0.15	1.30	0.08	0.55
	[0.11]	[1.82]	[0.13]	[0.59]
Education	0.16*	0.54***	0.25***	0.38
	[0.08]	[0.16]	[0.07]	[0.22]
Age	0.06	-0.81*	0.35***	-0.01**
	[0.04]	[0.44]	[0.03]	[0.25]
Foreign	-0.01	-0.08	0.01	0.11**
	[0.01]	[0.05]	[0.01]	[0.05]
East	0.66***	0.17	-0.09***	0.23
	[0.17]	[0.23]	[0.03]	[0.10]
Industry	-0.06	0.67	0.07	-0.16
	[0.13]	[3.88]	[0.05]	[2.67]
Constant		-0.17		0.28
		[4.36		[2.81]
Reweighting error		-0.30		-0.03
		[0.17]		[0.08]
Specification error		-0.67***		0.15**
		[0.21]		[0.07]
Total	2.56***	2.44***	0.05**	1.25***
	[0.37]	[0.65]	[0.19]	[0.18]

Notes: See notes of Table 1.2. We construct the measure of between-plant (within-plant) variance by using yearly regressions of log individual wages on a full set of establishment fixed effects. We then take the variance of predicted (residual) wages as a measure of between-plant (within-plant) inequality.

We first turn to the detailed decomposition results of between-establishment wage inequality, shown in the first two columns of Table 1.3. As was the case with the overall variance, aggregate composition effects are roughly as important as aggregate wage structure effects. Among the composition effects, the largest contribution to the increase in between-establishment wage inequality comes again from changes in collective bargaining coverage rates. The bargaining-related composition effect amounts to 1.85 log percentage points (corresponding to 46 percent of the total increase in between-plant wage inequality or 72 percent of the total composition effect) and is, thus, even larger than its contribution to overall inequality, both in relative and absolute terms. Thus, the decline in collective bargaining, driven primarily by a strongly decreasing share of establishments covered by sector-level agreements, has been associated with a greater dispersion of wages across establishments.

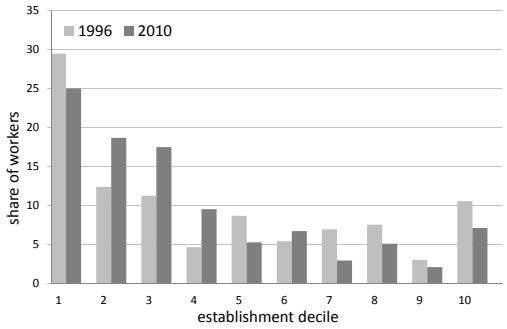
The second largest contribution (0.66 log percentage points, about a quarter of the total composition effect) comes from the regional shift towards a larger share of eastern German employment. Like in the case of the overall variance, this is due to the pronounced East-West gap in establishment-level wages so that a relative increase in the group of workers whose mean wages are relatively far from the grand mean contributes to greater inequality.

Composition effects related to individual characteristics also matter, but to a much smaller extent. This applies to the explanatory factors education, occupation, and age, where only the former is statistically significant. This reflects that those worker groups with larger between-establishment wage differentials and those that are overrepresented at the tails of the establishment-level wage distribution (such as high-skilled workers) have grown relative to worker groups with smaller between-establishment wage differentials and those that are overrepresented in the middle of the establishment-level wage distribution (such as medium-skilled workers). In total, the sum of composition effects associated with individual-level variables amounts to 0.36 log percentage points, corresponding to 9 percent of the total increase in between-establishment wage inequality or 14 percent of the total composition effect.

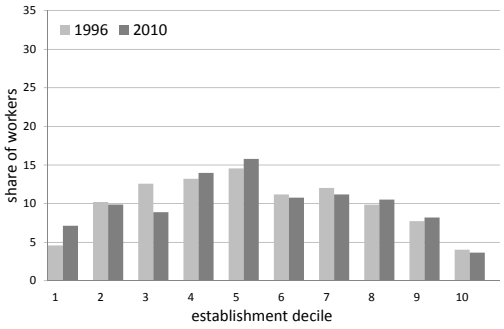
When it comes to the wage structure effects, the ones associated with collective bargaining and exporting are positively related to increasing between-establishment wage inequality, albeit not statistically significant. They reflect increasing collective bargaining and exporter wage premia as well as rising wage dispersion among covered relative to uncovered establishments. In contrast, the wage structure effect associated with technology is negative, reflecting that between-establishment wage dispersion has increased less among high-technology than among low-technology plants. Among the wage structure effects associated with worker-level variables, the ones related to education are positive, while the ones related to age are negative. The education-related wage structure effect mainly captures that establishment-level wage differentials between education groups have increased. That is, in particular the gap between the mean establishment wage of a high-skilled versus a medium-skilled worker, and the mean establishment wage gap of a worker with missing information on education versus a medium-skilled worker, has increased over time. This is likely the result of an increased assortative matching along the skill dimension, where high-skilled workers are more and more concentrated at high-wage paying plants and low skilled workers at low-wage paying plants. This result is in line with Card et al. (2013) who also find that the degree of sorting of different education and occupation groups to different establishments has risen in West Germany.[28] To provide some illustrative evidence in this respect, we plot the distribution of skill groups across establishment-level wage deciles (Figure 1.4). It becomes apparent that from 1996 to 2010 the share of workers with missing education (low skilled) disproportionately increased at low-wage establishments, while the share of high skilled workers disproportionately sorted into high-wage plants.

We now turn to the results on within-establishment wage inequality. Total composition effects are less important for this subcomponent of wage inequality than for between-establishment wage dispersion, contributing only slightly more than one quarter to the total increase. Partly, this is due to the very different implication of the decline

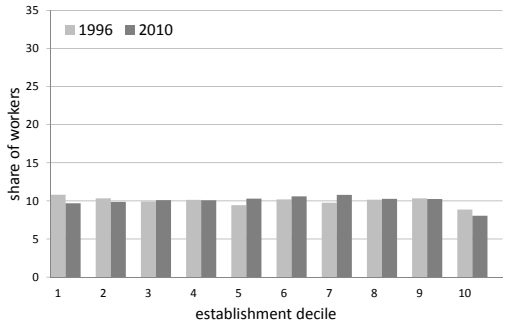
[28] We assume that workers with missing educational information are most likely low skilled workers. According to their unconditional mean wage gap this is a plausible assumption, see Table 1.1.



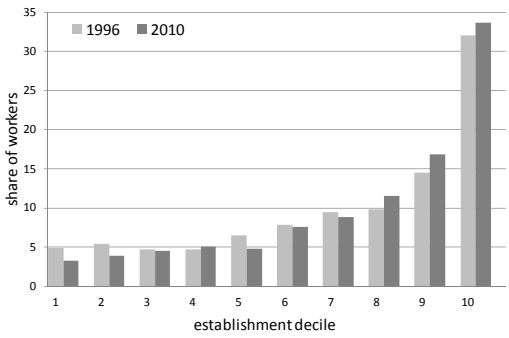
(A) Missing Education



(B) Low Skilled



(C) Medium Skilled



(D) High Skilled

Figure 1.4
Distribution of Workers at Establishment Deciles

Notes: Figure 1.4 shows the distribution of workers by education on establishment deciles for the years 1996 and 2010. Establishment groups are formed according to employment-weighted mean plant wages in both years. Figure (A) refers to workers where the information on education is missing (4 percent (8 percent) of the workforce in 1996 (2010)). According to their unconditional mean wages, this group of workers most closely resembles low skilled workers (see Table 1.1). All Figures are based on LIAB data and refer to the manufacturing sector. The sample corresponds to full-time male workers between 18 and 65 years of age.

in collective bargaining, which has contributed to a decline rather than an increase in within-establishment wage dispersion. This is due to the fact that, surprisingly, within-plant wage dispersion is larger among covered establishments, which most likely reflects that they are typically larger. In contrast, the composition effect associated with exporting is inequality-increasing, reflecting that the share of workers employed at exporters, which are characterized by higher within-plant wage dispersion, further increased.

Both the age and the education-related composition effects, brought about by increasing employment shares of more highly skilled and older workers, are inequality-increasing,

in line with the notion that wage dispersion among these worker groups, even within establishments, is larger than for younger and less-skilled workers.

Regarding the wage structure effects, both the one associated with collective bargaining and the one associated with exporting are negative, although only the latter is (weakly) statistically significant. This implies that export behavior as well as collective coverage at the plant level have an inequality reducing impact on workers within plants. In contrast, the wage structure effect associated with technology is positive, reflecting that technology investments have an inequality increasing impact on wages within establishments. In fact, the technology-related wage structure effect is the single most important contributing factor to increasing within-plant wage inequality, amounting to 0.8 log percentage points, which corresponds to 43 percent of the overall increase and 65 percent of the total wage structure effect, respectively.

Between- and Within-Plant Wage Decomposition for West-Germany Columns 3 to 6 of Table A.1.3 report the results of a decomposition of between- and within-plant wages for West-Germany, respectively. Considering first the results related to the between-plant wage decomposition, again most findings of our previous analysis carry through. The most notable difference is once again related to the composition effect of collective bargaining, which are found to be smaller in magnitude for the sample of West-Germany. Turning to the decomposition of within-plant wages it can be seen that the positive wage structure effect related to technology is primarily driven by West-German plants.

In summary, this analysis shows that the main drivers of between- and within- establishment wage dispersion differ and several explanatory factors even are related to both subcomponents of wage inequality in opposing ways. While the decline in collective bargaining contributes to the increase in between-establishment wage inequality, it is negatively related to the increase in within-establishment wage inequality. In contrast, technology is correlated with growing within-establishment wage dispersion, but does not seem to matter for between-establishment wage inequality. The worker-level characteristics occupation and education are the only ones, where both the composition and wage

structure effects are positively correlated with both subcomponents of wage dispersion, although the occupation-related effects are never statistically significant. Interestingly, the wage structure effect associated with education is quantitatively even more important for between-plant than for within-plant wage inequality. This mirrors the finding that most of the increase in the high-to-medium skill wage gap arises from an increase in between-establishment rather than within-establishment wage differentials, reflecting increased assortative matching along the skill dimension (in line with Card et al. (2013)).

Top vs Bottom Although the log wage variance has the advantage that the between-plant and the within-plant subcomponents add up to the total, the downside is that it does not allow one to distinguish sources of wage dispersion at the top and the bottom of the wage distribution. Therefore, we also do our decomposition analysis for the the 50–15 log wage differential (as a measure of lower-tail wage inequality) and the 85–50 log wage differential (as a measure of upper-tail wage inequality) of both mean establishment wages and within-establishment wage residuals, respectively. Note that, now, the between-plant and the within-plant component of any inequality measure do not anymore (necessarily) add up to the total.

As far as between-plant wage inequality is concerned, more than two thirds of the increase in wage dispersion over the period of analysis (12.44 of 18.33 log percentage points) occured at the lower part of the wage distribution. And also all relevant composition effects relate to lower-tail wage inequality. This applies in particular to the composition effect associated with collective bargaining, which is zero in the case of upper-tail wage inequality, but amounts to 5.8 log percentage points (46 percent of the total increase or 94 percent of the total composition effect) in the case of lower-tail wage inequality. Thus, the decline in collective bargaining has been associated with a widening of the lower part of the plant wage distribution, which is not surprising since there, union wages should be the most binding. A similar pattern, although quantitatively less important, can be found for the composition effect related to the regional shift towards more eastern German employment.

When it comes to wage structure effects, it is again the one related to collective

TABLE 1.4
Decomposition of Quantile Differences, 1996-2010

	Between-Plant			Within-Plant		
Inequality Measure	**85-15**	**50-15**	**85-50**	**85-15**	**50-15**	**85-50**
Observed Change	18.33***	12.44***	5.89	3.25***	0.83	2.42***
	[3.34]	[2.39]	[3.56]	[1.08]	[0.52]	[0.79]
Composition						
Export	-1.70**	-1.14**	-0.56	0.55**	-0.02	0.57*
	[0.67]	[0.44]	[0.43]	[0.25]	[0.07]	[0.29]
Collective Bargaining	5.76**	5.76**	0.00	-1.35***	0.43*	-1.78***
	[2.76]	[2.23]	[1.12]	[0.46]	[0.23]	[0.39]
Technology	-0.14	-0.04	-0.10	-0.01	0.00	-0.02
	[0.28]	[0.15]	[0.25]	[0.07]	[0.03]	[0.06]
Occupation	0.68	-0.01	0.68	0.45	0.05	0.41
	[0.90]	[0.55]	[0.71]	[0.82]	[0.26]	[0.64]
Education	0.62	0.23	0.39	0.52**	0.01	0.51**
	[0.36]	[0.25]	[0.24]	[0.23]	[0.07]	[0.20]
Age	0.02	-0.14	0.16	1.90***	0.17***	1.73***
	[0.19]	[0.19]	[0.17]	[0.21]	[0.08]	[0.23]
Foreign	-0.10	-0.09*	-0.01	-0.01	0.00	-0.01
	[0.08]	[0.05]	[0.04]	[0.02]	[0.02]	[0.02]
East	2.42**	2.27*	0.16	-0.35**	-0.17**	-0.18
	[1.08]	[1.17]	[0.33]	[0.14]	[0.07]	[0.11]
Industry	-0.53	-0.69	0.16	0.30	-0.15	0.45
	[0.96]	[0.48]	[0.74]	[0.28]	[0.11]	[0.29]
Total	7.03	6.15*	0.89	2.00*	0.33	1.68*
	[4.29]	[3.00]	[1.66]	[1.06]	[0.33]	[0.84]
Wage-Structure						
Export	5.53	7.45	-1.92	-2.07	-0.46	-1.61
	[9.21]	[8.48]	[3.64]	[2.39]	[1.04]	[2.00]
Collective Bargaining	13.34*	20.55***	-7.21	-2.46	1.33	-3.79*
	[6.88]	[7.11]	[5.44]	[2.52]	[1.29]	[2.04]
Technology	0.39	-0.07	0.46	4.36**	2.02**	2.34*
	[4.16]	[3.54]	[3.57]	[1.64]	[0.74]	[1.24]
Occupation	-1.50	-7.04	5.54	-0.10	-2.15	2.05
	[8.18]	[8.31]	[4.09]	[2.66]	[1.80]	[3.12]
Education	2.41	1.62	0.80	0.40	-0.04	0.44
	[1.45]	[1.38]	[0.67]	[1.11]	[0.40]	[0.85]
Age	-3.27	-1.87	-1.40	-0.62	-0.81	0.19
	[2.84]	[2.25]	[1.17]	[1.34]	[0.85]	[1.09]
Foreign	-0.39	-0.49	0.10	0.43*	0.30**	0.13
	[0.41]	[0.40]	[0.21]	[0.22]	[0.11]	[0.18]
East	-10.96**	-10.44**	-0.52	0.93	0.31	0.62
	[4.38]	[4.41]	[0.92]	[0.57]	[0.20]	[0.51]
Industry	1.21	-1.96	3.17	-3.62	-0.28	-3.34
	[27.12]	[22.89]	[24.22]	[10.82]	[6.45]	[11.44]
Constant	3.62	-3.38	7.00	3.23	-0.10	3.33
	[32.59]	[26.76]	[25.41]	[11.82]	[6.86]	[11.52]
Reweighting error	-1.32	-1.15	-0.17	-0.28	-0.03	-0.26
	[1.19]	[1.13]	[0.35]	[0.46]	[0.13]	[0.36]
Specification error	2.23	3.08	-0.85	1.04	0.41	0.63
	[3.25]	[3.06]	[1.25]	[0.62]	[0.32]	[0.64]
Total	10.39**	4.36	6.02**	0.49	0.12	0.37
	[4.43]	[3.56]	[2.80]	[1.07]	[0.36]	[1.08]

Notes: See notes of Table 1.3.

bargaining which works strongly inequality-increasing for lower-tail wage inequality. Thus, not only the decline in collective bargaining (composition effect), but also changes in the collective bargaining wage premium and rising wage dispersion within the covered (relative to the non-covered) sector (wage structure effect) have contributed to increasing wage dispersion in the lower part of the wage distribution. Considering the wage structure effects related to education we find, albeit not statistically significant, that about two thirds of the sorting along the skill dimension can be attributed to the lower part of the wage distribution, implying that assortative matching from low wage workers to low wage plants is particularly important for the rise in between-establishment wage inequality.

Regarding within-establishment wage inequality, about three quarters of the increase in total wage dispersion over the sample period took place in the upper half of the wage distribution (2.42 of 3.25 log percentage points). Turning to the individual factors and focusing primarily on the ones that previously have been found to be relevant for the development of within-plant wage dispersion, we find that the wage structure effect associated with the establishment's technology contributes the most to both lower-tail and upper-tail wage inequality. Thus, wage dispersion within high-technology plants has been strongly and monotonically increasing relative to low-technology plants. There is less monotonicity involved with other factors, which contribute asymetrically (and sometimes in opposing ways) to lower-tail and upper-tail within-plant wage dispersion. For example, the decline in collective bargaining coverage rates has been associated with an increase in lower-tail wage inequality, which, however, was compensated by an even larger decrease in upper-tail wage inequality, again reflecting the notion that union wages are binding at the bottom, but less so at the top of the wage distribution. The same pattern, although less significant, can be found for the bargaining-related wage structure effect. In contrast, age- and education-related composition effects, brought about by a relative shift towards older and more educated workers, have had an inequality-increasing effect particularly in the upper half of the wage distribution.

Dynamics So far, we have analysed the contributions of the different factors to the increase in wage dispersion over the entire period of analysis, 1996 to 2010. However, these associations do not have to be constant, and it might well be the case that by focusing on a rather long time period, we omit some potentially interesting dynamics. Therefore, we redo our decomposition analyses of changes in both between-plant and within-plant wage dispersion for two equally spaced subperiods: 1996 to 2003 and 2003 to 2010. For simplicity, we now again focus on the variance of wages as a summary measure of overall wage dispersion. Results are displayed in Table 1.5.

Focusing first on the total observed increase, it can be seen that between-plant wage inequality increased more strongly in the later period, while within-plant wage inequality have grown more steadily. Turning to between-plant wage dispersion, the relative importance of composition and wage structure effects also changed over time. While in the first period the ratio of total composition to wage structure effects is 2.4 to 1, it inverts to 1 to 4 in the second period. Changes in collective bargaining seem to be at the core of this development. In the first period, both the composition and the wage structure effect of collective bargaining are by far the most important determinants of the increase in between-plant wage dispersion, while in the second period, the bargaining-related composition effect is still positive, but much smaller in magnitude and only weakly statistically significant, and the bargaining-related wage structure effect is insignificant. In contrast, several other wage structure effects, most notably the ones relating to exporting, occupation (though insignificant), and education gain substantial importance in the later period. It is conceivable that these patterns are interrelated. In line with findings by Card (2001) for the US and Fitzenberger and Kohn (2005) for Germany, who show that characteristics as well as the returns to those characteristics are compressed under collective bargaining, it seems quite likely that in a setting, where collective bargaining coverage rates have already gone down (to some extent) and wages within the unionized sector have become more flexible, productivity characteristics at the individual (e.g. education) and the establishment level (e.g. exporting) become more relevant in the wage setting process, which in turn leads to greater wage dispersion.

Table 1.5
Decomposition of Variance, 1996-2003 & 2003-2010

	1996-2003	2003-2010	1996-2003	2003-2010
	Between-Plant		Within-Plant	
Inequality Measure	**Variance**	**Variance**	**Variance**	**Variance**
Observed Change	1.59***	2.44***	0.95***	0.93***
	[0.43]	[0.53]	[0.17]	[0.14]
Composition				
Export	-0.13*	-0.16*	0.08	0.03
	[0.07]	[0.09]	[0.05]	[0.02]
Collective Bargaining	1.05***	0.32*	-0.15***	0.00
	[0.15]	[0.18]	[0.05]	[0.03]
Technology	0.02	0.06	0.02	-0.07**
	[0.05]	[0.08]	[0.02]	[0.03]
Occupation	0.08	0.07	0.05	0.05
	[0.08]	[0.07]	[0.08]	[0.09]
Education	0.05	0.06*	0.10***	0.19***
	[0.03]	[0.04]	[0.03]	[0.06]
Age	0.01	0.03	0.15***	0.18***
	[0.02]	[0.02]	[0.02]	[0.03]
Foreign	0.00	-0.01	0.00	0.01
	[0.00]	[0.01]	[0.00]	[0.00]
East	0.30***	0.28**	-0.04***	-0.03**
	[0.10]	[0.11]	[0.01]	[0.02]
Industry	0.02	-0.05	0.03	-0.01
	[0.11]	[0.16]	[0.03]	[0.04]
Total	1.40***	0.59*	0.23*	0.33**
	[0.26]	[0.33]	[0.13]	[0.12]
Wage-Structure				
Export	-1.22*	1.16**	-0.46	-0.31
	[0.62]	[0.54]	[0.35]	[0.28]
Collective Bargaining	1.92***	-0.32	-0.66	0.04
	[0.84]	[0.56]	[0.40]	[0.28]
Technology	-0.53	-0.66**	0.64**	0.07
	[0.53]	[0.30]	[0.30]	[0.35]
Occupation	-0.26	0.99*	0.48	-0.85
	[1.25]	[0.57]	[0.35]	[0.67]
Education	0.22*	0.33***	0.24*	0.16
	[0.12]	[0.11]	[0.13]	[0.11]
Age	-0.02	-0.51**	-0.27	0.54***
	[0.22]	[0.22]	[0.18]	[0.18]
Foreign	-0.03	-0.03	0.01	0.07**
	[0.05]	[0.05]	[0.04]	[0.03]
East	-0.13	0.13	0.04	0.11**
	[0.17]	[0.18]	[0.07]	[0.04]
Industry	-0.04	0.19	-0.11	0.12
	[5.78]	[6.16]	[2.22]	[2.37]
Constant	0.67	0.87	0.82	0.68
	[5.84]	[6.12]	[2.22]	[2.54]
Reweighting error	-0.13	-0.04	-0.05	-0.02
	[0.09]	[0.06]	[0.04]	[0.03]
Specification error	-0.26*	-0.26***	0.05	-0.02
	[0.13]	[0.09]	[0.03]	[0.05]
Total	0.58	2.14***	0.72***	0.64***
	[0.46]	[0.52]	[0.15]	[0.10]

Notes: See notes of Table 1.3.

Changes with respect to within-plant wage dispersion are less drastic. For example, composition effects associated with age and education contribute almost equally to greater within-plant wage dispersion in both subperiods. Still, some differences between the subperiods do exist. The (now again negative) composition effect related to collective bargaining is again concentrated in the earlier subperiod, while several wage structure effects (relating to age, nationality, and region) become more important in the later subperiod, similar to the pattern found for between-plant wage inequality. However, interestingly and in contrast to this general pattern, the most important determinant of the change in within-establishment wage dispersion, the wage structure effect associated with technology, refers almost entirely to the earlier period 1996 to 2003. It is reasonable to assume that this finding primarily reflects technological reasons – e.g., the internet revolution mainly occured in the first subperiod.

1.7 Summary and Conclusion

Like many other countries, Germany experienced a strong increase in wage dispersion in the recent past. Much of this increase took place between as opposed to within establishments, in line with an increasing international evidence.

In this chapter, we have used rich linked employer-employee data and applied a detailed decomposition analysis based on recentered influence function (RIF) regressions to identify the sources of this increase in wage dispersion in the German manufacturing sector. In doing so, we have paid particular attention to the importance of establishment characteristics and to the divergent sources of between-establishment and within-establishment wage dispersion, respectively.

Our main decomposition results point to the decline in collective bargaining as a main driver for the increase in wage inequality and we find that this effect is stronger in eastern than in western Germany. In addition to that, changes in the skill- and occupation-related wage structure are main sources of increased overall wage dispersion.

The same factors and in addition, shifts in the regional employment structure and a widening of the wage distribution among establishments covered by collective bargaining,

also contributed to increased between-establishment wage inequality. Thus, not only characteristics attached to the establishments –most notably the wage bargaining regime–, but also changes in the wage structure associated with specific individual-level attributes – i.e., education – are responsible for the increasing divergence of wages paid at different establishments. This individual-level component of rising between-establishment wage dispersion reflects increased sorting of workers along the skill dimension.

Among the remaining establishment characteristics, both the technology intensity and the export status are of little quantitative importance for the increase in overall wage dispersion over the full period of analysis. However, they do matter for subcompents of wage dispersion and subperiods, respectively. In particular, technology is a main driver of increased within-plant wage inequality (but negatively related to between-establishment wage dispersion), reflecting that particularly in high-technology plants, workers' wages have developed very unevenly. In contrast, the increasing exporter wage premium has become an important factor of rising between-establishment wage inequality in more recent years.

Not only the export status of the establishment, but also the education and the occupation of the worker have become more important for the wage-setting process over time. In contrast, the decline in collective bargaining coverage rates as well as an increasing dispersion within the covered sector have been more relevant in the first half of our period of analysis. We interpret this as tentative evidence that the decline in collective bargaining did not only have an immediate impact on the wage structure but also gave rise to an increasing importance of other productivity characteristics. Digging deeper into this interrelation is an interesting avenue for future research.

It is important to note, however, that, while the decomposition analysis has enabled us to identify the proximate sources of increased wage dispersion between and within establishments, we are not able to attach to them a causal interpretation in a deeper, structural sense. For example, the decline in collective bargaining came not about exogenously but was the result of firms' endogeneous choices. It is perfectly conceivable that these in turn are caused by changes in the competitive environment, potentially induced,

e.g., by an accelerated globalization. Therefore, relating the proximate sources of rising wage inequality identified in our analysis to deeper structural causes is a high priority for future research.

A.1 Appendix

Table A.1.1
Descriptive Statistics: Main Variables (LIAB)

LIAB	**1996**		**2010**	
(A) worker-level	mean	std. dev.	mean	std. dev.
log daily real wage	4.488	0.365	4.514	0.439
education: missing	0.035	0.185	0.082	0.274
education: low	0.160	0.367	0.120	0.325
education: medium	0.725	0.447	0.698	0.459
education: high	0.080	0.271	0.100	0.300
age: 18-25	0.074	0.261	0.060	0.238
age: 26-35	0.321	0.467	0.178	0.383
age: 36-45	0.287	0.452	0.298	0.457
age: 46-55	0.224	0.417	0.329	0.470
age: 56-65	0.094	0.292	0.134	0.341
foreign citizenship (0/1)	0.103	0.324	0.075	0.263
east Germany (0/1)	0.111	0.314	0.142	0.349
exporter (0/1)	0.677	0.468	0.756	0.429
investment in ICT (0/1)	0.616	0.486	0.594	0.491
high technological status (0/1)	0.195	0.396	0.161	0.367
collective agreement sector-level (0/1)	0.778	0.416	0.529	0.499
collective agreement firm-level (0/1)	0.105	0.306	0.121	0.326
number of observations (unweighted)	558152		388621	
(B) establishment-level	mean	std. dev.	mean	std. dev.
exporter (0/1)	0.200	0.400	0.314	0.464
investment in ICT (0/1)	0.340	0.474	0.288	0.453
high technological status (0 /1)	0.156	0.363	0.120	0.325
collective agreement sector-level (0/1)	0.534	0.499	0.321	0.467
collective agreement firm-level (0/1)	0.106	0.308	0.035	0.185
east Germany (0/1)	0.199	0.400	0.232	0.422
number of observations (unweighted)	1524		2836	

Notes: Panels (A) and (B) are based on the LIAB data and refer to our estimation sample for the years 1996 and 2010. For sample restrictions see Section 1.2. Education groups are defined as: 1) low: no vocational training, no high-school; 2) medium: high school and/or vocational training; 3) high: university or technical college. The fourth category consists of observations with missing educational information. Sampling weights are employed. See also Table A.1.2.

TABLE A.1.2
Descriptive Statistics: Main Variables (SIAB)

SIAB	**1996**		**2010**	
(C) worker-level	mean	std. dev.	mean	std. dev.
log daily real wage	4.438	0.374	4.492	0.472
education: missing	0.049	0.216	0.087	0.292
education: low	0.175	0.380	0.112	0.316
education: medium	0.687	0.464	0.679	0.470
education: high	0.089	0.285	0.122	0.327
age: 18-25	0.081	0.273	0.062	0.062
age: 26-35	0.317	0.465	0.194	0.194
age: 36-45	0.281	0.450	0.299	0.299
age: 46-55	0.222	0.416	0.315	0.315
age: 56-65	0.099	0.298	0.129	0.129
foreign citizenship (0/1)	0.116	0.321	0.083	0.277
east Germany (0/1)	0.095	0.293	0.115	0.320
number of observations	106402		88721	

Notes: Panel (C) is based on the SIAB data, a representative two percent sample of all employment biographies, which is also provided by the IAB. Sample restrictions are the same as for the LIAB data. Education groups are defined as: 1) low: no vocational training, no high-school; 2) medium: high school and/or vocational training; 3) high: university or technical college. The fourth category consists of observations with missing educational information. See Table A.1.1: the statistics are very similar across both datasets, ensuring the representativeness of the LIAB data.

Table A.1.3
Main Decomposition Results on West-Germany

	Overall Variance		Between-Plant Variance		Within-Plant Variance	
Observed Change	5.40***		3.41***		2.04***	
	[0.91]		[0.77]		[0.21]	
	Composition	**Wage-Structure**	**Composition**	**Wage-Structure**	**Composition**	**Wage-Structure**
Export	-0.09	-0.74	-0.21***	1.21	0.14**	-0.88
	[0.05]	[1.11]	[0.07]	[0.86]	[0.06]	[0.60]
Collective Bargaining	0.68**	-0.63	1.01***	0.71	-0.29**	-0.37
	[0.31]	[1.05]	[0.24]	[1.05]	[0.12]	[0.60]
Technology	-0.02	1.23**	-0.02	0.18	0.00	1.02***
	[0.04]	[0.45]	[0.03]	[0.44]	[0.02]	[0.34]
Occupation	0.18	2.54**	0.02	0.67	0.24	1.28
	[0.29]	[1.01]	[0.11]	[0.95]	[0.19]	[0.82]
Education	0.76***	1.40***	0.23**	0.26	0.36***	0.03
	[0.23]	[0.45]	[0.09]	[0.25]	[0.10]	[0.23]
Age	0.63***	-0.14	-0.01	-0.36	0.38***	-0.25
	[0.08]	[0.66]	[0.02]	[0.32]	[0.04]	[0.31]
Foreign	0.01	0.00	-0.01*	-0.11	0.00	0.12**
	[0.01]	[0.09]	[0.01]	[0.07]	[0.01]	[0.06]
Industry	0.22	0.19	0.12	1.26	0.11	-0.24
	[0.23]	[6.06]	[0.18]	[3.62]	[0.07]	[3.29]
Constant		-0.28		-1.27		0.34
		[6.34]		[3.91]		[3.58]
Reweighting error		-0.13		0.02		-0.15
		[0.25]		[0.13]		[0.15]
Specification error		-0.37		-0.28		0.20*
		[0.34]		[0.19]		[0.10]
Total	2.36***	3.59***	1.13***	2.55***	0.94***	1.05***
	[0.01]	[0.68]	[0.35]	[0.69]	[0.28]	[0.22]

Notes: Analysis is based on West-Germany only. For additional information see notes of Table 1.2. We construct the measure of between-plant (within-plant) variance by using yearly regressions of log individual wages on a full set of establishment fixed effects. We then take the variance of predicted (residual) wages as a measure of between-plant (within-plant) inequality.

Chapter 2

Trade Exposure and the Decline in Collective Bargaining*

*This chapter is based on joint work with Daniel Baumgarten.

2.1 Introduction

One of the most important changes in the institutional landscape of many advanced countries' labor markets has been a strong decline in unionization and collective bargaining coverage. For example, Egger et al. (2015b) report an average decline in union density of 18 percentage points over the period 1980–2009 in a sample of 31 OECD countries.

The consequences of this decline in unionization and collective bargaining coverage have been widely discussed in the related literature, where the considered outcome variables include wage inequality (e.g. DiNardo et al. (1996); Card et al. (2004)), demographic employment patterns (Bertola et al. (2007)), macro performance (Mitchell and Erickson (2005)), or even the extent of international outsourcing (Lommerud et al. (2009)).

The reasons for this decline are less clear, however. Acemoglu et al. (2001) argue that skill-biased technical change has been an important driver. Their argument is that, by increasing the outside option for skilled workers, technical change undermines the coalition among skilled and unskilled workers in the formation of unions. Another explanation is related to the changing nature of economic production in advanced economies (Hirsch (2008)). The idea here is that unions decline due to attrition – since an employment decline in heavily unionised industries is offset by new jobs in non-unionized industries.

In this chapter, we focus on an alternative explanation: globalization – and in particular increased exposure to low-wage country import competition. Moreover, we explore changes in bargaining regimes at the level of the employer, instead of looking at the formation of unions at the workers' side. This fits the institutional setting in Germany, the focus of our analysis.[1]

Germany is an interesting point in case, for two main reasons. First, Germany experienced a strong decline in collective bargaining coverage over the last two decades. From 1996 to 2010 the share of establishments covered by a collective bargaining agreement (CBA) fell from 58 to 33 percent.[2] The major part of this decline was driven by a de-

[1] We give a detailed account of the institutional background and the way how collective agreements are formed in Germany in Section 2.2.

[2] These numbers refer to the IAB Establishment Panel. Details on this dataset are provided in Section 2.4.

crease in industry-wide collective agreements, which led to a decentralization of the wage setting process from the industry level to the level of the individual firm. This remarkable shift has been hinted at as a source of increased German competitiveness (Dustmann et al. (2014)), but also as a major driver of rising wage inequality (Dustmann et al. (2009), Antonczyk et al. (2010), Baumgarten et al. (2016)). The second reason is that Germany's import exposure increased greatly during the same period of time. Much of it has been due to two major globalization shocks which predominantly stem from labor abundant countries with substantially lower wages than Germany: The rise of China and its accession to the World Trade Organization (WTO) in 2001 and the fall of the iron curtain and the subsequent transformation of the former socialist countries into market economies. Over the period from 1996 to 2010 German imports from China and Eastern Europe – in the following refered to as "the East"[3]– grew by more than 400 percent (from 40 Billion Euro in 1996 to 213 Billion Euro in 2010).[4]

In this chapter, we explore how much of the decline in sector-wide CBAs can be attributed to the rise in import competition from China and Eastern Europe. We argue that an increase in import penetration on final goods markets is likely to induce some firms to opt out of collective wage agreements, both because particularly smaller, less productive firms find it increasingly difficult to pay union wages and because workers are more willing to accept an opting-out decision if their employers face a credible threat of going bankrupt or downsize production.[5][6] For our analysis, we exploit variation in changes in import (and export) exposure both across three-digit industries as well as over time and relate them to establishments' changes of their bargaining regime. To identify a

[3]The East covers China and the following Central and Eastern European countries: Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovakia, Slovenia, the former USSR or its succession states Russian Federation, Belarus, Estonia, Latvia, Lithuania, Moldova, Ukraine, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan.

[4]Of course, Germany also increased its export volumes to China and Eastern Europe over the respective time period. Figure 2.1 in Section 2.4 illustrates the evolution of German import and export volumes with respect to both regions.

[5]We discuss the theoretical mechanism we have in mind in Section 2.3.

[6]That globalization and the firm's choice of leaving sector-level collective bargaining might be linked, is also backed up by anecdotal evidence. For example, the agricultural machinery producer Amazone from Northern Germany left sector-level collective bargaining in 2012, claiming that it wanted to become "more flexible and better positioned for global competition" (authors' translation; source in German: `http://www.wochenblatt.com/landwirtschaft/nachrichten/amazone-verlaesst-arbeitgeberverband-4871.html`).

causal relationship, we apply the instrumental variable (IV) strategy pioneered by Autor et al. (2013) and instrument trade flows between Germany and the East by trade flows between the East and other high-income countries.

We contribute to the literature in two main ways. First of all, we analyze a new dimension of how firms react to increased import competition. In doing so, we contribute to the rich empirical literature that analyzes the causal effects of import competition on different margins of firm adjustment.[7] The channel we look at is important, since changes in collective bargaining coverage are likely to influence a host of economic and labor market outcomes. We therefore shed light on an indirect, albeit important link between international trade and labor market outcomes that, to our knowledge, has been neglected in the existing literature. Our second, more general contribution is that we stress the endogeneity of labor market institutions. Most existing trade models treat labor market institutions as exogenous. To the extent that international trade changes bargaining regimes, this exogeneity assumptions is challenged and should lead to modified trade models that treat labor market institutions as endogenous. On a more general level, this chapter therefore also speaks to the trade-and-institutions literature as summarized in Nunn and Trefler (2014).[8]

Our results can be summarized as follows: We find that an increase in import competition from China and Eastern Europe over the period from 1996 to 2008 induces firms to

[7]Bernard et al. (2006) investigate the effect of increased import penetration from low wage countries on U.S. manufacturing firms' employment growth and survival. They find that plants are negatively affected by increased industry exposure to low-wage country imports. Bloom et al. (2016) examine the impact of Chinese import competition on different measures of technical change across twelve European countries. They show that the absolute volume of innovation increases within the firms most strongly affected by Chinese imports. Bernard et al. (2010) investigate the impact of trade liberalization on a firm's product mix and find that firms shift their product portfolio towards more high-tech products as a reaction to falling trade costs. Mion and Zhu (2013) find that Belgian firms react with skill upgrading to increased import competition from China.

[8]A large part of this literature analyzes the role of domestic institutions as a source of comparative advantage, where some papers have indeed focused on labor market institutions. Egger et al. (2015b) even show that differences in unionization rates across countries can be a source of comparative advantage and, therefore, shape trade patterns. Other labor market institutions that have been considered in this context are worker monitoring capabilities (Costinot (2009)), labor market protection regulations (Tang (2012)), and overall labor market flexibility (Cuñat and Melitz (2012)). We focus on the other direction of causality and analyse to what extent trade shapes domestic labor market institutions. Dreher and Gaston (2007) have analyzed the importance of globalization, in a much broader sense, on deunionization in a cross-country setting. Our analysis, however, departs from their contribution in several respects. Most importantly, our analysis allows us to establish a causal relationship.

leave collective bargaining regimes. In terms of magnitude we conclude that the increase in import exposure explains about 22 percent of the overall decline in sector-level CBAs in the German manufacturing sector. In contrast, we do not find any sizable effect of increased export opportunities on firms' decisions to change their collective bargaining status. Digging deeper into the analysis of heterogeneous effects reveals that it is especially the smaller, less productive firms that are most strongly affected by an increase in import penetration.

Our analysis relates to the following strands of literature. Most importantly, our methodology builds upon recent work by Autor et al. (2013) who analyze U.S. labor market consequences from increased Chinese import competition. To account for unobserved shocks that simultaneously affect imports and labor market outcomes, they develop an instrumental variable strategy which uses trade flows to other high income countries as an instrument for US trade exposure. They find severe negative effects on manufacturing employment.[9] Dauth et al. (2014) apply the same empirical strategy to the German context. They, however, do not only focus on China, but also consider trade with Eastern Europe. Moreover, they investigate the effects induced by both increased import competition and rising export opportunities. Taking both channels into account, they find that trade with China and Eastern Europe has contributed to retaining employment in the manufacturing sector in Germany. In a related paper Dauth et al. (2016) find that rising import penetration reduces cumulated earnings and induces workers to leave the exposed industries. Rising export opportunities, again, work in the opposite direction. We closely follow this literature and apply a similar empirical approach.

Furthermore, our research relates to a more specific literature that deals with firm or establishment determinants of the choice of the bargaining regime (e.g. Schnabel et al. (2006)) and with reasons to leave centralized wage bargaining (Kohaut and Schnabel (2003)) in Germany. This literature, however, does not explore the role of increased trade exposure, nor does it aim at the causal identification of effects. Further contributions

[9]In further contributions, they analyze the effect of increased import penetration on cumulative earnings and general employment shifts, see Autor et al. (2014) and Acemoglu et al. (2016). For an overview and related research, see Autor et al. (2016).

that theoretically model the endogenous choice of different bargaining regimes at the firm level are discussed in Section 2.3.

The rest of the chapter is organized as follows. Section 2.2 discusses the institutional background and the system of industrial relations in Germany. Section 2.3 presents the theoretical mechanism we have in mind and formulates the working hypothesis. The data employed in our analysis is introduced in Section 2.4. Section 2.5 describes our empirical approach, before the results are discussed in Section 2.6. Section 2.7 concludes.

2.2 Institutional Background

The German system of industrial relations is based on the principle of *autonomy of wage bargaining*, which is rooted in the German constitution.[10] It implies that the right to negotiate over wages and working conditions is assigned only to the labor market parties, that is employers, employer associations, and trade unions. The principle of wage bargaining autonomy guarantees that the process of industrial relations is independent of the government or the political process. Different from many other countries, industrial relations are therefore based on contracts and mutual agreements and are not rooted in legislation.[11] Moreover, Germany has introduced a statutory minimum wage only after our period of analysis (1996 – 2008).

Collective agreements are negotiated either at the region-industry-level or at the firm-level. They typically cover arrangements with respect to wages, working hours, and other aspects of working conditions. Union wages generally act as minimum wages. Payments above the union wage – the so-called wage cushion or wage drift – appear to be common (see Dustmann and Schönberg (2009)). A special feature of the German institutional setting is that the recognition of trade unions is at the discretion of the firm. This implies that collective contracts cover only workers that are employed in firms that recognize the

[10] The so called "Tarifautonomie" is anchored in Article 9 (3) of the German constitution.

[11] An exception are so called "Allgemeinverbindlichkeitserklärungen". In exceptional cases, the government can declare a collective agreement legally binding for all firms in an industry, including employers and employees that originally were not covered. Since the legal requirements for these government-extended collective agreements are quite high, they play only a minor role today. In 1996 (2010) 4,1% (1,5%) of all collective agreements were declared generally binding. The majority of these apply to the construction sector. See Bispinck (2012) and Schulten and Bispinck (2013) for further information.

relevant collective agreement – and this is generally true whether the worker is a union member or not.[12] On average, collective agreements in Germany are formed for a period of 22 months.[13] During this period a duty not to engage in industrial disputes holds.

Firms that once have recognized a collective contract can choose to opt out at their own discretion. They can do so by leaving the respective employer association or by becoming a so called "OT member" (OT = "ohne Tarif", i.e. without collective agreement), which gives employers the possibility to be a member of the association without being covered by the collective agreement, thereby still benefiting from other services. If a firm leaves its association or changes membership, this does not instantly terminate the collective agreement. Instead, the employer has to stick to the agreement until it ends (so called "Nachwirkungsfrist"). During this period, however, the collective agreement does not apply anymore to new hires, nor is the firm obliged to honor newly negotiated wage increases and after expiration of an agreement, new employment and wage contracts can be formed. Over time, a firm therefore may be able to lower wage costs and increase workforce flexibility by opting out of a collective agreement, given that its employees accept this.[14]

2.3 Theoretical Background and Working Hypothesis

Although there is a long-standing literature on the effects of trade (liberalization) on labor market outcomes in the presence of unionization (e.g. Brander and Spencer (1988); Bastos and Kreickemeier (2009)), it does not serve us as guidance for our empirical analysis. This is because in these models, unionization is a fixed country and/or industry characteristic and thus exogenous.[15] More relevant for our analysis is a recent strand of literature, which

[12] From a legal perspective, a collective agreement is only binding for union members of a firm. However, the employer generally extends the agreement conditions to all (comparable) workers to weaken workers' incentives to become a union member. Due to this practice, collective bargaining coverage rates are generally higher than union membership rates (see Fitzenberger et al. (2013)).

[13] See `http://www.boeckler.de/wsi-tarifarchiv_4832.htm`

[14] Over the last years so called opening or hardship clauses also have gained importance (see Brändle et al. (2011) and Bispinck et al. (2010)). The use of such rules allows firms to *temporarily* deviate from some collectively agreed standards in times of economic difficulties. The firm is, however, expected to return to the general conditions of the original agreement after a defined period.

[15] In the model of Bastos and Kreickemeier (2009), deunionization is modeled as a decrease in the share of unionized sectors, but again exogenously with respect to trade liberalization.

considers the endogenous formation of wage bargaining regimes from the employer's part – without focusing on globalization effects, however. Hirsch et al. (2014) consider a partial equilibrium framework in which a firm's bargaining decision is primarily driven by its average total factor productivity. High productivity firms self-select into centralized wage regimes since it allows them to hide behind less productive firms.[16] Baumann and Brändle (2015) establish a link between the extent of collective bargaining and the degree of productivity dispersion within an industry. They show that a more dispersed productivity distribution among firms leads to lower collective bargaining coverage. They further predict that high productive firms are most likely to be covered by firm-level agreements, while low productive firms follow decentralized wage regimes. Capuano et al. (2014) analyze the decision to adopt collective bargaining together with the choice to export within a partial equilibrium model. They find a positive correlation between exporting and centralized wage setting and explain it through firm size.[17] Another variant is proposed in Jimeno and Thomas (2013). They consider a one sector Mortensen-Pissarides economy with firm-specific productivity shocks and firm- as well as sector-level bargaining. Part of their analysis is related to an *efficient-opting-out* scenario where all firms are ex-ante covered by a centralized wage regime, but where firms and workers can mutually agree to move from sector-level bargaining to firm-level bargaining. In this framework, the productivity threshold below which workers are laid off is higher in the centralized than in the decentralized regime. This implies that firms which cannot afford to pay collective wages opt out of CBAs. Its employees accept this since they face a credible threat of losing their jobs.

Thus, despite highlighting different mechanisms, all models share the prediction that the smallest, least productive firms will choose decentralized wage bargaining. In contrast, larger, more productive firms will opt for centralized wage regimes.[18]

[16] The underlying idea is that under a decentralized regime, firms pay wages according to their own productivity, while under centralized bargaining, the wage is exogenously given and fixed at some level $\bar{w}$, which does not depend on a given firm's productivity and which is invariant to firms entering or leaving the sector-wide regime.

[17] Central here is the transaction-cost savings argument: The larger the firm, the more likely it is to export and the higher the efficiency gains due to transaction cost savings at the centralized regime relative to costs of higher union wages.

[18] Only the model by Baumann and Brändle (2015) deviates slightly in this respect, as they predict that

As outlined above, these models remain silent about the effects of increased trade exposure or globalization. We argue, however, that to the extent that trade affects the size (and profit) distribution within an industry, it is also likely to expect an effect on firms' choices with respect to their bargaining regime. More specifically, we argue that an increase in import penetration from low wage countries particularly affects those firms that directly compete within the import-affected industries. We expect that this will induce some of the firms to opt out of a collective bargainng regime in order to lower wage costs and increase workforce flexibility. Similar to Jimeno and Thomas (2013) we assume that such exits are more likely, if employers and employees agree upon such a decision. Given a strong increase in import competition, we argue that employees are likely to accept an opting-out decision, if they face a credible threat of losing their jobs. We therefore expect in particular the least productive firms to leave collective wage agreements as a reaction to increased import pressure.[19]

We should note that the mechanism we have in mind relates primarily to increases in final goods trade exposure. We acknowledge however that the rise of the East also implies an increase in the opportunities of offshoring, i.e. the threat of relocating (parts of) the production abroad, which constitutes an alternative mechanism through which firms and employees might be influenced in their decision to agree upon leaving a centralized bargaining regime. Dustmann et al. (2014) refer to this second channel.[20] Although we are not going to test this second channel explicitly, we will discuss to what extent our results might capture this alternative mechanism.

the most productive firms choose firm-level collective bargaining.

[19] In contrast, increased export exposure should benefit the largest firms and thus lead to less exits or even more entry into CBAs among this subset of firms.

[20] They argue that German firms were able to increase their bargaining position significantly after the transformation of Central and Eastern Europe since this development made it credible that German firms might relocate production. They however also point out, that the pace at which German production effectively moved abroad to Central and Eastern Europe was very slow (the stock of German foreign direct investment to Poland, Hungary as well as the Czech and Slovak Rebublics amounted to 1 percent of German GDP in 2000 and 2.3 percent in 2010, see Dustmann et al. (2014), p.182.) A similar but more general point is made by Rodrik (1997), who argues that trade increases labor demand elasticities which leads to a decline in the bargaining power of labor, thus weakening unions.

2.4 Data

Trade Data For our analysis we use data on international trade from the BACI Database which is provided by the CEPII and builds on the UN Comtrade Database. It contains detailed bilateral trade statistics for more than 200 countries and 5,000 products, covering the period from 1995 to 2014. Since it is available on a product level (HS92) we aggregate it up to trade flows on a three-digit industry level (equivalent to NACE Rev.1). Trade flows are converted into Euros of 2000 using exchange rates and consumer price indices supplied by the German Bundesbank and the German Statistical Office. Figure 2.1 illustrates the evolution of German import and export volumes with respect to China and Eastern Europe. It can be seen that the German economy experienced a sizeable increase in trade volumes with respect to both regions.

(A) China (B) Eastern Europe

Figure 2.1
German Trade Volumes in (constant) Billion Euros, 1995-2014

Establishment Data Our establishment level data stems from the IAB Establishment Panel (EP), which is provided by the Research Data Centre of the Institute for Employment Research (IAB). The EP is a representative sample of all German establishments which employ at least one worker covered by social security. Establishments are chosen along three strata dimensions: regions, industries and size classes. Appropriate weights are provided to ensure the representativeness of the data. The EP started in 1993 with 4,265 establishments in West Germany. East German establishments were included from

1996 onwards. After taking in several waves of additional establishments, the sample size increased to about 16,000 in 2008 (16,300 in 2010).[21] Although participation is voluntary, the response rate of repeatedly interviewed establishments is high, amounting to about 80 percent. The survey covers many different topics. For our analysis at hand, information regarding the collective bargaining regime of an establishment is most important, which is available from 1996 onwards. It is surveyed every year and distinguishes between collective agreements at the industry level, at the firm level or no collective agreement. Other important establishment level variables for our analysis are the (detailed) industry affiliation of a plant at the three-digit level, regional affiliation, information on its size (in terms of employees and sales), whether it has a work council, establishment age, whether it is part of a larger group of plants, information on its legal status, its export behaviour and its technological status, as well as information about its workforce composition.[22] Figure 2.2 displays the evolution of collective bargaining coverage in Germany. It becomes apparent that from the mid 1990s onwards there was a strong decline in collective coverage rates and most of this development was due to a decrease of sector-wide agreements: While in 1996 about 49 percent of all establishments were covered by an industry-wide contract, this share declined to only 31 percent in 2010 (Panel (A)).[23] Moreover, the decline in CBAs is not driven by shifts in the sectoral employment share, but also found within sectors. The manufacturing sector shows the strongest decline (Panel (B)).[24]

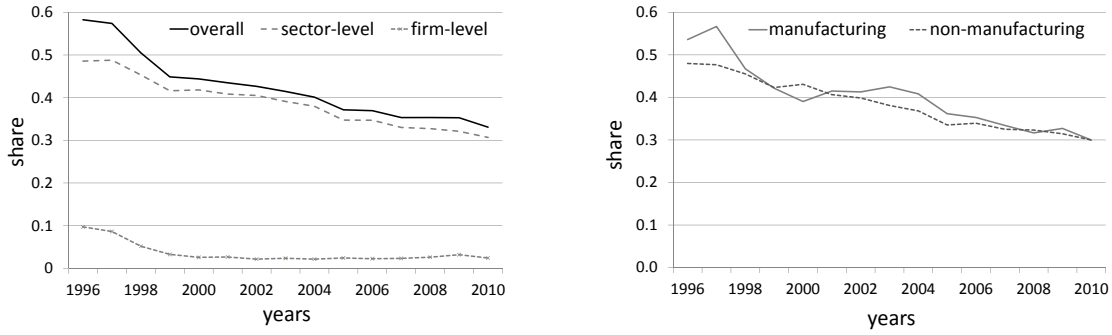
We combine both datasets by harmonizing industry and product classifications and merge all trade flows to the EP. We restrict our analysis to the years from 1996 (which is the first year we observe information on CBAs) to the year 2008 (to ensure that our analysis is not confounded by the global economic crisis). Moreover, we focus on manufacturing, since we have most detailed trade information for this sector. We end up with 84 to 89 different three-digit industries and 1,563 (1996) to 2,926 (2008) plants each year.

[21] At the time of this analysis, data is available up to the year 2010.

[22] For further details of this dataset see Ellguth et al. (2014).

[23] The share of plants covered by firm-level contracts declined from about 10 to 2 percent over the respective time period.

[24] The observed decline is partly driven by establishment turnover, with newly founded establishments being less likely to follow collective agreements, but to a great extent by previously covered establishments leaving collective contracts. We will provide evidence on this when discussing our dependent variable.



(A) Overall (B) Sector-Level CBAs by Industry

FIGURE 2.2
Decline in Collective Bargaining Coverage in Germany, 1996-2010

Supplement Data To supplement our main analysis, we make use of the 1995 input-output-table from the German Statistical Office. We exploit this source to distinguish final goods imports from overall imports. Details on the application of input-output-tables are given in the result section. A final data source which we consult for a robustness exercise is the number of migrants from China and Eastern Europe for each German district and year. We will be more explicit on this in section 2.6. Details on the construction of the latter two datasets can be found in the Appendix.

2.5 Empirical Approach

For our empirical strategy we closely follow previous work by Autor et al. (2013) and Dauth et al. (2014). In particular, we make use of the fact that the productivity rise in China as well as the fall of the iron curtain and the subsequent transformation of the former socialist countries, happend quickly and unexpectedly for Germany and led to massive increases in trade volumes worldwide.[25] In order to investigate how the rise in trade exposure frm China and Eastern Europe affected German firms to adjust their collective bargaining status, we relate changes in a plant's bargaining regime to changes

[25]Dauth et al. (2014) discuss in detail that the growth in trade with respect to both regions was much larger than with respect to any other German trading partner in the world, making it the major trade shock that hit the German economy during the last two decades – and one which originated primarily from low-wage countries.

in import and export exposure from the East. We first discuss how we measure the exogenous increase in trade exposure, before we turn to the exact definition of changes in collective bargaining states at the establishment level. We elaborate on the exact empirical specification at the end of this section.

Trade Exposure to the East Our main measure of trade exposure is the change in import penetration for each three-digit industry of the manufacturing sector between t and $t + \Delta$, which is defined as:

$$\Delta IM_{jt}^{East} = \frac{\Delta IM_{jt}^{D \leftarrow East}}{E_{j,95}}, \tag{2.1}$$

where $\Delta IM_{jt}^{D \leftarrow East}$ corresponds to total change in imports from the East to Germany in industry j between t and $t + \Delta$. We normalize trade volumes with total employment in industry j in the pre-sample period, $E_{j,95}$. Our measure of import exposure ΔIM_{jt}^{East} therefore captures the per-capita change in imports for industry j between t and $t + \Delta$.[26] One concern regarding the use of (2.1) in our empirical analysis is that it might also capture domestic shocks that affect both firm-level outcomes and German import demand. To extract only the supply-driven component in (2.1) we instrument for German import exposure by using the change in imports of other high-income countries vis-a-vis the East, constructing the following variable:

$$\Delta IMO_{jt}^{East} = \frac{\Delta IM_{jt}^{Other \leftarrow East}}{E_{j,95}}, \tag{2.2}$$

where $\Delta IM_{jt}^{Other \leftarrow East}$ now corresponds to changes in total import flows of industry j goods from the East to other high-income countries between t and $t + \Delta$.[27] Note that we

[26] Table A.2.1 in the Appendix lists the industries that show the highest import exposure.

[27] This intrumental variable approach has been developed by Autor et al. (2013) and applied to the German case by Dauth et al. (2014). We follow the latter and consider the following countries as instrument countries: Australia, New Zealand, Japan, Singapore, Canada, Sweden, Norway and the UK. The underlying idea is that those countries are similarly affected by the rise of the East, while industry demand shocks across Germany and those other high income countries are largely uncorrelated.

construct both measures ((2.1) and (2.2)) also with respect to export exposure:

$$\Delta EX_{jt}^{East} = \frac{\Delta EX_{jt}^{D \to East}}{E_{j,95}}, \tag{2.3}$$

and

$$\Delta EXO_{jt}^{East} = \frac{\Delta EX_{jt}^{Other \to East}}{E_{j,95}}. \tag{2.4}$$

Changes in Collective Bargaining States We measure the collective bargaining status of plant i at time t with a dummy variable, CB_{it}, that indicates whether the establishment recognizes an industry-wide collective agreement or not. We consider this information to be the most relevant for our analysis, since most of the variation in collective bargaining coverage rates relates to sector-level as opposed to firm-level agreements (see Figure 2.2). Furthermore, switching from an industry-level agreement to either a firm-level agreement or no collective agreement at all captures the idea of an increasing decentralization of the wage setting process, which we are after. As our dependent variable of interest we define the change in collective bargaining status at the establishment level between t and $t + \Delta$, ΔCB_{it}. It can take the value 0 if establishment i has not changed its bargaining status, -1 if the plant has left an industry-wide agreement, and $+1$ if the establishment has joined such an agreement between t and $t + \Delta$.[28]

When choosing the interval length Δ, we aim to find the optimal balance between different objectives. On the one hand, Δ should not be too small since we have to take into account that establishments might react to a change in economic conditions only with a certain time lag. Moreover, we need to consider that establishments that are willing to leave a collective agreement are still bound by the latter until it expires. Thus, the

[28]Since we want to capture permanent changes in a plants' bargaining status, we impute the CBA variables, when an establishment reports a differenf status only for one year (and switches back to the previous status directly in the next period). In such a case, we ignore the switch and adjust the CBA variable. We provide details on this imputation in the Appendix. Generally, our results are not sensible to this adjustment.

probability of observing a change in the plant's bargaining regime increases with the length of Δ. On the other hand, Δ should not be too large since panel attrition and the ensuing reduction in sample size as well as sample selectivity would increasingly compromise the analysis.[29] Taking this trade-off into account, we opt for three-year windows.[30] Since our analysis covers the years 1996 to 2008, we end up with four stacked three-year differences: 1996–99, 1999–02, 2002–05, and 2005–08. Tables 2.1 and 2.2 show descriptive statistics of the dependent variable as well as the trade measures for the respective time periods.

Table 2.1
Descriptive Statistics: Dependent Variable

Dependent variable	ΔCB_{it}	1996-1999	1999-2002	2002-2005	2005-2008
Exiting CBA (in %)	-1	20.50	4.44	9.63	10.15
No change in CBA (in %)	0	75.25	89.88	86.05	86.19
Entering CBA (in %)	+1	4.25	5.68	4.32	3.66
Number of establishments		797	1010	1763	1772

Notes: Numbers reported are percentages since weighting factors (establishments weights) are employed. Note that we observe only between 797 and 1772 establishments each period since our analysis requires plants to be observed at t and $t + \Delta$.

As can be seen, we observe between 4 and 21 percent of establishments leaving collective bargaining agreements each period. At the same time, between 4 and 6 percent of plants are observed to enter CBAs. Although these numbers refer to our restricted sample, they match quite well the overall decline in CBAs that we observe on the entire sample (see Figure 2.2 Panel (B)).

With respect to trade exposure it becomes apparent that we see a steady increase in the average import penetration over time. Starting with a change in imports per capita of about 3,000 Euro between 1996 and 1999, it rises to more than 6,600 Euro in the period

[29] If we choose Δ from 1996 to 2008, we only observe 211 plants in our sample, preventing a reasonable analysis.

[30] Alternatively, one could think of measuring the dependent variable not at the plant, but at the industry level. For example one could consider the change in the share of sector-wide covered plants at the three-digit industry level as dependent variable. However, cell sizes would become too small, and representativeness of aggregate three-digit industry shares cannot be ensured. As the Research Data Center points out (see Fischer et al. (2008), p.21), it is not feasible to obtain representative results on a more disaggregate level than the strata variables. Since the strata industry dimension is quite aggregated (in 1996 there are only 16 strata-industries out of which only three refer to the manufacturing sector), it is not feasible to construct valid maesures of the share of collectively covered plants on a three-digit-industry level. It is however possible to conduct valid establishment-level analysis, since one can explicitly control for the strata variables. See Fischer et al. (2008) for a detailed discussion.

TABLE 2.2
Descriptive Statistics: Changes in Import and Export Exposure

	N	mean	p50	sd	min	max
1996-1999						
Change in imports	84	3.05	1.67	4.66	-2.25	32.97
Change in imports, instrumented	84	4.53	1.16	9.48	-4.47	52.52
Change in exports	84	2.09	1.24	3.49	-4.87	14.73
Change in exports, instrumented	84	2.03	0.51	5.46	-9.74	29.70
1999-2002						
Change in imports	88	3.82	1.70	7.45	-5.88	39.97
Change in imports, instrumented	88	13.76	4.57	27.69	-1.13	163.72
Change in exports	88	3.45	2.45	4.36	-5.93	22.39
Change in exports, instrumented	88	5.16	1.54	12.14	-9.48	94.15
2002-2005						
Change in imports	89	5.14	1.89	11.18	-10.52	71.95
Change in imports, instrumented	89	12.03	3.33	29.39	-14.21	183.18
Change in exports	89	3.29	2.38	4.90	-14.94	19.87
Change in exports, instrumented	89	5.53	1.67	12.84	-13.98	70.50
2005-2008						
Change in imports	88	6.64	2.73	17.64	-12.55	119.57
Change in imports, instrumented	88	8.54	3.37	28.61	-56.89	195.10
Change in exports	88	5.76	4.35	6.88	-14.91	25.69
Change in exports, instrumented	88	1.54	1.20	12.16	-61.33	36.83

Notes: Measures refer to three-digit manufacturing industries.

from 2005 to 2008. With respect to exports we also see an overall increase from the first to the fouth period of analysis. In each period, the change in imports per capita exceeds the respective change in exports.

Empirical Specification To investigate the effect of the rise in trade exposure on establishment level responses with respect to their bargaining status, we relate the dependent variable ΔCB_{it} at the establishment level, to changes in our import and export measures ΔIM_{jt}^{East} and ΔEX_{jt}^{East} at the industry level. More specifically, we estimate variants of the following regression model:

$$\Delta CB_{it} = \beta_0 + \beta_1 \Delta IM_{jt}^{East} + \beta_2 \Delta EX_{jt}^{East} + \beta_3 X_{it} + \delta_r + \gamma_k + \mu_t + \epsilon_{it}, \qquad (2.5)$$

where we control for a rich set of start-of-period establishment-level characteristics, X_{it}, that have been identified to be relevant for the choice of the bargaining regime (Kohaut and Schnabel (2003) and Schnabel et al. (2006)). These are: establishment size (10 cat-

egories) and age (dummy indicating whether the establishment is younger than 6 years), information on the existence of a work council and its legal status, information if the plant is a single-unit plant, whether it engages in exporting, information on its technological status (dummy indicating whether the plant reports to have a technological status that is above industry average), the share of low-educated workers and the share of employees with fixed-term contracts. We further include the start-of-period collective bargaining status.[31] Moreover, we add federal state indicators (δ_r), as well as time (μ_t) and two-digit industry dummies (γ_k). Given that we consider a specification in first differences, the dummies capture region- and industry-specific time trends. The main coefficients of interest are β_1 and β_2. Estimated by OLS, they would capture the causal effect of rising trade exposure on plant-specific changes in the bargaining regime only if ΔIM_{jt}^{East} and ΔEX_{jt}^{East} were fully exogenous. Since this is unlikely, we instrument these measures as outlined above.[32]

2.6 Results

We now report regression results pertaining to different variants of regression equation (2.5). We start with our baseline results, then explore heterogeneous effects along different dimensions, before subjecting our results to a series of robustness checks.

2.6.1 Baseline Results

Column (1) of Table 2.3 reports the OLS results of specification (2.5). It can be seen that a rise in import competition from the East is associated with a significant increase in establishments' probability of leaving sector-level bargaining agreements. An increase in export exposure is not found to have any significant impact on plants' decisions to change their collective bargaining status. With respect to the included control variables,

[31] We report descriptive statistics of plant-level control variables in Table A.2.2 in the Appendix.

[32] Note that the direction of the endogeneity bias is a priori unclear. If a negative cost shock (e.g. due to past bargaining "mistakes"), leads to both increased opting-out of collective bargaining as well as an increase in imports, OLS estimation would lead to a downward bias in the import exposure coefficient. In contrast, a positive productivity or demand shock that leads to both more imports as well as less opting-out, would lead to an upward bias of the OLS estimate.

we find - as expected - that establishment size is negatively related to the probability of leaving industry-wide collective agreements.[33] Similarly, the results suggest that newly founded plants as well as single-unit establishments are more likely to leave centralized wage agreements, although only the latter effect is statistically significant. Interestingly, also exporting plants are found to be more likely to exit from collective agreements.[34] On the other hand, the displayed results show that plants having a work council and those who are privately owned (as opposed to corporate enterprises) seem to be less likely to opt out of aggregate bargaining regimes. With respect to workforce composition, a higher share of low-skilled labor seems to be associated with a higher likelihood of leaving collective bargaining regimes. It is however not found to be statistically significant.

Coming closer to a causal interpretation of the impact of trade exposure on establishments' probability to change bargaining status, we next consider the results of the IV estimation (shown in Column (2)). First-stage evidence is provided at the bottom of Table 2.3 and indicates that the instrument for our import measure is strong, with an F-test statistic above the common rule of thumb of ten. This does not hold for the instrument of export exposure, which shows a first-stage F-test value of 7.44 only. We therefore need to exert some caution when interpreting the results pertaining to exporting. Turning to our second stage results, the import coefficient in Column (2) is again found to be negative and statistically significant. It is even larger in absolute terms than the corresponding OLS estimate. This suggests that the OLS coefficient is biased towards zero, which could be due to measurement error and unobserved demand shocks that cause both increased imports as well as less pressure to leave sector-level bargaining agreements. Note, that we do not find any effect related to the export channel. In terms of economic magnitude, our IV estimate implies that an increase in import penetration from the East by 1,000 Euro per worker increases (decreases) a plants' probability of leaving (joining)

[33] We include dummies for 10 establishment size groups. Results are not shown to save on space. They are available upon request.

[34] This is in line with previous evidence by Capuano et al. (2014), who report that exporting establishments are less likely to be covered, conditional on plant size. It would also be in line with the offshoring argument mentioned previously. The threat of relocating part of the production is arguably more credible for exporting than for purely domestic plants, given that the former are already globally connected.

sector-level bargaining agreements by 0.31 percentage points. A back-of-the-envelope calculation therefore suggests, that a cumulated increase in import exposure of 17, 000 Euro per worker, which approximately corresponds to the sample average over the entire period, yields a change in collective bargaining coverage of 5.27 percentage points. As a result, the rise of the East explains about 22 percent of the entire decline in sector-level collective coverage from 1996 to 2008.

We obtain very similar results to this baseline specification if we consider only imports or net imports as our instrumented trade shock variables. The respective results are shown in Columns (3) and (4) of Table 2.3.

2.6.2 Heterogeneous Effects

We now turn to heterogeneous effects and analyze which type of establishments show the strongest responses in adjusting their bargaining status due to increased trade exposure. Following our reasoning in Section 2.2, we expect the import effect to be strongest for least productive establishments. The mechanism we have in mind is that increased import competition, which originates predominantly from low-wage countries, puts a particular pressure on the least competitive plants in Germany. If these establishments credibly face the threat of going bankrupt or the need to downsize production, we expect them to be more likely to convince their employees to accept an opting-out decision.

To approximate establishment productivity, we consider the following two avenues. First of all, we stick closely to the new-new trade literature and use establishment size as a proxy for productivity. According to this strand of research, which was pioneered by Melitz (2003), important firm level characteristics such as firm size or the export status of a firm, can be traced back to one sufficient statistic, which is firm productivity. In empirical applications, firm size is therefore often used to approximate productivity. We follow this literature and estimate the regression model (2.5) separately for three different plant-size groups. For our second approach, we exploit further information from the IAB Establishment Panel and construct a mark-up measure, which we define as sales over total costs, where the latter refers to the sum of input costs and total wage payments.

TABLE 2.3
Effects of Trade Exposure on Changes in CBAs: Baseline Results

Dependent variable: Change in sector-level collective bargaining status at the plant level
ΔCB_{it} takes the value -1 for plants leaving collective agreements

	(1) OLS	(2) 2SLS	(3) 2SLS	(4) 2SLS
Import Exposure	-0.0018***	-0.0031**	-0.0032*	
	(0.0006)	(0.0015)	(0.0016)	
Export Exposure	-0.0007	-0.0000		
	(0.0008)	(0.0018)		
Net-Import Exposure				-0.0026**
				(0.0011)
CBA-status	-0.3017***	-0.3021***	-0.3021***	-0.3022***
	(0.0158)	(0.0156)	(0.0156)	(0.0156)
Work council	0.0764***	0.0770***	0.0770***	0.0767***
	(0.0141)	(0.0140)	(0.0140)	(0.0139)
Young plant	-0.0135	-0.0141	-0.0141	-0.0144
	(0.0152)	(0.0151)	(0.0151)	(0.0150)
Single plant	-0.0502***	-0.0502***	-0.0502***	-0.0496***
	(0.0140)	(0.0139)	(0.0139)	(0.0139)
Private plant	0.0222*	0.0215*	0.0215*	0.0222*
	(0.0116)	(0.0114)	(0.0114)	(0.0114)
Exporter	-0.0178**	-0.0177**	-0.0177**	-0.0176**
	(0.0090)	(0.0089)	(0.0089)	(0.0088)
Technology above average	0.0043	0.0041	0.0041	0.0040
	(0.0113)	(0.0112)	(0.0112)	(0.0112)
Share of low-skilled workers	-0.0173	-0.0167	-0.0167	-0.0168
	(0.0165)	(0.0163)	(0.0163)	(0.0163)
Share of fixed-term workers	0.0023	0.0022	0.0022	0.0026
	(0.0482)	(0.0481)	(0.0481)	(0.0483)
N	5342	5342	5342	5342
R2	0.16	0.16	0.16	0.16
First Stage, import exposure				
Import (other countries)		0.2719***	0.2417***	
		(0.0621)	(0.0696)	
Export (other countries)		-0.1570***		
		(0.0556)		
Net-import (other countries)				0.2894***
				(0.0391)
F-test		18.25	12.05	60.54
First Stage, export exposure				
Import (other countries)		-0.0140		
		(0.0247)		
Export (other countries)		0.1406***		
		(0.0411)		
F-test		7.44		

Notes: Regressions are based on four stacked 3-year windows from 1996 to 2008. Establishment controls are measured at the start of each window. All regressions include a constant, indicators for 10 plant-size groups, regional dummies (one for each German region), 2-digit industry controls and a time trend. First stage regressions include the same set of control variables as the corresponding second stage. Levels of significance: *p<0.10, **p<0.05, ***p<0.01. Standard errors (clustered at the 3-digit industry level) are given in parentheses.

We take this mark-up measure as an alternative proxy for establishment productivity and split the entire sample according to the median value of the mark-up distribution in two groups. We run separate regressions for both subsets of establishments. Unfortunately, information on sales and / or input costs is missing for some fraction of establishments, which further reduces our sample size in this specification.

Columns (1) to (3) of Table 2.4 report the results of our estimation for different plant-size groups. We find that in particular small (< 50 workers) and medium-sized (≥ 50 and < 200 workers) plants are likely to leave a sector-wide agreement in response to an increase in low-wage import competition. For large establishments this effect is less pronounced. In terms of magnitude, the point estimate is lower than for medium-sized and small plants and it is not significant. At the same time, we find a positive and statistically significant effect of a change in export exposure for large establishments only, suggesting that an increase in export opportunities makes large plants less likely to opt out of a collective agreement. This is in line with the notion that in particular large and high productive plants benefit from increased export opportunities. This makes it less likely that they leave collective agreements, since its employees would strongly oppose an opting-out decision. Using the mark-up of a plant as alternative productivity proxy supports this finding (results are shown in Columns (4) and (5) of Table 2.4): We find the group of establishments with a relatively low mark-up to be significantly affected by an increase in import exposure, while this is not the case for the alternative group of plants showing a high measure of mark-up. Overall we take this as evidence that the least productive establishments are indeed most strongly affected by an increase in import competition from the East. Moreover, this supports our notion, that we are indeed capturing effects of final goods trade as opposed to offshoring (or threats to relocate production), since the latter should apply in particular to larger firms or establishments.[35] That is, however, not what we find in the data.

With respect to futher heterogeneous effects at the plant level, one might expect that the share of labor in production and the low-skill intensity of the workforce matters for

[35]There is strong evidence that the most productive and largest firms within an industry self-select into offshoring (as summarized in, e.g., Egger et al. (2015a)).

TABLE 2.4
Heterogeneous Effects: Plant Productivity

Dependent variable: Change in sector-level collective bargaining status at the plant level
ΔCB_{it} takes the value -1 for plants leaving collective agreements

	Plant-size			Mark-up	
	small	medium	large	below median	above median
	(1)	(2)	(3)	(4)	(5)
Import exposure	-0.0034*	-0.0043*	-0.0024	-0.0053*	-0.0023
	(0.0018)	(0.0025)	(0.0019)	(0.0029)	(0.0018)
Export exposure	-0.0034	-0.0017	0.0070*	0.0007	-0.0017
	(0.0041)	(0.0036)	(0.0041)	(0.0033)	(0.0029)
Establishment controls	YES	YES	YES	YES	YES
Estimation method	2SLS	2SLS	2SLS	2SLS	2SLS
N	2571	1275	1496	2069	2263
R2	0.20	0.18	0.12	0.16	0.16
First Stage F-test					
Imports	6.85	9.51	38.71	29.84	36.35
Exports	5.44	7.01	8.27	7.39	8.85

Notes: Establishment size groups refer to the following: small $<$ 50 workers, medium-sized $\leq$ 50 and $>$ 200 workers, large $\geq$ 200 workers. Mark-up is defined as sales over the sum of input costs and total wage payments. All regressions include a constant, a full set of establishment-level control variables as in Table 2.3 and a complete set of time, region and 2-digit-industry dummies as well as indicators for 10 plant-size groups. First stage regressions include the same set of control variables as the corresponding second stage. Levels of significance: *p<0.10, **p<0.05, ***p<0.01. Standard errors (clustered at the 3-digit industry level) are given in parentheses.

the impact of increased trade exposure on the probability of changing the bargaining regime. The underlying idea is that, the more important the factor labor for production, the more relevant is a collective wage agreement for a firm. Thus, we would expect those establishments with a high share of labor in production to react more strongly to an increase in trade exposure. Similar arguments hold with respect to the low-skill intensity of the workforce. Since collective agreements are generally more binding for low-skilled than for high-skilled workers (see Dustmann and Schönberg (2009)), we would expect to see those plants to be more strongly affected by increased trade exposure, which employ a relatively large share of low-skilled workers. To shed light on this dimension of heterogeneity, we run two further specifications. First, we split the sample in two groups along the median value of the share of labor in production (using sales over the number of total employees), and run separate regressions on both subsamples. Second, we split the whole sample along the median share of low-skill employment (using the share of low-skilled workers relative to high skilled workers) and repeat the analysis for both groups.

Table 2.5 displays the results. Different to our presumption, however, we find for both specifications, that the two respective groups of plants are affected very similarly, showing almost identical point estimates and roughly the same level of significance. We explain this finding by the fact that although plants with a high share of labor in production and a high share of low-skilled employees might be more strongly affected by low-wage competition, they might also be confronted with a stronger opposition from their workforce if they want to opt out, since collective wages are binding for a larger fraction of their workforce.

Table 2.5
Heterogeneous Effects: Workforce Composition

Dependent variable: Change in sector-level collective bargaining status at the plant level ΔCB_{it} takes the value -1 for plants leaving collective agreements				
	Share of labor in production		Low-skilled intensity	
	below median	above median	below median	above median
	(1)	(2)	(3)	(4)
Import exposure	-0.0041*	-0.0036	-0.0035*	-0.0033*
	(0.0024)	(0.0024)	(0.0021)	(0.0018)
Export exposure	-0.0018	0.0001	-0.0001	-0.0002
	(0.0039)	(0.0035)	(0.0031)	(0.0023)
Establishment controls	YES	YES	YES	YES
Estimation method	2SLS	2SLS	2SLS	2SLS
N	2549	2358	2743	2599
R2	0.20	0.15	0.16	0.18
First Stage F-test				
Imports	8.61	39.95	7.29	29.71
Exports	6.59	8.55	5.12	9.76

Notes: Share of labor in production refers to sales over number of total employees. Low-skilled intensity is defined as ratio of low-skilled workers to high-skilled workers. All regressions include a constant, a full set of establishment-level control variables as in Table 2.3 and a complete set of time, region and 2-digit-industry dummies as well as indicators for 10 plant-size groups. First stage regressions include the same set of control variables as the corresponding second stage. Levels of significance: *p<0.10, **p<0.05, ***p<0.01. Standard errors (clustered at the 3-digit industry level) are given in parentheses.

2.6.3 Robustness Analysis

In the following, we run several robustness checks, which are summarized in Table 2.6. First, we restrict our analysis to single-unit plants only (shown in Column (1)), thereby taking into account that decisions on collective agreements are rather formed at the firm than at the plant level. As expected, the estimated effect of an increase in import pene-

tration on firms' propensity to opt out of sector-level collective agreement is still positive and significant and slightly larger in absolute terms than in our baseline specification with the full sample. This suggests that our establishment-level analysis approximates the decisions taken at the firm level reasonably well.

Next, we focus on the risk set of establishments that could potentially leave collective bargaining and restrict our sample to plants that have been covered by a sector-wide collective agreement at the beginning of each time window. In this specification our dependent variable, ΔCB_{it}, can therefore only take the values minus one for CBA leavers and zero for CBA stayers. Moreover, the number of observations reduces significantly (from 5,342 in the baseline to 2,569 in this specification). Column (2) shows the results. We estimate roughly similar coefficients as in our baseline specification, albeit with less statistical precision. We take this as supporting evidence for the validity of our symmetry assumption which is implicit in our baseline estimation, i.e. the assumption that the explanatory variables have a symmetric effect on the probabilities of leaving and joining, respectively, sector-level bargaining agreements. Comfortingly, we also obtain qualitatively the same results regarding the heterogeneous effects by establishment size when restricting the sample to single-unit plants or to establishments initially covered by a collective agreements (see Table A.2.3 in the Appendix).

As a further robustness check, we restrict attention to final goods imports. One might think that imported intermediates have a different effect on German firms, potentially leading to lower marginal costs and less pressure to leave collective bargaining. To distinguish final goods import from intermediate goods imports, we rely on the German input-output table from the pre-sample period 1995 (similar to Autor et al. (2013) and Dauth et al. (2014)). Specifically, we calculate the share of imports originating from a given two-digit industry abroad that is not used as an input in any (other) two-digit industry. We apply this share to all three-digit industries within a given two-digit industry.[36] Restricting attention to final goods imports hardly affects the regression results (Column (3)).

[36]Instruments are adjusted accordingly.

Given our regression set-up, one further concern could be related to panel attrition. Although the average response rate of the survey is quite high (about 80 percent), we still lose establishments over our three-year windows. Unfortunately, we only have very incomplete information on reasons why plants disappear from the survey.[37] Panel attrition could lead to biased estimates if it is not random but correlated with our main variables of interest. In particular, we would expect to underestimate our main effect (the β_1 coefficient) if an increase in import penetration is positively related to panel attrition, implying that such an increase induces some (low-productivity) establishments not only to exit a collective agreement but also to disappear from the panel. We systematically analyze this possibility by regressing a dummy variable of plant survival (which takes the value one if a plant is observed in t as well as in $t+\Delta$ and zero otherwise) on all covariates of our model.[38] Column (4) of Table 2.6 shows the results. As can be seen, both trade shock coefficients are close to zero and not statistically significant. We therefore conclude that panel attrition does not confound our analysis.

In the following we conduct further robustness checks with respect to our sample definition (Columns (5) and (6)). In Column (5) we stick to our three-year-window specification, but do not take a stand on the exact beginning of each window. Instead of using stacked first differences, we consider a rolling-window approach. It can be seen that our main effect of interest, β_1, is again negative and significant, but in terms of absolute magnitude slightly smaller than in our baseline specification. Finally, we report evidence of a simple long-difference model over the period from 2000 to 2008 in Column (6). Although the number of observations decreases significantly to 715 only, the general relationship between an increase in import penetration and establishment's opting-out decision from a sector-wide collective contract remains remarkably stable, but loses statistical significance.[39]

[37] Only for a small fraction of establishments that disappear from the panel, information that they went bankrupt is available. For the rest, the reasons why they are not further observed are unknown.

[38] Unfortunately, it is not feasible to run a true selection model since this would require a valid exclusion restriction, which is difficult to come by in the setting at hand.

[39] Considering the entire period from 1996 to 2008 would reduce the number of observations even further to 211 plants only, preventing a reasonable analysis.

TABLE 2.6
Robustness Analysis: Different Samples

Dependent variable: Change in sector-level collective bargaining status at the plant level ΔCB_{it} takes the value -1 for plants leaving collective agreements						
	Single-unit plants	Initially covered plants	Final-goods only	Panel attrition	3-year rolling window	Long difference 2000-2008
	(1)	(2)	(3)	(4)	(5)	(6)
Import exposure	-0.0037**	-0.0035	-0.0032*	0.0009	-0.0020*	-0.0020
	(0.0016)	(0.0022)	(0.0017)	(0.0009)	(0.0010)	(0.0017)
Export exposure	-0.0011	0.0030		0.0015	0.0023	0.0020
	(0.0020)	(0.0039)		(0.0044)	(0.0018)	(0.0043)
Establishment controls	YES	YES	YES	YES	YES	YES
Estimation method	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
N	3899	2569	5342	9227	13129	715
R2	0.17	0.11	0.16	0.03	0.16	0.31
First Stage F-test						
Imports	17.55	43.52	11.57	17.92	65.47	5.02
Exports	9.98	7.92		10.04	15.51	12.37

Notes: All regressions include a constant, a full set of start-of-period establishment-level control variables as in Table 2.3 and a complete set of time, region and 2-digit-industry dummies as well as indicators for 10 plant-size groups. First stage regressions include the same set of control variables as the corresponding second stage. Levels of significance: *p<0.10, **p<0.05, ***p<0.01. Standard errors (clustered at the 3-digit industry level) are given in parentheses.

Migration One potentially confounding factor that we have not addressed so far relates to migration. It is well known that the German labor market attracted many migrants, especially from Central and Eastern Europe, during our period of analysis. Although Germany restricted the freedom of movement of citizens from the new EU member states, a sizable number of migrants already arrived during the 2000s (see e.g. Haug (2004), Elsner and Zimmermann (2013)). Arguably, this migration inflow could also have influenced German employers and employees to agree upon leaving collective wage regimes, given that the implied increase in labor supply might have affected the bargaining position of establishments vis-a-vis their incumbent workers.

Note, however, that this potential channel would only be a threat to our identification strategy if migration did not only influence the establishments' choice of the bargaining regime, but also trade flows between the East and our instrument countries. Although this seems unlikely, the possibility cannot be ruled out completely. One potential mechanism could be, for example, that workers from comparative-advantage sectors in the Eastern

countries, who potentially have valuable and internationally mobile labor market skills, migrate to Germany seeking employment in the same sectors or in those regions where these sectors predominate. In this scenario, trade flows from the East to other countries would go hand in hand with migration from the East to Germany. To rule this mechanism out, we consider two further robustness checks. First, we exclude all plants from our analysis that are located in a district at the eastern border of Germany. Since migration is generally concentrated at regions which are relatively close to the home country (for this distance pattern of migration from Central and Eastern European countries to Germany see e.g. Lehmann and Nagl (2015)), we thereby exclude those plants that are arguably most strongly affected by migration from the East. Furthermore, it is likely that these plants are also most exposed to cross-border worker flows, which could work through a similar channel. Second, we consider our baseline specification but include additional controls to account for the number of migrants from the East at the district level. In particular, we control for the number of migrants from the East relative to total employment at the district level (specification 1) or for the change in the share of migrants to total employment over period Δ (specification 2). Note, that we do not aim at a causal identification of the migration channel itself, which would require us to use proper instruments for the district-specific migration flows, but focus on how the inclusion of these variables affects the estimated trade exposure effects. The results, which are shown in Table 2.7, show that neither the exclusion of plants at the border, nor the control for migrants at the district level affect our main results. We therefore conclude that the trade effect we capture in our analysis is not confounded by simultaneous migration flows to Germany.[40]

2.7 Conclusion

In this chapter we shed light on a hitherto unexplored dimension of establishments' adjustment to increased import competition. Using rich establishment-level data from Germany over the period from 1996 to 2008, we analyze how establishments change their collective bargaining status in response to stronger trade exposure. We show that estab-

[40]Details on how we construct the variables at the district level are provided in the Appendix.

TABLE 2.7
Robustness Analysis: Migration

Dependent variable: Change in sector-level collective bargaining status at the plant level ΔCB_{it} takes the value -1 for plants leaving collective agreements				
	Baseline (1)	Excluding border districts (2)	Controlling for migration (3)	Controlling for migration (4)
Import exposure	-0.0031**	-0.0030*	-0.0032**	-0.0032**
	(0.0015)	(0.0016)	(0.0015)	(0.0015)
Export exposure	-0.0000	-0.0002	-0.0000	0.0000
	(0.0018)	(0.0018)	(0.0018)	(00018)
Level of migrants / total workforce			-0.4722	
			(0.6240)	
Change in level of migrants / total workforce				0.8737
				(0.9385)
Establishment controls	YES	YES	YES	YES
Estimation method	2SLS	2SLS	2SLS	2SLS
N	5342	4847	5342	5342
R2	0.16	0.16	0.16	0.16
First Stage F-test				
Imports	18.25	18.04	18.30	18.67
Exports	7.44	7.14	7.43	7.58

Notes: All regressions include a constant, a full set of start-of-period establishment-level control variables as in Table 2.3 and a complete set of time, region and 2-digit-industry dummies as well as indicators for 10 plant-size groups. First stage regressions include the same set of control variables as the corresponding second stage. Levels of significance: *p<0.10, **p<0.05, ***p<0.01. Standard errors (clustered at the 3-digit industry level) are given in parentheses. Column (1) shows our baseline results as in Column (2) of Table 2.3. In Column (3) we account for the level of migrants relative to the total workforce at the district level. We consider migrants in the age of 18 to 65 from all countries that are considered as "the East" in our analysis. The total number of the workforce at the district level refers to the year 1995 and is held fix. In Column (4) we control for the change in the level of migrants over period Δ relative to the total number of workers at the district level.

lishments facing stronger import competition from China and Eastern Europe are more likely to leave sector-wide collective bargaining, thereby contributing to the increased decentralization of wage negotiations. We find that in particular small and medium-sized establishments have reacted to increased import competition in this way. In contrast, and as expected, we do not find any effect of stronger export exposure on establishments' likelihood of leaving sector-level bargaining.

A back-of-the-envelope calculation suggests that about 22 percent of the entire decline in sector-wide collective bargaining coverage in the German manufacturing sector over the period of analysis from 1996 to 2008 can be explained by the increase in import competition from China and Eastern Europe.

Previous literature has shown that the decline in collective bargaining coverage matters

for a wide range of economic and labor market outcomes. Among others, it has been identified as a major source of increasing wage dispersion. In this chapter, we have identified an important driving factor of this decline.

On a more general level, the following conclusions can be drawn from our analysis. First, labor market institutions do not only shape comparative advantage and, hence, trade patterns, but are themselves endogenous with respect to international trade. Second, the decline in collective bargaining seems to constitute one potentially important channel linking international trade and labor market outcomes – and one that is likely to have long-term consequences. Exploring in detail the link between international trade, the decline in collective bargaining, and labor market outcomes seems to be fruitful avenue for future research.

A.2 Appendix

A.2.1 Input-Output Data

To differentiate between total imports and final-goods imports, we make use of the German input-output table of the year 1995 which is provided by the German Statistical Office. Similar to Autor et al. (2013) and Dauth et al. (2014) we use information on the shares of world imports (by industry) that are used for consumption or investment rather than as an input by any industry. We multiply these shares with German imports from Eastern Europe and China. This gives us a measure on each sector's imports in final goods. We adjust the instruments accordingly.

A.2.2 Migration Data

Migration information at the district level stems from the German Statistical Office. In particular, we make use of the Central Register of Foreigners. This dataset contains information on the stock of migrants by year, nationality, age and gender at the district level. It covers the period from 1998 to 2014. For the years 1996 and 1997 the number of migrants by nationality, age and gender is only available at a more aggregate level of German regions. We therefore impute the number of migrants at the district level for these two years, taking the relative distribution of migrants per district from the year 1998. Moreover, we adjust the data taking all regional reforms at the district level into account (Gebietsreformen).

In order to construct our control variables, we consider all migrants in the age of 18 to 65 from all countries that are considered as "the East" in our analysis (China, Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovakia, Slovenia, the Russian Federation, Belarus, Estonia, Latvia, Lithuania, Moldova, Ukraine, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan). We normalize the total number of migrants (the change in the total number of migrants) by the total number of the workforce at the district level. We extract the latter information from the SIAB dataset (Sample of Integrated Labor Market Biographies, provided by the IAB). The denominator

is fixed to the year 1995.

A.2.3 Imputation of Collective Bargaining Status

To ensure that we capture permanent changes in the bargaining status and not only temporary ones (e.g. potential exits that are only instrumented to achieve a better bargaining position in the next period, and which are therefore followed by a reentry in the next period), we explicitly check the data for such patterns and impute the CBA variable in these cases. In particular we do so, if a plant reports to change bargaining status in two consecutive years, e.g. if a plant reports to be covered in period 0 and period 2 but to be uncovered in period 1 (of course, we equally consider changes in the opposite direction). In such a case, we ignore the first change and impute the CBA variable such that this particular plant is covered in all three periods.[41] On the entire dataset the imputation affects between 1.04 and 2.65 percent of all observations per year. With respect to the regression windows of our baseline specification, less than 4 percent of changes (ΔCB_{it}) are affected by this procedure. We run our specifications also with the original, non-imputed, CBA variable. Our results are largely stable to this adjustment.

[41] As soon as a plant reports three changes in a row (which is very rarely observed), we do not impute but only flag these observations and exclude these plants in a robustness check. The whole set of our results remains unaffected.

TABLE A.2.1
Most Affected Industries by Import Exposure Per Capita

Industry		Change in trade volumes p.c.
177	Manufacture of knitted and crocheted articles	217.56
365	Manufacture of games and toys	177.94
300	Manufacture of office machinery and computers	140.01
323	Manufacture of television and radio receivers, sound or video recording or reproducing apparatus and associated goods	79.95
321	Manufacture of electronic valves and tubes and other electronic components	54.04
152	Processing and preserving of fish and fish products	50.81
274	Manufacture of basic precious and non-ferrous metals	48.06
322	Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy	42.65
351	Building and repairing of ships and boats	34.85
364	Manufacture of sports goods	34.56
343	Manufacture of parts and accessories for motor vehicles and their engines	34.42
174	Manufacture of made-up textile articles, except apparel	33.87
193	Manufacture of footwear	32.76
314	Manufacture of accumulators, primary cells and primary batteries	28.48
342	Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semitrailers	27.06
316	Manufacture of electrical equipment n.e.c.	27.01
312	Manufacture of electricity distribution and control apparatus	25.92
313	Manufacture of insulated wire and cable	25.19
154	Manufacture of vegetable and animal oils and fats	24.36
192	Manufacture of luggage, handbags and the like, saddlery and harness	22.39

Notes: Change in import volumes per capita from the East in (constant) thousand Euros (1996-2008).

Table A.2.2
Descriptive Statistics: Plant-Level Control Variables

	N	mean	sd	min	max
1996-1999					
CBA-status (1/0)	797	0.587	0.493	0	1
Work council (1/0)	797	0.146	0.353	0	1
Young plant (1/0)	797	0.087	0.283	0	1
Single plant (1/0)	797	0.918	0.275	0	1
Private plant (1/0)	797	0.562	0.496	0	1
Exporter (1/0)	797	0.203	0.403	0	1
Technology above average(1/0)	797	0.172	0.377	0	1
Share of low-skilled workers	797	0.255	0.287	0	1
Share of fixed-term workers	797	0.009	0.040	0	0.850
1999-2002					
CBA-status (1/0)	1010	0.437	0.496	0	1
Work council (1/0)	1010	0.127	0.333	0	1
Young plant (1/0)	1010	0.052	0.222	0	1
Single plant (1/0)	1010	0.922	0.268	0	1
Private plant (1/0)	1010	0.554	0.497	0	1
Exporter (1/0)	1010	0.263	0.441	0	1
Technology above average(1/0)	1010	0.218	0.413	0	1
Share of low-skilled workers	1010	0.300	0.285	0	1
Share of fixed-term workers	1010	0.017	0.051	0	0.85
2002-2005					
CBA-status (1/0)	1763	0.438	0.496	0	1
Work council (1/0)	1763	0.107	0.309	0	1
Young plant (1/0)	1763	0.075	0.263	0	1
Single plant (1/0)	1763	0.915	0.279	0	1
Private plant (1/0)	1763	0.533	0.499	0	1
Exporter (1/0)	1763	0.211	0.408	0	1
Technology above average(1/0)	1763	0.127	0.333	0	1
Share of low-skilled workers	1763	0.307	0.320	0	1
Share of fixed-term workers	1763	0.015	0.052	0	0.928
2005-2008					
CBA-status (1/0)	1772	0.388	0.487	0	1
Work council (1/0)	1772	0.099	0.299	0	1
Young plant (1/0)	1772	0.043	0.203	0	1
Single plant (1/0)	1772	0.914	0.281	0	1
Private plant (1/0)	1772	0.513	0.500	0	1
Exporter (1/0)	1772	0.230	0.421	0	1
Technology above average(1/0)	1772	0.122	0.327	0	1
Share of low-skilled workers	1772	0.363	0.330	0	1
Share of fixed-term workers	1772	0.018	0.066	0	1
Overall number of observations	5342				
Overall number of establishments	3131				

Notes: Data stems from the IAB Establishment Panel. Descriptives refer to start of each period.

TABLE A.2.3
Robustness Analysis: Plant Productivity

Dependent variable: Change in sector-level collective bargaining status at the plant level
ΔCB_{it} takes the value -1 for plants leaving collective agreements

	Single-unit plants only			Initially covered plants only		
	Plant-size			Plant-size		
	small	medium	large	small	medium	large
	(1)	(2)	(3)	(4)	(5)	(6)
Import exposure	-0.0035*	-0.0047	-0.0025	-0.0088*	-0.0058	-0.0024
	(0.0018)	(0.0028)	(0.0020)	(0.0052)	(0.0042)	(0.0017)
Export exposure	-0.0038	-0.0066	0.0135	-0.0022	-0.0009	0.0081
	(0.0043)	(0.0044)	(0.0095)	(0.0126)	(0.0056)	(0.0062)
Establishment controls	YES	YES	YES	YES	YES	YES
Estimation Method	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
N	2299	937	663	770	638	1161
R2	0.21	0.18	0.16	0.13	0.14	0.09
First Stage F-test						
imports	8.26	15.34	146.12	23.19	9.61	99.95
exports	8.38	10.88	8.43	10.75	5.38	7.30

Notes: All regressions include a constant, a full set of start-of-period establishment-level control variables as in Table 2.3 and a complete set of time, region and 2-digit-industry dummies as well as indicators for 10 plant-size groups. First stage regressions include the same set of control variables as the corresponding second stage. Levels of significance: *p<0.10, **p<0.05, ***p<0.01. Standard errors (clustered at the 3-digit industry level) are given in parentheses.

Chapter 3

Employment Stability at Trading Firms

3.1 Introduction

Firms differ with respect to their international activity. The majority of firms is still purely domestic, implying that they neither export nor import, whereas a significant and increasing number of firms engages in international trade.[1] It is well known that internationally active firms are important employers, since they are on average larger than purely domestic firms and are generally found to pay higher wages (Bernard et al. (2007) and Bernard et al. (2009)). Moreover, such globally connected firms are likely to differ from purely domestic firms also with respect to the magnitude and volatility of shocks that they face as well as the way they react to them. As a result, workers who are employed at trading firms might experience not only higher wages but also different levels of employment stability compared to workers employed at non-trading firms.

In this chapter, I study the link between international trade activity at the establishment-level and individual employment stability. To this end, I conduct a duration analysis and focus on job durations that end in unemployment. This is motivated by two main reasons: The first is that separations into unemployment are most likely reflecting involuntary job dismissals from the point of view of the worker, implying that the decision can fully be attributed to the firm.[2] The second reason refers to welfare consequences. It is plausible to assume that separations into unemployment induce higher welfare losses than other forms of job separations (e.g. job-to-job transitions): they do not only affect workers' future wage profiles (Arulampalam (2001)) and risks of repeated unemployment spells (Gregg (2001), Nilsen and Reiso (2011)), but also induce search costs and welfare losses due to idle production factors. It is therefore of particular interest to understand how the trade activity of a firm relates to separations into unemployment. In the following, I will refer

[1] According to the IAB Establishment Panel, the fraction of establishments in the German manufacturing sector that served foreign markets through exports amounted to 22 percent in 2003 and increased to 27 percent in 2010. In 2003 about 31 percent of establishments in manufacturing reported to import raw materials or intermediate inputs from abroad, while 63 percent of plants reported neither to import nor to export. There is no information on establishments' imports for more recent years in the IAB Establishment Panel.

[2] Unfortunately, the data does not contain any explicit information on voluntary versus involuntary separations. Considering separations into unemployment as involuntary dismissals (and separations to employment as predominantly voluntary quits) is therefore only an approximation, which is however in line with empirical evidence from other data sets (e.g. Burda and Mertens (2001)). Hirsch (2016) also uses this approximation.

to this as an analysis of *employment stability*. To the extent that the global engagement of a firm affects individual employment stability, this is one channel through which international trade impacts individual income (risks). This chapter therefore complements the literature that focusses on wage differentials between trading and non-trading firms (e.g. Schank et al. (2007), Baumgarten (2013)). To the best of my knowledge, there is no previous analysis that provides individual-level evidence on employment stability with respect to the global engagement of firms. I want to close this gap.

From a theoretical point of view, a firms' engagement in international trade can affect employment stability through different channels.[3] On the one hand, exporting firms are likely to face a larger volatility of shocks relative to non-exporting firms, given that the occurence of shocks can be substantially higher and more volatile in destination countries than in the home market.[4] Moreover, export activity could inherently be a more volatile engagement than sales to the domestic market, e.g. due to exchange rate risks, shocks to transportation costs or general foreign demand uncertainty.[5] In these cases, workers employed at exporting firms would face a higher probability of job separations than employees at non-exporting firms. On the other hand, a firm can diversify its risks by selling to different markets and smooth its production as long as shocks are not perfectly correlated. Accordingly, exporting firms can also be expected to offer more stable job relationships than non-exporting plants.[6]

With respect to the import activity of a firm, the effects on employment stability are similarly ambiguous. On the one hand, it might be easier for firms that source their inputs from different destinations to substitute between alternative providers and smooth their production as a reaction to productivity shocks (Bergin et al. (2011)). As a result, importing firms would offer more stable employment relationships. On the contrary, employment stability can be lower at importing firms as soon as the production process

[3]The subsequent line of argument closely follows Kurz and Senses (2016) who investigate the relationship between international trade activity of a firm and its overall employment volatility using U.S. data.

[4]This depends on both, the destination countries and the home country. For Germany, which is the focus of my analysis, it is likely to hold. China or Russia, which are important export markets for Germany, face considerably higher levels of political and economic shocks than Germany.

[5]See Amiti et al. (2014) for a recent contribution dealing with exchange rate risks at the firm-level.

[6]See Vannoorenberghe (2012) for a theoretical modelling of these channels at the firm-level. He investigates the relationship between exporting and sales volatility.

is sufficiently fragmented and dependend on specific inputs that are particularly prone to shocks. A further argument relates to differences in labor demand elasticities at importing and non-importing firms. Senses (2010) shows, that firms engaging in offshoring display higher labor demand elasticities than purely domestic firms. This can be traced back to a higher substitution between foreign inputs and domestic labor as a reaction to wage increases at offshoring firms. One would therefore expect a lower employment stability at importing firms. Hence, the theoretical link between the global engagement of firms and individual employment stability is ambiguous – it is therefore an empirical question.

To employ the duration analysis, I use detailed linked employer-employee data on the (West-)German manufacturing sector. The case of (West-)Germany is particularly interesting for different reasons. Firstly, it is one of the largest economies in the European Union and characterized by a regulated labor market as well as relatively rigid wages. This is important in order to expect that trade activity affects employment stability more than individual wages. Secondly, globally connected firms are important employers in Germany. According to the IAB Establishment Panel for the year 2010, 76 percent of all workers in the manufacturing sector were employed at exporting establishments.

I start to analyze the general effects of a plants' import and export activity on individual employment stability. As a first extension, I distinguish between different export destinations, namely exports to the Eurozone and to the rest of the world. To the extent that macroeconomic shocks tend to be more strongly correlated between Germany and the Eurozone than between Germany and the rest of the world, employment stability could be relatively lower at plants exporting to the Eurozone than at those establishments that export to the rest of the world. On the other hand, export activity to the Eurozone does not face any exchange rate risks, shocks to transportation costs are less important and export markets are likely to be geographically as well as culturally closer. This can lead to less volatility and thus to higher employment stability at exporters to the Eurozone than at plants that export to the rest of the world. Although my data does not allow to truly separate all these channels, the differential analysis of exporting is a way to obtain indirect evidence on the effects outlined above. I complete my analysis by

briefly examining how job-to-job transitions are affected by international trade activity of the employer. I consider job-to-job transitions as predominantly voluntary quits and it therefore complements my main analysis where I focus on dismissals. How trade is expected to influence job-to-job separations is discussed in the result section.

My main findings can be summarized as follows: Conditional on a rich set of individual- and establishment-level controls, exporting establishments provide a *stability premium*, meaning that involuntary job separations are less likely. In terms of magnitude, the estimations imply that transitions into unemployment are on average about 30 to 40 percent less likely for employees at exporting plants, thus beeing in line with the idea that exporting helps to diversify risks across countries. Moreover, I find export destinations to matter for employment stability. The results reveal that the *stability premium* can be traced back to export activity to the Eurozone. Sales to the rest of the world are found to lead to lower employment stability, implying that exporting to more remote markets is indeed related to more volatility and higher employment risks. Once I control for unobserved establishment heterogeneity, I find a (weakly) positive relationship between transitions into unemployment and export intensity, which, however, is only driven by few establishments that realize more than half of their sales in foreign markets. This effect can again be traced back to exports to the rest of the world. Consistent with previous findings, my results therefore suggest a non-monotonic relationship between exporting and employment stability, according to which low and medium levels of export activity are found to lead to less involuntary separations. If an establishment realizes the majority of its sales from exporting, transitions into unemployment are more likely. Throughout the analysis, employment at importing establishments appears to be more risky, being related to a probability of separations into unemployment which is up to 70 percent higher compared to non-importing plants. This corroborates the idea that importing plants have a higher labor demand elasticity which points to an increased substitutability of in-house production with foreign inputs as a reaction to domestic shocks.

The chapter relates to a recent strand of literature that analyzes the relationship between trade status and volatility at the firm-level. Vannoorenberghe (2012) documents

that the share of exports in total sales of a firm has a positive but non-monotonic impact on sales volatility. Using French data he estimates that an export share of less (more) than 10 percent implies a lower (higher) output volatility. Kurz and Senses (2016) find similar non-linear effects for employment volatility in the U.S.. Consistent with my evidence, they report that exporting to remote regions is related to higher levels of employment volatility than exporting to regions close-by. They furthermore find more volatile employment growth at importing firms. For Germany, Buch et al. (2009) study the link between trade and output volatility at the firm-level. According to their results, sales growth volatility is lower at exporting than at non-exporting firms. In a similar vein, Baumgarten (2015) analyzes the relationship between aggregate worker flows and international trade involvement of German establishments and reports (weak) evidence for lower separation rates at exporting firms.[7] Bachmann et al. (2014) look at the impact of foreign direct investment (FDI) at the sector-level on individual employment security in Germany.[8] They find that both inward as well as outward FDI significantly reduces employment security. Finally, this chapter also builds on two recent contributions that investigate the role of firm-level characteristics for individual job durations in Germany (see Boockmann and Steffes (2010) and Hirsch (2016)).[9]

The remainder of the chapter is structured as follows. Section 3.2 describes the data and the sample definition. Section 3.3 introduces the empirical strategy, while Section 3.4 discusses the results. I briefly conclude in Section 3.5.

3.2 Data

Data Source The data used for this analysis is the German linked employer-employee data set, LIAB, which is provided by the Institute for Employment Research (IAB). It combines administrative data on employees from social security records with employer

[7] His findings lose statistical significance once he controls for unobserved establishment-level heterogeneity.
[8] They define employment security as the probability of remaining employed either in the same or another job.
[9] Boockmann and Steffes (2010) document that the existence of work councils and the opportunity for further training on the job are important determinants for (longer) job durations. Hirsch (2016) investigates how the use of temporary agency workers at the establishment-level influences job durations of non-temporary agency workers and finds a positive relationship.

information from a representative annual survey of German establishments, the IAB Establishment Panel. The longitudinal version of the LIAB[10] comprises yearly plant-level information from the IAB Establishment Panel covering the years 2000 to 2008. Moreover, it contains information on all workers that were employed for at least one day at the surveyed establishments between 1999 and 2009. For those workers, information on their entire employment biography, covering daily employment and benefit recipient information over the period from 1993 to 2010, is provided.

The employee part of the LIAB stems from the Employment Statistic Register and are administrative social security records. They are based on mandatory notifications made by employers to the social security system at the beginning and the end of each employment spell. Moreover, employers update the information at the end of each calendar year. The overall reliability of the data is therefore very high. The Register is further combined with data on periods of unemployment benefit receipts. Spells of unemployment are only recorded if an unemployment benefit is paid or if there is participation in active labor market programs. The entire employee information, however, only encompasses workers covered by social security, which amount to roughly 80 percent of all employees in Germany. Self-employed or civil servants are therefore not contained in the data. Further information given in the Employment Statistics Register that is relevant for my analysis are demographic characteristics such as year of birth, gender, education, nationality as well as the industry and the region of the workplace. Moreover, since the data covers entire employment biographies, previous and past employment states can be constructed.[11]

The employer side of the data comes from the IAB Establishment Panel, a random sample of establishments that employ at least one worker covered by the social security system.[12] It started in 1993 and is currently available up to the year 2014. For the longitudinal version of the LIAB, information covering the years from 2000 to 2008 is provided. The establishment survey covers many different topics. For this analysis, information on

[10] I use LIAB version LM 9310. Note that this version differs in its construction from the cross-sectional LIAB which is referred to in Chapter 1. Whereas plant-level information is only available for the years from 2000 to 2008, worker-level information is much richer. See Klosterhuber et al. (2013) for details.

[11] The explicit definitions of employment states are discussed in the next section.

[12] For details, see Ellguth et al. (2014).

the international trade activity of a plant is of major interest. With respect to export activity, the share of exports in total sales is surveyed every year. The data also contains information on the region of export destination, differentiating between sales to the Eurozone and to the rest of the world. Information on import activity is less explicit and allows only a qualitative judgment whether the establishment is engaged in importing or not. Moreover, it is only asked in two of all available years in the data, in 2001 and 2003. Further plant-level characteristics that I employ in my analysis relate to average establishment size, establishment age, information on whether the establishment is part of a larger group of plants, its collective bargaining status (the presence of a work council, collective agreement at the firm- or at the sector-level), information on the technological status, availability of training and workforce composition measures.

Sample Definition and Descriptive Statistics In the following, I define a job spell as the period from the beginning until the end of an employment relationship within a particular establishment.[13] A job spell ends if one out of two conditions applies. First, if the worker is observed to move into unemployment, non-employment or is hired by a new employer. Second, if the current employer reports the end of the relationship to the insurance system. The job spell is generally right censored if none of these conditions applies or if the end of the observation period is reached. Since my main focus is on job spells that end in transitions into unemployment, I consider this as my "failure" event.[14] I define the following different employment states before and after each job spell: unemployment, non-employment and employment. Furthermore, I use a separate category for workers who are likely to be in their first job. Table 3.1 displays the exact definitions of the single employment states.

For my analysis at hand I need uninterrupted information on all variables of interest. Since I have only very incomplete information on why establishments might exit from the survey, I have to choose a balanced panel approach. As a first step I therefore construct a panel of plants with continuous participation in the survey and complete information

[13]Building upon Boockmann and Steffes (2010) and in order to avoid many short employment spells (e.g. due to seasonal factors), I define two consecutive job spells with the same employer as only one employment spell if reemployment takes place within 90 days.

[14]I adjust this accordingly when considering job-to-job transitions.

Table 3.1
Definitions of Previous and Past Employment States

Employment State	Definition
Exit States	
Unemployment	Worker receives unemployment benefits for at least one day within 60 days after separation and is not employed with the current employer for at least 90 days after separation.
Non-employment	Worker is not employed with the current employer for the next 90 days after separation, receives no unemployment benefits and does not change from job-to-job for at least 60 days after separation and has recorded an end of the employment spell.
Employment	Worker takes up employment with another employer within 60 days after separation and has recorded an end of the employment relationship.
Previous Employment States	
Unemployment	Worker received unemployment benefits for at least one day during 60 days before hiring and was not employed with current employer for at least 90 days before hiring.
Non-employment	Worker was not employed with current employer for at least 90 days before hiring, received no unemployment benefits for at least 60 days before hiring, did not change from job-to-job at least 60 days before hiring and was observed in the data before hiring.
Employment	Worker was employed a maximum of 60 days before employment.
First employment	Worker was not observed before and not older than 30 years at the first observed spell.

Notes: Definitions are based on Boockmann and Steffes (2010).

on all relevant variables.[15] I choose the period from 2000 to 2005 for my analysis.[16] The balanced panel approach implies that my analysis only focusses on surviving plants and necessarily abstracts from effects related to establisment closures. This has to be kept in mind when interpreting the results.

[15] With respect to the import variable, which is available only in two of the six years, I construct a time-invariant indicator variable which equals one if a plant is observed to import either in 2001 or in 2003 and which equals zero if the plant is not observed to import in neither of these years.

[16] Using a balanced approach from 2000 to 2005 and taking all restrictions into account, results in a sample of 324 establishments each year. Considering a balanced panel of the entire period from 2000 to 2008 further reduces sample size and complicates identification.

In order to avoid problems related to left-censoring, I further restrict my analysis to job spells starting between 2000 and 2005 at the sample establishments (*flow-sampling approach*).[17] Furthermore, I analyze employment durations of male workers only, since employment histories of women are often determined by interruptions due to maternity leave and the data does not allow me to explicitly control for it. I further restrict data to persons in the age of 20 to 60 years and I exclude all spells that do not reflect fulltime employment. Due to my focus on the impact of international trade on job stability, I restrict my attention to the manufacturing sector. Finally, I only consider the western part of Germany, since there are still striking differences between eastern and western Germany, that should not confound my main analysis (see Boockmann and Steffes (2010) for differences in job stability between East- and West-Germany). Taking these restrictions into account, I end up with a sample of 45,888 jobs, held by 43,166 workers at 324 establishments. Out of all jobs in my sample 34 percent end during the time of observation (this implies a fraction of censored spells of 66 percent), where the majority of them (14 percent) are transitions into unemployment, 11 percent are job-to-job changes and 9 percent of all observed separations end in non-employment. Table 3.2 summarizes this information. Descriptive statistics of all relevant variables at the plant- and at the job-level are provided in Tables A.3.1 to A.3.4 in the Appendix.

TABLE 3.2
Jobs and Separations

Jobs	45,888	
Workers	43,166	
Plants	324	
Separations to unemployment (in %)	6,424	(14)
Separations to non-employment (in %)	4,130	(9)
Separations to employment (in %)	5,048	(11)
Right censored job spells (in %)	30,286	(66)

Notes: Percentages in parentheses. Numbers refer to a sample of male fulltime workers in West-German manufacturing sector. Sample is based on longitudinal version of LIAB LM 9310. For details on sample restrictions see text.

[17] For details on flow-sampling and the alternative approach of stock-sampling, see Wooldridge (2010), p. 992ff.

3.3 Empirical Approach

To investigate the impact of international trade activity of a plant on individual employment stability, I fit different duration models and include measures of import and export activity of the establishment as explanatory variables. The dependent variable in the following is therefore the conditional hazard rate λ_{ijt} of individual i employed at plant j, which is defined as the probability to exit from the current job in time interval $[t, t+1)$ conditional upon survival up to t:

$$\lambda_{ijt}(X_{ijt}, \lambda_{0t}) = Pr(t \leq T < t+1 | T \geq t, X_{ijt}, \lambda_{0t}), \tag{3.1}$$

where t indicates time, T is the actual job duration, X_{ijt} is a vector of individual and plant characteristics and λ_{0t} is the baseline hazard. In particular, I specify a simple Cox model (see Cox (1972)) which assumes that the baseline hazard λ_{0t} is shifted proportionately by the covariates (see Kalbfleisch and Prentice (2002), p.95ff. and Cleves et al. (2002), p.129ff.):

$$\lambda_{ijt}(X_{ijt}, \lambda_{0t}) = \lambda_0 exp(X'_{ijt}\theta). \tag{3.2}$$

Throughout my analysis, I use a wide range of person- and plant-specific covariates that are likely to determine job duration.[18] There may remain, however, unobserved heterogeneity at the establishment- or the employee-level, that is correlated with trade activity and also influences job stability. I account for establishment-level heterogeneity by stratifying the sample in some specifications and fitting stratified Cox models (see Ridder and Tunali (1999)). This implies that I assume separate baseline hazards for each establishment:

$$\lambda_{ijt}(X_{ijt}, \lambda_{0jt}) = \lambda_{0j} exp(X'_{ijt}\theta), \tag{3.3}$$

[18] At the individual-level, these determinants are a workers' age, education, nationality and previous employment status, whereas at the establishment-level they cover average establishment size, establishment age, information whether the establishment is part of a larger group of plants, its collective bargaining status (presence of a work council, collective agreement at firm- or sector-level), information on the technological status, availability of training and workforce composition measures. I further include industry, region and time indicators.

where λ_{0j} denotes a baseline hazard specific to establishment j. This estimator restricts identification to within-variation at the establishment-level and is therefore similar to the within-group estimator in linear regressions. It allows me to control for unobserved time-invariant employer characteristics. Unfortunately, it is not feasible to include separate baseline hazards at the individual-level, since it would require multiple spells per worker in the sample establishments. I only observe 2,722 individuals having more than one job in the sample, which amounts to 6 percent of all observations and would render identification difficult.[19] I try to address the problem of unobserved worker heterogeneity in a robustness exercise.

3.4 Results

I start to estimate the model described in Section 3.3 for transitions from employment into unemployment, including different measures of global engagement at the establishment-level. In a first extension to this baseline approach, I analyze whether the destination of export activity matters for job transitions. In each case, I discuss the results of a simple Cox model as well as those of the respective stratified specification and point to the source of identification. In a final part of the chapter, I briefly analyze how the international trade behaviour of plants affects job-to-job changes.

3.4.1 Baseline Results

Table 3.3 presents results of the baseline specification. It shows hazard ratios as well as p-values of the main variables of interest and the included control variables.[20] The first column displays the results of the Cox model for the most parsimonious specification, where I include all variables at the individual level, however only export and import

[19] Although I observe 11 percent of jobs ending in job-to-job transitions, almost half of these switches occur to establishments outside the Establishment Panel. For those workers I do not observe any establishment-level information after the switch.

[20] Hazard ratios can be derived by exponentiating the coefficients. They indicate the ratio of the hazard for a one-unit change in the corresponding covariate. A hazard ratio of 0.9 means that the hazard rate decreases by 10 percent if the covariate changes by one unit. See Cleves et al. (2002).

indicators at the establishment-level.[21] This first specification is motivated by the new-new trade literature that focusses on firm heterogeneity and was pioneered by Melitz (2003). According to the theoretical framework provided by the heterogeneous firms literature, the export status of a firm is related to one sufficient statistic, which is firm productivity. This, in turn, also determines firm size. Hence, in a structural regression, there would be no room for the inclusion of both firm size and the export status among the regressors.[22] The displayed results of this specification have the expected signs and magnitudes: transitions into unemployment are less likely, the higher the educational attainment of a worker. In particular, workers with a university or technical college degree (high skilled) face a hazard rate which is about 80 percent lower than employees with no vocational training and no high-school certificate (low skilled, reference group). The relationship between age and the hazard rate is U-shaped, with young (20 to 30 years, reference group) and old (50 to 60 years) workers being more at risk of getting unemployed than middle-aged workers. Employees with foreign nationality also face a higher risk of becoming unemployed than comparable workers with German nationality. With respect to the previous labor market status of a worker, only a previous unemployment spell has a significant impact on the future transition into unemployment. This effect, however, is very large: workers who have previously been unemployed have a hazard rate which is about three times as large as job-to-job switchers. Turning to the results related to trade activity at the plant-level, employment at exporting establishments is associated with a significantly lower hazard rate into unemployment (about 40 percent). At the same time, the import activity of a plant is related to higher unemployment risk (about 37 percent). According to this first evidence, exporting establishments seem to provide some form of *stability premium* – thus beeing in line with the argument of shock diversification through exporting – while the opposite holds for importing plants. The latter finding seems to corroborate the idea that importing firms adjust their domestic employment more easily (more frequently), since they can substitute foreign for domestic labor.

[21] In all specifications I control for time, region and two-digit industry dummies.

[22] The literature on the exporter wage premium discusses this relation extensively, see e.g. Baumgarten (2013).

TABLE 3.3
Baseline Results

Dependent variable: Hazard rate of transitions into unemployment						
	(1) Cox model		(2) Cox model		(3) Stratified Cox	
Individual-level variables:						
Non-German	1.143**	[0.024]	1.173***	[0.004]	1.154***	[0.007]
Age 31-40	0.746***	[0.000]	0.726***	[0.000]	0.712***	[0.000]
Age 41-50	0.804***	[0.007]	0.776***	[0.001]	0.758***	[0.000]
Age 51-65	1.414***	[0.001]	1.349***	[0.007]	1.328**	[0.013]
Education Medium	0.665***	[0.000]	0.699***	[0.000]	0.650***	[0.000]
Education High	0.224***	[0.000]	0.248***	[0.000]	0.227***	[0.000]
Non employment	0.917	[0.306]	0.968	[0.701]	0.904	[0.224]
Unemployment	3.033***	[0.000]	2.865***	[0.000]	2.399***	[0.000]
First employment	1.072	[0.612]	1.131	[0.393]	1.017	[0.906]
Plant-level variables:						
Exporter	0.605***	[0.000]	0.727***	[0.008]	1.091	[0.571]
Importer	1.371*	[0.100]	1.694***	[0.002]		
Sector-level CBA[1]			1.059	[0.779]	1.334	[0.181]
Firm-level CBA[1]			1.128	[0.621]	1.416	[0.131]
Work council			1.234	[0.372]	0.887	[0.629]
Single-unit plant			1.037	[0.733]	0.954	[0.739]
Young plant (<6 years)			1.052	[0.894]	1.674	[0.413]
High technological status			0.835*	[0.091]	0.949	[0.789]
On-the-job training			0.924	[0.713]		
Share of TAWs[2]: > 0 and $< 25\%$			0.864	[0.162]		
Share of TAWs[2]: $> 25\%$			0.596	[0.140]		
Plant size: 11-20 workers			1.800*	[0.090]		
Plant size: 21-50 workers			0.901	[0.749]		
Plant size: 51-100 workers			1.142	[0.627]		
Plant size: 101-200 workers			0.781	[0.456]		
Plant size: 201-500 workers			0.819	[0.551]		
Plant size: 501-1000 workers			0.731	[0.384]		
Plant size: >1000 workers			0.400**	[0.012]		
N	167911		167911		167911	

Notes: Reported numbers are hazard ratios and p-values in parentheses. ***/**/* denotes statistical significance at the 1/5/10 percent level. Standard errors are clustered at the establishment-level. Stratified Cox models allow for plant-specific baseline hazards. All specifications include time, region and 2-digit industry indicators. [1] CBA: collective bargaining agreements; [2] TAW: temporary agency workers; Reference groups are: German, Age 20-30, Education Low, Job-to-job change, non-exporter, non-importer, no CBA, no work council, multi-unit plant, plant age > 6 years, low technological status, no on-the-job training, no TAWs, plant size: 1-10 workers.

The results so far can still be confounded by other establishment characteristics that are correlated with trade activity and employment stability at the same time, thus leading to spurious results. In the next specification, I therefore add a rich set of plant-level characteristics and now explicitly control for average establishment size[23], a plant's collective bargaining regime, an indicator for its technological status, information on on-the-job training as well as on the share of temporary agency workers (TAW) used at the plant.[24] The results are shown in Column (2). The effect related to the export activity of a plant slightly decreases compared to the previous specification, still indicating, however, a hazard rate which is about 30 percent lower than at non-exporting plants.[25] The estimated effect for the import variable even increases, now suggesting a risk of becoming unemployed that is almost 70 percent higher than at non-importing plants. With respect to other plant-level variables, only a high technological status of a plant and plant size are significantly (negatively) related to transitions into unemployment.[26] Thus, even after accounting for a large set of control variables, trade activity still seems to matter for employment stability, indicating that employees at exporting establishments face lower risks of becoming unemployed than workers at non-exporting plants. On the contrary, employment at importing establishments is associated with lower employment stability.

Coming closer to a causal interpretation of these effects, I turn to the results of the stratified Cox model, which are presented in Column (3) of Table 3.3. As identification in the stratified model relies on within-plant variation, it is not possible to identify any import effect, since the information on import activity is time-invariant due to construction and data availability reasons. With respect to the export variable, identification relies on plants that switch in and out of exporting.[27] Once I take unobserved establishment-level

[23] I take the average over all six years from 2000 to 2005.

[24] The inclusion of the share of TAWs is motivated by a recent paper (Hirsch (2016)) which reports a positive relationship between the share of TAWs employed at a firm and job stability of its non-TAWs. Accordingly, one could expect that trading firms employ a higher share of temporary agency workers and therefore show a higher employment stability.

[25] Note that the effect decreases since the hazard ratio becomes closer to one.

[26] I further find that the use of TAWs at the establishment-level seems to be associated with a higher employment stability for non TAW workers. It is however not found to be statistically significant at conventional levels.

[27] I observe 68 out of 324 establishments (about 20 percent) that change export status over my sample period. 42 plants change their status several times and switch in as well as out of exporting. 13 (13) establishments only switch into (exit from) exporting. In terms of employment, 17 percent of jobs are

heterogenity into account, the exporter effect is no longer found to be statistically significant. The displayed hazard ratio is close to one, suggesting no difference in job stability between an exporting and a non-exporting plant.

At this point, one has to keep in mind however, that the impact of plant-level export activity at the extensive margin might be very different to its effect at the intensive margin, e.g. due to general adjustment processes after entry into or exit from foreign markets.[28] In a next specification, I therefore use the share of exports in total sales as a continuous measure to capture the effect of export activity on employment stability. This allows me to explicitly account for potential differences at the extensive and the intensive margin: In Table 3.4, I first show the results of the (full) Cox model and the stratified Cox model for the entire sample and then for the sample excluding all establishments that switch in and out of exporting. Considering first the results of the Cox model on the entire sample (Column (1)), the impact of the export share on involuntary job separations is not found to be statistically significant. Implementing the stratified approach however reveals (Column (2)), that a higher export intensity seems to lead to lower employment stability, although this effect is found to be only marginally significant (at the 10 percent level). In terms of magnitude the results imply that an increase in the export share of ten percentage points increases the hazard rate of separation by about 12 percent. Shutting down the extensive margin by excluding all (export-)switching plants yields very similar findings (Columns (3) to (4)). Overall this suggests that the extensive margin does not drive the results. In the following, I therefore continue to look at the entire sample.

Digging deeper into the effect of export intensity on employment stability reveals a non-monotonic relationship, which is consistent with previous findings in the literature. In particular, Vannoorenberghe (2012) and Kurz and Senses (2016) both report a non-linear relationship between export intensity and sales as well as employment growth volatility, according to which low (high) levels of export shares are related to less (more) volatility at the firm-level. In order to investigate if such a non-linearity is also present in my data, I

at switching plants.

[28] Kurz and Senses (2016) and Nguyen and Schaur (2012) report evidence that the effects of trade on employment and sales volatility differ between the intensive and the extensive margin.

Table 3.4
Accounting for Export Intensity

Dependent variable: Hazard rate of transitions into unemployment

	Entire Sample				Excluding switching plants			
	(1) Cox model		(2) Stratified Cox		(3) Cox model		(4) Stratified Cox	
Export share	1.002	[0.386]	1.012*	[0.054]	1.004*	[0.066]	1.016*	[0.100]
Importer	1.688***	[0.003]			1.361*	[0.098]		
	(5) Cox model		(6) Stratified Cox					
Export intensity								
Export share <33%	0.646***	[0.000]	1.045	[0.772]				
Export share >33% and <66%	0.864	[0.342]	1.293	[0.229]				
Export share >66%	0.846	[0.257]	1.642**	[0.045]				
Importer	1.782***	[0.001]						

Notes: Reported numbers are hazard ratios and p-values in parentheses. ***/**/* denotes statistical significance at the 1/5/10 percent level. Standard errors are clustered at the establishment-level. Stratified Cox models allow for plant-specific baseline hazards. All specifications include the full set of control variables as in Table 3.3, Columns (2) and (3) (unless otherwise indicated). Columns (2) and (3) of this Table exclude all jobs at plants that switch in and out of exporting. All specifications include time, region and 2-digit industry indicators.

differentiate between four categories of export intensity (Columns (5) and (6) of Table 3.4) and rerun the analysis. It can be seen that the results of the simple Cox model show higher employment stability at plants with a low export share (share of exports in total sales of less than 33 percent). For the stratified estimation, the results reveal that plants realizing the large majority of sales on foreign markets (those plants with an export share of more than 66 percent) show a higher risk of involuntary job displacements than non-exporting plants. I therefore conclude that the weakly positive relationship between export share and employment stability which is reported in Column (2) of Table 3.4 can be traced back to establishments that realize a large majority of their sales on foreign markets.[29] In terms of overall economic relevance one has to bear in mind that the share of jobs at plants with an export share of over 66 percent amounts only to roughly 14 percent (see Table A.3.3 in the Appendix). Next, I analyze whether the export destination matters for job separations.

[29]This finding is not driven by small establishments that mechanically obtain high export shares even through small changes in absolute export volumes. As a robustness exercise, I split the sample in two groups, one with establishments of less than 100 employees and one with plants of more than 100 workers. I only find an effect for the group of large establishments. The results are shown in Table A.3.5 in the Appendix.

3.4.2 The Impact of Export Destination

The impact of export activity on employment stability might differ according to export destination. On the one hand, it is likely that sales to the Eurozone are less volatile and therefore linked to lower risks of involuntary job displacements than exports to the rest of the world. One reason for this is that exporting to the Eurozone is not related to any exchange rate risk. Furthermore, it is likely that shocks to transportation costs play only a minor role for sales to the Eurozone compared to exports to the rest of the world. And finally, since the Eurozone is geographically as well as culturally relatively close to Germany, estimations of foreign demand realizations are easier. On the other hand, the argument of shock diversification through exporting might be stronger for establishments engaged in trade with the rest of the world than for those trading with countries nearby, given that shocks are generally more strongly correlated within the Eurozone. In order to investigate this relationship, I perform an additional set of regressions, where I differentiate between exports to the Eurozone and exports to the rest of the world. Again I start employing indicator variables and then show the results using the share of exports to each separate destination as main explanatory variables. Results are given in Table 3.5. The hazard ratios of the Cox model in Column (1) show that exporting to the Eurozone is associated with a significantly higher employment stability, while the opposite is found for export activity to the rest of the world. Once I control for plant-specific baseline hazard functions, the relationship between export activity to either destination region and job stability cannot longer be statistically identified. Using again the share of exports to each region as explanatory variable supports the first finding and reveals that trading with the Eurozone is not considered as a risky engagement, while sales to the rest of the world are linked to an increased risk of involuntary job displacements. These results suggest that the *stability premium* found for exporting establishments can be traced back to exports to the Eurozone. It implies that sales to these markets provide some form of risk diversification. In contrast, sales to more remote markets are related to an increase in the risk of involuntary job displacements. I also perform an additional analysis where I group establishments according to their share of exports in total sales similar to the

exercise shown in Columns (5) and (6) of Table 3.4. The pattern I find suggests that plants that export more than 50 percent of their sales to the Eurozone display more stable job relationships, whereas those establishments with a high share of sales to the rest of the world show less stable job relations.[30] Since the hazard ratios are, however, not found to be statistically significant, I report the results only in the Appendix. See Table A.3.6.

Table 3.5
Accounting for Export Destination

Dependent variable: Hazard rate of transitions into unemployment								
	(1) Cox model		(2) Stratified Cox		(3) Cox model		(4) Stratified Cox	
Exporter to Eurozone	0.645***	[0.000]	1.037	[0.778]				
Exporter to Rest of World	1.328***	[0.003]	1.108	[0.400]				
Export share to Eurozone					1.000	[0.882]	1.006	[0.315]
Export share to Rest of World					1.002	[0.398]	1.013**	[0.033]
Importer	1.673***	[0.002]			1.695***	[0.003]		

Notes: Reported numbers are hazard ratios and p-values in parentheses. ***/**/* denotes statistical significance at the 1/5/10 percent level. Standard errors are clustered at the establishment-level. Stratified Cox models allow for plant-specific baseline hazards. All specifications include the full set of control variables as in Table 3.3, Columns (2) and (3) (unless otherwise indicated). All specifications include time, region and 2-digit industry indicators.

3.4.3 Robustness Analysis

One concern with the analysis so far could be related to unobserved worker heterogeneity. To the extent that exporting plants employ workers with higher unobserved ability than non-exporting plants and assuming that employees with higher ability face lower risks of involuntary job displacements, this channel could confound my results. Unfortunately, the data at hand does not allow to consider different baseline hazards at the individual-level, so an explicit control for unobserved worker heterogeneity is not feasible. One way, however, to approach this issue is to run an additional set of regressions where I exclude all observable skill information (education groups) from the analysis. Since it is plausible to assume that unobserved ability is (positively) correlated with the observed skill level, such an exercise provides indirect evidence for omitted variable biases. The results of the

[30] Different to the specification in 3.4.1, I only consider three instead of four categories, since I observe very few establishments with export shares of more than 66 percent if I also split along export destinations.

simple Cox model and a respective stratified specification are shown in Table A.3.7 in the Appendix. The displayed hazard ratios hardly differ from the baseline results. I take this as indirect evidence that unobserved worker ability is not likely to drive the results with respect to a plants' trade activity on employment stability.

3.4.4 Job-to-job Transitions

As argued before, analyzing the determinants of transitions into unemployment is particularly important, since they most likely reflect involuntary job separations and since periods of unemployment induce particularly large welfare losses at the individual-level as well as at the level of the whole economy. In the following, I conduct a brief analysis on how international trade activity of plants influences job-to-job transitions. I consider this kind of transitions as predominantly voluntary quits, which also implies that the expected effect from trade should differ. On the one hand, employees at exporters can be expected to show lower job-to-job transition rates since exporting firms are generally known to pay higher wages (Schank et al. (2007), Baumgarten (2013)), which could make voluntary quits less likely. On the other hand, being employed at an exporter can promote employment biographies, e.g. due to strong network-effects and human capital accumulation, thus being associated with higher job-to-job transition rates.[31]

Columns (1) and (2) of Table 3.6 show the results for job-to-job separations. Both specifications reveal that workers employed at exporting establishments face a significantly higher probability of job-to-job changes than workers employed at non-exporting plants. In terms of magnitude, being employed at an exporter increases the hazard rate of a transition by 32 to 43 percent. The import activity of a plant, however, seems unrelated to the hazard rate of job-to-job transitions. These findings suggest that employees at exporting establishments are more mobile and more likely to change their jobs. To the extent that job-to-job transitions truly reflect voluntary quits, this result suggests that exporting plants are good employment promoters. Investigating this pattern more thoroughly is a promising avenue for future research.

[31] From the import activity of a plant I would not expect any differential impact on job-to-job transitions.

Table 3.6
Job-to-Job Transitions

Dependent variable: Hazard rate of transitions to employment

	Baseline				Excluding observable skill information			
	(1) Cox model		(2) Stratified Cox		(3) Cox model		(4) Stratified Cox	
Exporter	1.323**	[0.040]	1.427**	[0.020]	1.348**	[0.032]	1.394**	[0.031]
Importer	1.087	[0.546]			1.100	[0.504]		

Notes: Reported numbers are hazard ratios and p-values in parentheses. ***/**/* denotes statistical significance at the 1/5/10 percent level. Standard errors are clustered at the establishment-level. Stratified Cox models allow for plant-specific baseline hazards. All specifications include the full set of control variables as in Table 3.3, Columns (2) and (3) (unless otherwise indicated). All specifications include time, region and 2-digit industry indicators.

3.5 Conclusion

In this chapter, I analyze how international trade activity of establishments affects individual employment stability. Using detailed linked employer-employee data for (West-) Germany allows me to follow individual workers over time and to account for a rich set of establishment-level characteristics.

The main focus of this analysis is on job transitions into unemployment - separations that I consider as involuntary dismissals. I argue that these kinds of separations are of major interest, since they truely reflect firm decisions and since they induce particularly large welfare losses. I consider different measures of import and export activity at the plant-level and investigate their respective impact on transitions into unemployment. I fit different kinds of duration models, i.e. simple Cox models and stratified Cox models, where the latter allows me to control for unobserved plant-level heterogeneity. Moreover, I distinguish between different export destinations, i.e. the Eurozone and the rest of the world. Finally, I examine how job-to-job transitions are influenced by a plant's international trade behaviour.

My main findings can be summarized as follows: Conditional on a rich set of individual- and establishment-level controls, exporting establishments provide a *stability premium*, meaning that involuntary job separations are less likely. In terms of magnitude the estimations imply that transitions into unemployment are on average about 30 to 40 percent

less likely for employees at exporting plants, thus being in line with the idea that exporting helps to diversify risks across countries. Moreover, I find export destinations to matter for employment stability. The results reveal that the *stability premium* can be traced back to export activity with the Eurozone. Sales to the rest of the world are found to lead to lower employment stability, implying that exporting to more remote markets is indeed related to more volatility and higher employment risks. Once I control for unobserved establishment heterogeneity, I find a (weakly) positive relationship between transitions into unemployment and export intensity, which, however, is only driven by few establishments with a very high export share in total sales of more than 66 percent and can again be traced back to exports to the rest of the world. Consistent with previous findings, my results therefore suggest a non-monotonic relationship between exporting and employment stability, according to which low and medium levels of export activity are found to lead to less involuntary separations. Nevertheless, if an establishment realizes the great majority of its sales from exporting, transitions into unemployment are more likely. Throughout the analysis, employment at importing establishments appears to be more risky, being related to a probability of separations into unemployment which is up to 70 percent larger compared to non-importing plants. This result is consistent with previous studies that find higher labor demand elasticities at importing plants and points to an increased substitutability of in-house production with foreign inputs as a reaction to domestic shocks. Finally, the analysis of job-to-job transitions reveals that employees at exporting plants face higher chances of changing their job.

Overall, the results suggest that exporters can be considered as favourable employers, since they are not only likely to pay higher wages but also offer some kind of insurance against unemployment. Furthermore, they are found to promote voluntary job-to-job transitions. A thorough analysis of the latter employment changes is an interesting avenue for future research.

A.3 Appendix

Table A.3.1
Descriptive Statistics at the Establishment-Level, I

	N	mean	sd	min	max
Trade activity:					
Importer (0/1)	1944	0.484	0.500	0	1
Exporter (0/1)	1944	0.339	0.473	0	1
Importer and Exporter (0/1)	1944	0.280	0.449	0	1
Export share	1944	9.547	19.893	0	100
Export intensity					
Export share in sales <33%	1944	0.221	0.415	0	1
Export share in sales >33% and <66%	1944	0.080	0.272	0	1
Export share in sales >66%	1944	0.037	0.189	0	1
Export destination					
Eurozone (0/1)	1944	0.299	0.458	0	1
Rest of World (0/1)	1944	0.218	0.413	0	1
Both Regions (0/1)	1944	0.186	0.389	0	1
Export share Eurozone	1944	5.319	11.330	0	100
Export share Rest of World	1944	3.733	11.322	0	95
Export intensity and destination					
Export intensity Eurozone					
below 50%	1944	0.290	0.454	0	1
above 50%	.	.	.	.	.
Export intensity Rest of World					
below 50%	1944	0.202	0.402	0	1
above 50%	1944	0.016	0.125	0	1
Export switcher (0/1)	1944	0.228	0.420	0	1

Notes: Table shows plant level descriptives over six year period from 2000 to 2005. Import information is only available in years 2001 and 2003. I therefore construct a time-invariant variable which indicates whether an establishment was ever engaged in importing or not. Information on the share of temporary agency workers is only available from 2002 onwards. I construct a time invariant measure and take the average over the years 2002-2005. I proceed similarly with information on on-the-job training. I build a time-invariant variable that indicates if an establishment has ever offered training or not. With respect to establishment size, I take average establishment size over the six year period. Probability weights are employed. "." indicates that respective numbers are not reported by the research data centre due to data sensitivity reasons.

TABLE A.3.2
Descriptive Statistics at the Establishment-Level, II

	N	mean	sd	min	max
Control variables:					
Work council (0/1)	1944	0.178	0.382	0	1
Collective agreement					
Sector-level (0/1)	1944	0.490	0.500	0	1
Firm-level (0/1)	1944	0.022	0.145	0	1
Young plant (0/1)	1944	0.032	0.177	0	1
Single plant (0/1)	1944	0.730	0.444	0	1
High technology (0/1)	1944	0.192	0.394	0	1
On-the-job training (0/1)	1944	0.501	0.500	0	1
Share of temporary agency workers	1944	0.009	0.034	0	0.87
Establishment size (average)					
1-10 workers	1944	0.388	0.488	0	1
11-20 workers	1944	0.238	0.426	0	1
21-50 workers	1944	0.166	0.372	0	1
51-100 workers	1944	0.117	0.322	0	1
101-200 workers	1944	0.049	0.212	0	1
201-500 workers	1944	0.029	0.169	0	1
501-1000 workers	.	.	.	.	.
>1000 workers	.	.	.	.	.

See notes of Table A.3.1.

TABLE A.3.3
Descriptive Statistics at the Job-Level, I

	N	mean	sd	min	max
Trade activity:					
Importer (0/1)	150996	0.780	0.414	0	1
Exporter (0/1)	150996	0.711	0.453	0	1
Importer and Exporter (0/1)	150996	0.748	0.478	0	1
Export share	150996	27.890	28.395	0	100
Export intensity					
Export share in sales <33%	150996	0.353	0.478	0	1
Export share in sales >33% and <66%	150996	0.214	0.410	0	1
Export share in sales >66%	150996	0.143	0.351	0	1
Export destination					
Eurozone (0/1)	150996	0.674	0.469	0	1
Rest of World (0/1)	150996	0.562	0.496	0	1
Both Regions (0/1)	150996	0.531	0.499	0	1
Export share Eurozone	150996	14.950	15.862	0	100
Export share Rest of World	150996	11.927	18.377	0	95
Export intensity and destination					
Export intensity Eurozone					
below 50%	150996	0.646	0.478	0	1
above 50%	150996	0.028	0.164	0	1
Export intensity Rest of World					
below 50%	150996	0.502	0.500	0	1
above 50%	150996	0.060	0.238	0	1
Export switcher (0/1)	150996	0.241	0.428	0	1

Notes: Table shows job level descriptives per year averaged over six year period from 2000 to 2005.

Table A.3.4
Descriptive Statistics at the Job-Level, II

	N	mean	sd	min	max
Control variables:					
Nationality					
Non-german (0/1)	150996	0.112	0.315	0	1
Age in years					
Age 20-30	150996	0.384	0.486	0	1
Age 31-40	150996	0.321	0.467	0	1
Age 41-50	150996	0.203	0.402	0	1
Age 51-60	150996	0.092	0.289	0	1
Education					
Low	150996	0.216	0.411	0	1
Medium	150996	0.685	0.465	0	1
High	150996	0.099	0.298	0	1
Previous employment state					
Employment					
Non-employment	150996	0.270	0.444	0	1
Unemployment	150996	0.197	0.398	0	1
First employment	150996	0.095	0.293	0	1
Work council (0/1)	150996	0.651	0.477	0	1.000
Collective agreement					
Sector-level (0/1)	150996	0.664	0.472	0	1
Firm-level (0/1)	150996	0.060	0.237	0	1
Young plant (0/1)	150996	0.037	0.189	0	1
Single plant (0/1)	150996	0.701	0.458	0	1
High technology (0/1)	150996	0.193	0.395	0	1
On the job training (0/1)	150996	0.837	0.369	0	1
Share of temporary agency workers	150996	0.023	0.057	0	0.868
Establishment size (average)					
1-10 workers	150996	0.060	0.237	0	1
11-20 workers	150996	0.064	0.245	0	1
21-50 workers	150996	0.141	0.348	0	1
51-100 workers	150996	0.148	0.355	0	1
101-200 workers	150996	0.174	0.379	0	1
201-500 workers	150996	0.162	0.368	0	1
501-1000 workers	150996	0.109	0.312	0	1
>1000 workers	150996	0.142	0.349	0	1

Notes: Table shows job level descriptives per year averaged over six year period from 2000 to 2005. All individual level information refer to the start of the job spell. Education information is imputed using the procedure proposed by Fitzenberger et al. (2006). Education groups refer to 1) Low: no vocational training, no high-school or missing information; 2) Medium: high-school and/or vocational training; 3) High: university or technical college degree.

TABLE A.3.5
Splitting along Plant Size

Dependent variable: Hazard rate of transitions into unemployment								
	Large plants (>100 workers)				Small plants (<100 workers)			
	(1) Cox model		(2) Stratified Cox		(3) Cox model		(4) Stratified Cox	
Export share	1.004**	[0.046]	1.012*	[0.062]	0.988	[0.113]	1.007	[0.664]
Importer	2.420***	[0.000]			1.808***	[0.002]		
N	158332		158332		4005		4005	

Notes: Reported numbers are hazard ratios and p-values in parentheses. ***/**/* denotes statistical significance at the 1/5/10 percent level. Standard errors are clustered at the establishment level. Stratified Cox models allow for plant-specific baseline hazards. All specifications include the full set of control variables as in Table 3.3 Columns (2) and (3) (unless otherwise indicated). Moreover, all specifications include time, region and 2-digit industry indicators.

TABLE A.3.6
Accounting for Export Intensity and Destination

Dependent variable: Hazard rate of transitions into unemployment				
	(1) Cox model		(2) Stratified Cox	
Export intensity to Eurozone				
Export share in sales <50%	0.645***	[0.000]	1.100	[0.466]
Export share in sales >50%	0.627	[0.120]	0.636	[0.156]
Export intenstiy to Rest of World				
Export share in sales <50%	1.328***	[0.002]	1.062	[0.585]
Export share in sales >50%	1.317	[0.107]	1.193	[0.451]
Importer	1.670***	[0.002]		
N	167911		167911	

Notes: Reported numbers are hazard ratios and p-values in parentheses. ***/**/* denotes statistical significance at the 1/5/10 percent level. Standard errors are clustered at the establishment level. Stratified Cox models allow for plant-specific baseline hazards. All specifications include the full set of control variables as in Table 3.3 Columns (2) and (3) (unless otherwise indicated). Moreover, all specifications include time, region and 2-digit industry indicators.

Table A.3.7
Excluding Observable Skill Information

Dependent variable: Hazard rate of transitions into unemployment

	Baseline				Without observable skill information			
	(1) Cox model		(2) Stratified Cox		(3) Cox model		(4) Stratified Cox	
Individual-level variables:								
Non-German	1.173***	[0.004]	1.154***	[0.007]	1.378***	[0.000]	1.371***	[0.000]
Age 31-40	0.726***	[0.000]	0.712***	[0.000]	0.684***	[0.000]	0.678***	[0.000]
Age 41-50	0.776***	[0.001]	0.758***	[0.000]	0.770***	[0.000]	0.758***	[0.000]
Age 51-65	1.349***	[0.007]	1.328**	[0.013]	1.384***	[0.009]	1.376**	[0.014]
Medium	0.699***	[0.000]	0.650***	[0.000]				
High	0.248***	[0.000]	0.227***	[0.000]				
Non employment	0.968	[0.701]	0.904	[0.224]	1.037	[0.628]	0.988	[0.873]
Unemployment	2.865***	[0.000]	2.399***	[0.000]	3.122***	[0.000]	2.621***	[0.000]
First employment	1.131	[0.393]	1.017	[0.906]	1.169	[0.257]	1.075	[0.589]
Plant-level variables:								
Exporter	0.727***	[0.008]	1.091	[0.571]	0.719***	[0.005]	1.094	[0.549]
Importer	1.694***	[0.002]			1.688***	[0.001]		
Sector-level CBA[1]	1.059	[0.779]	1.334	[0.181]	1.037	[0.852]	1.376	[0.162]
Firm-level CBA[1]	1.128	[0.621]	1.416	[0.131]	1.080	[0.744]	1.438	[0.128]
Work council	1.234	[0.372]	0.887	[0.629]	1.232	[0.343]	0.879	[0.601]
Single-unit plant	1.037	[0.733]	0.954	[0.739]	1.024	[0.819]	0.938	[0.668]
Young plant (<6 years)	1.052	[0.894]	1.674	[0.413]	1.040	[0.915]	1.745	[0.351]
High technological status	0.835*	[0.091]	0.949	[0.789]	0.808**	[0.044]	0.96	[0.827]
On-the-job training	0.924	[0.713]			0.880	[0.527]		
Share of TAWs[2]: >0 and $<25\%$	0.864	[0.162]			0.907	[0.325]		
Share of TAWs[2]: $>25\%$	0.596	[0.140]			0.703	[0.324]		
Plant size: 11-20 workers	1.800*	[0.090]			1.873*	[0.058]		
Plant size: 21-50 workers	0.901	[0.749]			0.877	[0.667]		
Plant size: 51-100 workers	1.142	[0.627]			1.116	[0.675]		
Plant size: 101-200 workers	0.781	[0.456]			0.751	[0.354]		
Plant size: 201-500 workers	0.819	[0.551]			0.801	[0.482]		
Plant size: 501-1000 workers	0.731	[0.384]			0.692	[0.273]		
Plant size: >1000 workers	0.400**	[0.012]			0.356***	[0.003]		
N	167911		167911		167911		167911	

Notes: Reported numbers are hazard ratios and p-values in parentheses. ***/**/* denotes statistical significance at the 1/5/10 percent level. Standard errors are clustered at the establishment level. Stratified Cox models allow for plant-specific baseline hazards. All specifications include the full set of control variables as in Table 3.3 Columns (2) and (3) (unless otherwise indicated). Moreover, all specifications include time, region and 2-digit industry indicators. [1] CBA: collective bargaining agreements; [2] TAW: temporary agency workers; Reference groups are: German, Age 20-30, Education Low, Job-to-job change, non-exporter, non-importer, no CBA, no work council, multi-unit plant, plant age > 6 years, low technological status, no on-the-job training, no TAWs, plant size: 1-10 workers.

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