Economic Analysis of Migrants and Natives on the German Labor Market

Microeconometric Evidence from German Administrative Data

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List of Abbreviations

BA	Bundesagentur für Arbeit (German Federal Employment Agency)
BeH	Beschäftigten-Historik (Employment History – data on employees)
BHP	Betriebs-Historik-Panel (Establishment History Panel – data on firms)
EU	European Union
FEA	Federal Employment Agency (Bundesagentur für Arbeit)
FRG	Federal Republic of Germany
GCEE	German Council of Economic Experts
GDR	German Democratic Republic
IAB	Institut für Arbeitsmarkt- und Berufsforschung (Institute for Employment Research)
IEB	Integrated Employment Biographies
IOM	International Organization for Migrants
OECD	Organisation for Economic Co-operation and Development
SOEP	Socio-Economic Panel
UN	United Nations

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Abstract

Every fourth inhabitant in Germany has a migration background. This proportion is even higher among the young population and especially among children in Germany. At the same time, further immigration flows to Germany are expected in the course of demographic ageing and the associated demand for labor. In consequence, migrants make a sizeable contribution to the economy, which will continue to grow in the coming decades requiring an appropriate empirical analysis of the labor market situation of migrants. This thesis presents four empirical articles focusing on different aspects related to unemployment and wages on the German labor market. All four articles address the topic of migration or migrants on the German labor market and thus take up an important and relevant discussion. I contribute to the literature and discussion in various ways: First, I draw on existing research and add important, previously not discussed elements for Germany, such as the occupation-specific wage curve, the wage differential as well as the differential in unemployment scarring between skilled migrants and natives and the interplay between fixed-term contracts and recalls. For the empirical analyses, I use German administrative data from the IAB with a large number of observations considering both individual and firm information. The results of the separate articles shed new light on the two main variables of the labor market: unemployment and wages. The results indicate that there are considerable differences in labor market outcomes between migrants and native employees, which are mainly due to differences in observable heterogeneity. Further, the results emphasize the relevance of unemployment and its interplay on individual wage and employment dynamics.

1 Introduction

The United Nations (UN) estimates the number of migrants living in the world, defined as persons who changed their country of usual residence, to 272 million or 3.5 percent of the global population in 2019 (UN 2019). According to the UN, this number of migrants is growing faster than world population (UN 2019). The world migration report of the International Organization for Migration (IOM) indicates further that the trend of increasing migration will not decline in the future, as increasing world population, conflicts, inequality and ecological effects will continue to cause migration flows (IOM 2020). At the same time, industrialized countries are often interested in immigration and its recruitment in order to prevent potential negative effects of workforce decline due to demographic ageing or shortages in demanded labor such as in Germany (Klinger and Fuchs 2019). In this way, the European Union (EU) has established laws to ease immigration into the EU. These laws as well as the effects described before, contribute considerably to increasing migration flows. Indeed, Europe has the world's largest number of migrants: 82 million (UN 2019). Moreover, Germany is the second-largest destination country for immigrants of the OECD countries with the highest number of migrants in the EU (OECD 2019). Migrants in Germany are thus not only an essential part of society but also of the whole economy and particularly the labor market, whose relevance increasingly grows caused by the mentioned demographic changes. This makes academic findings around the topic of migrants in the labor market of central importance. Such findings can be used for political recommendations for action and therefore contribute to e.g. a better economic integration and outcomes for migrants, which may decrease inequalities. Further, the gained knowledge can explain existing differences in economic terms between migrants and natives and thus identify issues, which can be tackled by policy makers.

Due to the increasing immigration to Germany, studies on immigration focus often on the two key variables of the labor market: wage and employment level. Different studies analyze whether and which overall effects for the domestic labor market result from immigration. For the German labor market, researchers find that immigration decreases wage levels and increases unemployment of migrants already living in the country (Brücker and Jahn 2011, Brücker et al. 2014; D'amuri 2010). These negative effects result due to greater substitutability between new immigrants and those migrants already living in the country compared to natives. According to the above named studies, native workers, in contrast, are not negatively affected by immigration or even benefit to some extent since they usually do not compete for the same jobs in the same extent due to various differences (Brücker et al. 2014). These differences regard particularly qualification

levels as well as experiences on the German labor market. However, these aggregate analyses offer little information and insights into individual labor market dynamics and employment biographies as they do not consider the mentioned structural differences in individual characteristics or long-term dynamics. In order to identify and explain the prevailing differences between migrants and natives in Germany, a different approach is needed.

This cumulative thesis discusses various aspects and issues of the labor market, particularly considering the group of migrants in Germany, in four separate articles. All four articles in this thesis address migrants in the German labor market as the common thread.[1] The main goal of the articles is to focus on both main outcome variables of the labor market unemployment and wages, and, further compare and analyze migrant and native workers on the German labor market. Using the provided results, this thesis contributes to the literature by adding knowledge on this topic and by driving useful implications for e.g. labor market integration policies.

This thesis is structured as follows: chapter 2 introduces the general topic of migrants in the German labor market. This chapter includes a motivation of the topic, a literature review on migrants and immigration in Germany, a brief summary of immigration history as well as theoretical considerations on the topic and a description of the data used for this thesis.

Chapter 3 presents an article on the wage differentials between migrants and natives on the German labor market, which is written with my co-author Stephan Brunow. In this article, we pick up the wage gap between migrants and natives and use the Oaxaca-Blinder decomposition approach to decompose and explain the prevailing wage gap on the German labor market. In the light of demographic ageing and skilled labor shortages, we focus our analysis on skilled employees with vocational qualification or university degrees, who provide particularly high labor market proximity. We identify a considerable wage differential between both groups, which however is virtually explained by differences in observable characteristics. Controlling for various characteristics, we find that differences in labor market experience as well as differences in firm characteristics are the main drivers of the prevailing wage differentials. We further find evidence that migrants holding vocational qualification or university degree provide the same productivity

[1] In the context of the four articles, the term migrant indicates employees who are registered with a foreign nationality in the data. This definition thus differs from the previously mentioned definition of the UN.

levels in the same jobs and task levels as native workers. We conclude therefore that skilled migrants are not disadvantaged on the German labor market and constitute a substantial source of labor in the light of demographic ageing and declining work force.

In addition, chapter 4 contains an article on the occupational specific wage curve in Germany, which is written with my co-authors Stephan Brunow and Mark Partridge. In this article, we take up the concept of the wage curve, according to which the regional wage level is affected by the regional unemployment rate and extend this concept by additionally including occupational unemployment in the labor market region. Our approach can take into account that not all employees in all occupations are equally affected by lower wages resulting due to an increase in regional unemployment. This is a main advantage of our paper compared to previous literature focusing on regional unemployment elasticity. Further, we focus on three groups of workers consisting of migrants, naturalized workers who became German during their employment biography and regular German workers. Our results indicate that migrants have the most rigid wage structures compared to natives as they are not affected by occupational unemployment in their region at all. Naturalized migrants in contrast have the steepest occupational specific wage curve followed by German workers. Accordingly, naturalized workers and Germans gain the highest wage growth with declining unemployment in their occupational fields. Therefore, our concept provides new insights into the topic and argue for a complementary consideration of the occupationally specific wage curve in addition to the regular wage curve.

Chapter 5 introduces an article on the scarring effect of unemployment on future wages, which is caused by unemployment incidence and its duration. For this purpose, I deviate from previous literature and consider the newest insights provided by recent studies by taking into account all unemployment episodes and not only those resulting from mass layoffs. This leads to a better representation of natural labor market dynamics and not only to a consideration of a minor part of unemployment incidences. Considering various observable characteristics as well as unobserved individual and firm heterogeneity, my results show long-lasting wage effects for workers affected by unemployment in Germany. Further, the results indicate that these effects increase with unemployment duration and that sorting in firms for re-employed workers is important for the explanation of the wage penalty. In addition, the results show that migrants suffer considerably less wage penalty compared to native workers due to unemployment, which is mainly explained by differences in unemployment duration.

Chapter 6 discusses recalls and their relationship with fixed-term contracts and unemployment in Germany with recalls relating to workers being re-employed by previous firms differentiating not only between men and women but also between migrants. This article takes up the often neglected phenomenon of recalls, which are important for understanding the dynamics of unemployment: almost 20 percent of all unemployed males in Germany return to their previous employer. Furthermore, I extend the analysis on recalls by considering fixed-term contracts, which employers can use to reduce cost-efficient work force if aggregate demand declines and recall those employees when aggregate demand rises. Considering various differences in observable characteristics and unobserved individual heterogeneity, the results show a higher recall of employees working in temporary employment than recalls of workers with permanent contracts. Moreover, the results indicate that migrants and women are even more often affected by recalls.

Chapter 7 concludes by summarizing the main findings and their implication of the thesis for migrants on the German labor market. According to the results, migrants in Germany differ considerably in their labor market outcomes and characteristics. However, according to the provided results, there are various differences in labor market dynamics between migrants and natives, which are mostly explained by differences in characteristics.

2 Immigration and Germany

2.1 Motivation

Although Germany has experiences with large migration flows of millions of people since the Second World War (Gotter et al. 2018), it took a long time for Germany being internationally perceived and recognized as an immigration country. At the latest since the migration flows of the recent past, however, Germany is been recognized as an immigration country not only by international policy makers but also in the scientific discussion (Green 2013). Moreover, in the meanwhile Germany became the second largest immigration destination within the OECD (OECD 2019) and ranks thus alongside classic immigration countries such as Canada, Australia, New Zealand and the United States. This becomes clear when looking at the process and numbers of immigration and migration in Germany. For the period from the Second World War to reunification, West Germany had a higher per capita immigration rate than the U.S., as indicated by Schmidt and Zimmermann (1992). This trend of immigration continued after the German reunification: Fuchs et al. (2016) show that there has been an average annual net immigration of about 200,000 persons to Germany since the German reunification for the years 1990 to 2013. These numbers increase significantly from 2015 onward in the course of humanitarian immigration. Thus, they lead to a net immigration of more than 1.1 million people in 2015 and 500,000 in 2016 with a slight decrease to 330,00 in 2019 (Destatis 2019). This high level of immigration to Germany, which has lasted for decades, is also reflected in the numbers on migrants and persons with migration background in Germany.

According to the Federal Statistical Office, more than 21 million people in Germany had a migration background in 2019 (Destatis 2021). This huge number includes individuals who immigrated to Germany from abroad themselves or who have at least one parent coming from abroad illustrating a crucial quantity for Germany: every fourth resident had a migration background in 2019. Various events in the past have contributed to this large quantity. In the postwar years, for example, labor market driven immigration of million guest workers determined the immigration to Germany. In the near past, in contrast, immigration was rather driven by the opening of the labor market within the European Union and due to massive humanitarian driven immigration in 2015 and 2016.

Although migrants in Germany have a considerable younger age structure and one in four inhabitant already has a migration background, Germany is still expected to experience issues arising from demographic ageing and retirements in the coming years (Fuchs and Weber 2020).

This upcoming retirement process is the result of the age structure of the baby boomers, who will retire particularly in the following years. According to current estimates, the number of people in Germany with a medium qualification, vocational qualification training, will more than half by 2030 (Fuchs et al. 2015). Similar applies to the workforce in Germany: the labor force will fall from 50 to 40 million by 2060 (Hunger and Krannich 2018). This change is linked to wide-ranging effects on the German economy. On the one hand, social spending will have to be borne by fewer and fewer workers in the future. On the other hand, workers who retire may leave a gap in the firm, as know-how and manpower are getting lost due to retirement. This is already evident in some regions and occupational fields, where pressing labor and skill demand prevails that cannot be met or only to a limited extent (Mergener 2018). Therefore, firms are forced to either restrain their business, relocate within the country or even abroad if necessary or, in the worst case, completely cease business operations (Fuchs et al. 2015).

According to Fuchs and Weber (2020), in order to avoid or decrease such economic issues related to demographic ageing in Germany, an annual net immigration of 400,000 persons is necessary. This high demand for immigration is coupled to many difficulties. Indeed, it is already evident that countries in the EU in particular, from which more migrants are coming to Germany, are also getting affected by demographic aging. Therefore, the authors expect migration from these countries to decrease (Fuchs and Weber 2020). As a result, non-EU countries will increasingly become the focus of immigration recruitment in order to meet the demand for skilled workers. This is why Germany will face much more competition in this area and the forecasts with regard to immigration from these countries are subject to considerable uncertainty (Fuchs et al. 2015).

Much greater difficulties related to the high immigration figures arise with regard to the labor market situation of the new arrived migrants. On the one hand, this concerns aspects of the general labor market integration of migrants and, on the other hand, issues of potential inequality. For example, foreigners considering Germany as a potential immigration destination or newly arrived migrants may question whether they can expect fair working conditions in Germany. These working conditions relate in particular to wages taking into account previously accumulated human capital such as qualification, labor market experience or special skills acquired abroad. Furthermore, the aspect of fair labor market conditions includes whether migrants are more likely to find themselves in precarious situations with regard to their work situation. On top of this, discussions should consider economic downturns in the future, which are leading to a reduction in

the labor demand. This raises the question of how and to what extent unemployment resulting from a recession and reduction in the labor demand would affect migrants.

In this context, this thesis takes up crucial aspects of migrant workers on the German labor market and discusses them against the background of demographic aging and the associated immigration. In addition, the articles in this thesis focus on the analysis of migrants either among their peers or in relation to the native population. From this, differences on the German labor market are identified and insights are gained that are relevant for policy implications and further discussions.

2.2 Historical review of Germanys immigration since the Second World War

After the Second World War Germany gained immediately considerable experience with large immigration waves of millions of people (Green 2013). These migration waves consisted primarily of expelled Germans or persons of German descent who were mainly expelled to the eastern European regions before and during the war.

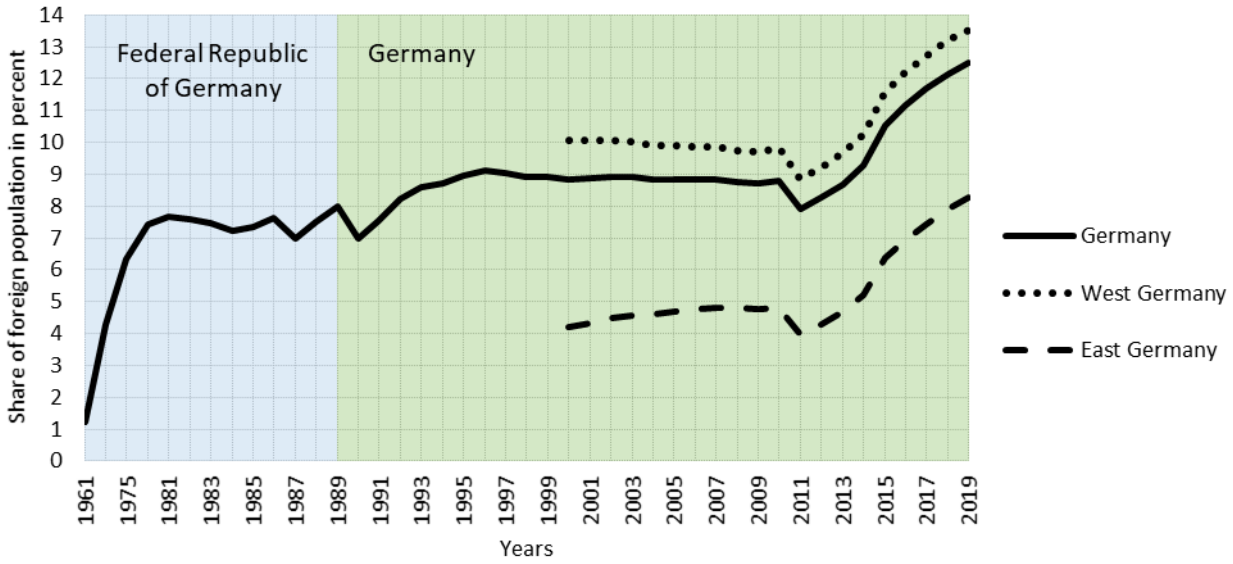
The first considerable immigration wave of non-ethnic Germans followed several years later to western Germany after the founding of the Federal Republic of Germany (FRG) and the German Democratic Republic (GDR). In the course of the emerging economic upturn after the war, the demand for labor increased rapidly. However, the domestic workforce could not cover the increase in labor demand (Gotter et al. 2018). This shortage of labor resulted on the one hand from the educational expansion after the war, after which the education period was extended, resulting in fewer workers being available (Gotter et al. 2018). On the other hand, many men died in the war, which reduced the workforce as well. In order to cover the labor demand of the domestic labor market, western Germany signed contracts with different countries to recruit guest workers covering the increasing labor demand. The first contracts were signed with Italy in 1955, Spain and Greece in 1960 and Turkey in 1961 (Kogan 2004). Since Germany needed particularly workers for lower task levels with high physical demands such as physical work and shift work, mainly guest workers with no or only low qualifications were recruited (Kogan 2011). Another factor contributing to the lower qualification levels was the limitation of guest workers` contracts to one year (Gotter et al. 2018). Thus, it was often not worthwhile for employers to recruit workers for tasks that required longer training periods or higher language skills.

To cover the labor demand, the GDR, which also experienced an increasing demand for labor, pursued a different strategy in the beginning: it encouraged the increase of female participation in

the workforce as an alternative to immigration (Gotter et al. 2018). However, this was not sufficient, and the GDR soon had to rely on guest workers as well. In contrast to West Germany, however, only workers from socialist countries were recruited, such as Poland, Hungary, Angola, Mozambique, Cuba and Vietnam (Gotter et al. 2018). As in West Germany, these workers tended to be recruited for jobs with lower task levels and higher physical workload, resulting in lower average qualification levels.

For West Germany, until the 1970s, this type of labor market driven migration was associated with a high turnover of guest workers, resulting in a rather balanced level of immigration and emigration. Due to the short residence periods in Germany and the lack of family access of guest workers, no assimilation processes in the economic integration could take place (Kogan 2004). However, the situation changed in the course of the oil crisis in 1973 when the recruitment contracts were suspended and the labor demand declined sharply. Nevertheless, many guest workers decided to stay because they were afraid that they would not be allowed to return to Germany if they left the country. In the following years after the oil crisis, the recruitment suspension was not reversed. This led to relatively low immigration to the FRG, which was particularly determined by the families of the guest workers between 1975 to 1981 (Kogan 2011). This pattern is illustrated in Figure 1 below, showing no appreciable increase of the share of migrants in the years after the oil crisis until 1986.

Figure 1: Share of migrants in the total population



Source: Population census until 1970. From 1975 population projection based on population census. Own depiction.

From the end of the 1980s immigration numbers began to rise again due to the influx of Kurdish refugees from Turkey and refugees from Iran and Iraq (Kogan 2004), which is also reflected in the increase of migrant's proportion in Germany. After the reunification of East and West Germany and the fall of the Wall, the immigration trend to Germany continued. At the beginning of the 90s, because of the conflict in Yugoslavia more and more refugees from this country came to Germany (Kogan 2004). At the same time, after the fall of the iron curtain immigration rates of ethnic Germans (*Spätaussiedler*) from Eastern Europe and the former Soviet Union rose continuously (Green 2013). However, unlike other immigrants, ethnic German immigrants were immediately granted German citizenship. Therefore, they are not listed as migrants in most administrative registers and do not contribute to a considerable increase in the proportion of migrants (Figure 1).

With regard to the qualification structure, immigration from 1990 onwards was predominantly characterized by lower qualifications, comparable to the recruitment of guest workers (Brücker 2015a). This low level of skilled immigration results from the fact that no official efforts have been made to regulate immigration since the recruitment stop in 1973, as immigration was not considered as necessary (Green 2013).

From the 2000s onwards, major changes in immigration regulations have been made, as the subject of immigration was also increasingly addressed in politics in the light of the shortage of skilled workers (Green 2013). These changes in immigration regulations were reflected in efforts to recruit skilled migrants using various methods, such as a German "green card" targeted on highly qualified immigrants. Although the figures on the qualification levels of immigrants show a rise of highly skilled immigrants from 2000 onwards (Brücker 2013), these new measures were not fruitful, as the total number of immigrants did not increase considerable as shown in Figure 1 (Green 2013). However, these stagnating or even falling levels of immigration can be particularly attributed to Germany's poor economic condition, as Germany was considered as the sick man of Europe. Therefore, Germany was not an attractive destination country for (skilled) workers.

This situation changed radically in the course of the financial crisis from 2008/09 onwards. The massive deterioration of economic conditions in some European countries due to the economic crisis led to massive emigration flows out of these countries (Brücker 2015b). As Germany was able to cope comparatively better with the crisis than other countries, it suddenly become an attractive destination for skilled workers. This was reflected in the immigration figures from 2009

onwards: more migrants from the EU-15 states immigrated to Germany (Seibert and Wapler 2020).[2] This was coupled to a substantial increase in the average qualification level of immigrants as the share of high-qualified persons rose to 47 percent in 2010 (Seibert and Wapler 2020). Compared to the level in 2000, the share of skilled workers thus increased by around 24 percentage points (Brücker 2013). However, the average qualification level declined slightly in the following years as the origin regions of immigration changed again considerably from 2011 onwards. This resulted due to the introduction of the free movement laws for workers from the EU-8 states in 2011 and workers from the EU-2 states in 2014.[3]

From 2015 onwards, again larger changes in immigration patterns to Germany became apparent. On the one hand, immigration numbers rose rapidly: the net immigration doubled from around 550 thousand in 2014 to over 1.1 million in 2015 (Destatis 2019). On the other hand, individuals' origin regions changed, as the majority of immigrants now came from Syria, Iran, Iraq, Nigeria, Eritrea, Pakistan, Somalia, Afghanistan or Ethiopia. These immigration flows were driven by humanitarian reasons (Gotter et al. 2018) and were accompanied by lower qualification levels resulting in an overall lower qualification structure of immigration on average (Seibert and Wapler 2020).

These changing immigration patterns over the decades provide various opportunities for migrant analysis and labor market research focused on migrants: as mentioned above, Germany has been able to gain experience with immigration and the economic integration of millions migrants for many decades. This experience is available in the form of long-term microdata since 1975 (chapter 2.4) and enables a detailed analysis of the integration and assimilation process regarding economic outcomes and other terms over time.

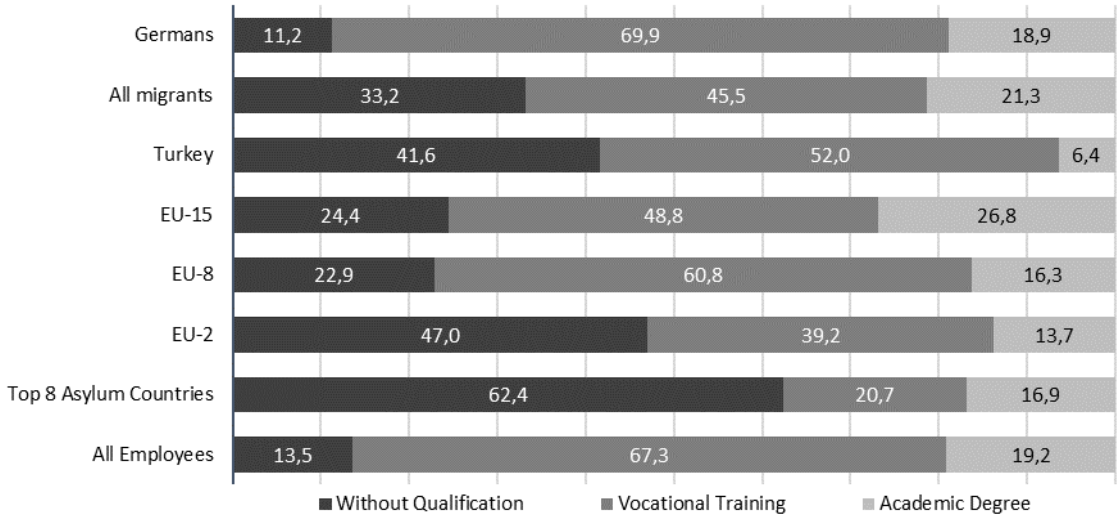
Another crucial factor that argues in favor of analyzing migrants on the German labor market is the heterogeneous structure of migrants in Germany particularly in terms of qualification, origin, immigration cohort and regional distribution. This heterogeneous structure offers compared to other countries an outstanding opportunity for migration research. As immigration to Germany is not mainly driven by strong selection as in classical immigration countries that regulate

[2] The EU-15 states include the following countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden and United Kingdom

[3] The EU-8 states include the following countries: Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, and Slovenia. The EU-2 states include the following countries: Bulgaria and Romania.

immigration through point systems or similar labor market driven restrictions (Dustmann and Glitz 2011). Figure 2 below shows this heterogeneity in qualification structures between the different groups.

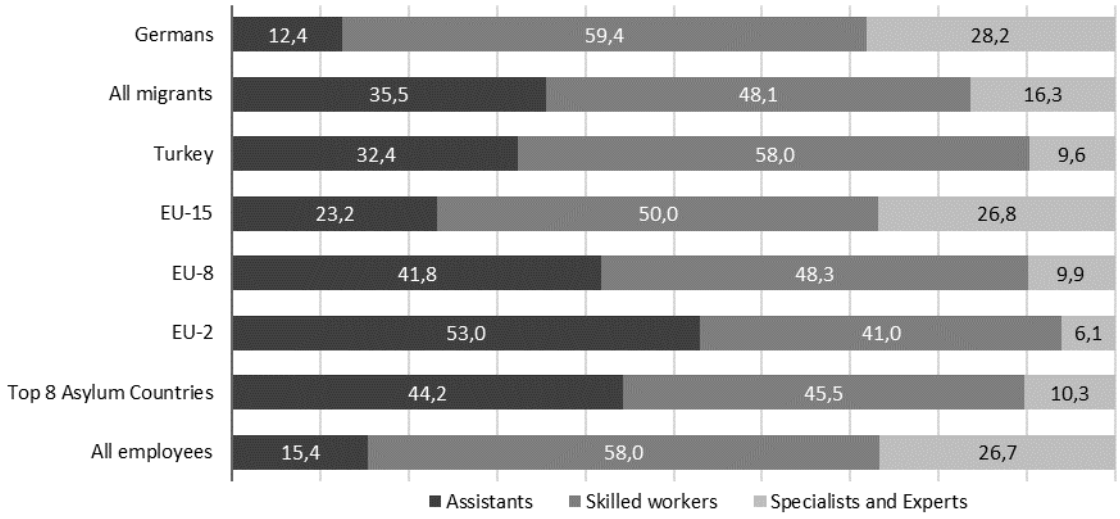
Figure 2: Qualification structure of migrant employees in Germany



Source: Employment statistics of the Federal Employment Agency, own depiction.
Note: Top 8 Asylum Countries are Afghanistan, Eritrea, Iraq, Iran, Nigeria, Pakistan, Somalia and Syria. Employees without information on educational attainment are not considered in the figure.

Accordingly, migrants have on average considerably lower qualification levels than German employees. At the same time, Figure 2 shows clear differences within the migrant group: workers from the EU-15 and EU-8 countries have in comparison higher qualification levels, whereas migrants from Turkey or particularly from the main asylum countries tend to have lower qualification levels. These difference show therefore significant disparities in employment and job positioning in the labor market. This is shown in Figure 3 illustrating the distribution within task levels in Germany, which indicates the job positioning. In line with the previous distribution of educational attainments, Figure 3 shows that the job position and thus the wage structure is unevenly distributed and thus heterogeneous within the group.

Figure 3: Task level structure of migrant employees in Germany



Source: Employment statistics of the Federal Employment Agency, own depiction.

These differences within the group of migrants enables a variety of intra-group difference analysis as well as the analysis of different dynamics driven by educational qualification and thus job positioning or spatial distribution within Germany. As a result, the analysis of this heterogeneous group yields results that have high validity and allows generalized statements for policy makers and immigration policy. Furthermore, results gained from this heterogeneous group can be applied to international arena, as other countries can learn from German experiences.

2.3 Migrants on the German labor market

A crucial aspect of research focusing on migrants is the determination and analysis of existing differences between migrants and natives. According to the literature and most statistics on migrants in Germany, migrants are on average worse off than natives are. This relates, on the one hand, to the primary economic variables of the labor market: unemployment and wage levels (Jost and Bogai 2016). According to the Federal Employment Agency, migrants have a substantially higher unemployment rate than the native population (Statistik der Bundesagentur für Arbeit 2020) and earn considerably lower wages (Lehmer and Ludsteck 2011, 2015). On the other hand, differences between migrants and Germans also relate to numerous other sociodemographic and population related variables. For instance, Granato and Kalter (2018) show that migrants are more likely to work in occupations with lower social prestige. Further, migrants are more often crowded in certain occupational fields (Glitz 2014) and tend to spatially segregation (de Groot and Sager 2010). Different articles indicate, that these differences are linked or even result due to disparities

in education and particularly in income between migrants and Germans (de Groot and Sager 2010; Kristen and Granato 2007). Therefore, analyses related to all aspects of wages are of utmost importance, as many other differences result due to income inequalities. The importance of wage structures and wage levels is also reflected in the political discussion, according to which the wage differential between migrants and natives is regarded as the most important criterion for economic integration (Glitz 2014; Dustmann and Glitz 2011).

Further, considering wage structures and wage related analyses between migrants and Germans, which are considered of crucial importance for economic and political discussions, the results reveal substantial differences between these two groups (Aldashev et al. 2012; Jost and Bogai 2016; Lehmer and Ludsteck 2011, 2015). Indeed, migrants consistently have lower wages on the German labor market compared to native workers. Moreover, even when comparing migrants and Germans within the same educational levels, the results show noticeable wage differences. Yet, not only the wage structures are characterized by differences: migrants are affected by higher unemployment levels, tend to cluster in certain occupations and regions or are more often affected by unstable employment relationships (Dustmann and Glitz 2011; Kogan 2011; Tanis 2020). This is linked to other dynamics, such as the effect on wages of regional unemployment or general wage developments of migrants (Baltagi et al. 2009; Brücker and Jahn 2011).

Given these results, a number of questions inevitably arise, such as: how can wage differentials within educational levels be explained? How stable are such wage differentials - do they decline over time in the course of the assimilation process? Which differences in sociodemographic variables apart of education contribute to wage inequality? Alternatively, with regard to occupational and spatial segregation, the question arises whether migrants are affected differently by labor market dynamics against the prevailing backdrop of regional or individual unemployment or distribution in occupational fields.

These questions require a more in-depth discussion. In the following, the theoretical framework of inequality with a particularly focus on wages is discussed, addressing reasons for primarily wage differentials, as these differences are considered as the most important criterion for economic integration (Glitz 2014). At the same time, these theoretical concepts offer an answer to why migrants are more often unemployed. Therefore, they indicate different implications and interdependencies for migrants and natives on the labor market.

2.3.1 Theoretical considerations on inequality between migrants and natives

Human capital

The most common approach for explaining differences in labor market outcomes is the human capital theory (Hinz and Abraham 2018). The basic concept of this human capital theory goes back to Becker (1964). It postulates that individual's productivity, which in turn determines the wage level, is defined by the human capital including all the knowledge and skills acquired by the individual, i.e. education. According to Becker (1964), individuals decide a priori how much human capital they want to acquire, since the acquisition is associated with costs (effort, lost wage). Existing differences in wages between migrants and Germans on the labor market, result thus due to a different willingness to invest in human capital and different productivity levels.

Two key implication can be followed, which are particular important for migrants: first, migrants may not be able to fully transfer human capital acquired in their home country to the destination country (Granato and Kalter 2018). This might not only be due to cross-country differences in educational programs and insufficient recognition of educational degrees in the destination country (Brücker et al. 2021), but also because labor market experience may be tied to the origin country (Basilio et al. 2017; Friedberg 2000).

Immigration thus contributes to a devaluation of human capital: migrants are not fully able to use their entire skills and knowledge in the new destination country and thus have to accept wage losses. This loss of income due to the insufficient transfer of human capital is of key relevance for Germany, as wages on the German labor market are particularly dependent on educational attainments (Fernandez-Kelly 2012). Also Basilio et al. (2017) confirm this aspect. They state that human capital acquired abroad receives low returns in Germany and thus contribute to wage differentials between migrants and natives.

The second implication concerns the acquisition of human capital over time after immigration to the country. This can take place, because migrants not only acquire more labor market experience, but also learn the language, which leads to an increase in their productivity resulting in higher wages (Chiswick and Miller 2009; Himmler and Jäckle 2018; Geis-Thöne 2019). This economic assimilation can account for a considerable wage premium and is a relevant part of the empirical discussion on migrant's wages as shown in the seminal work by Chiswick (1978).

For empirical research, focusing on differences between migrants and Germans, especially regarding wage-related research topics, these implications indicate that human capital has many

dimensions that have to be considered. On the one hand, educational attainment must be taken into account to allow intra-group comparisons within educational levels. On the other hand, information capturing gradual acquisition of human capital, such as labor market experience, which correlate with e.g. language skills, have to be considered as well as it relates to assimilation. Further, human capital differences effect various labor market aspects, such as job opportunities, individual unemployment risk or employment stability and are thus a key information for empirical analyses.

Discrimination

Another frequently discussed reason for wage differentials between migrants and natives is discrimination (Granato and Kalter 2018). Following Becker (1971), discrimination in the economic term implies unequal wages between two groups without any productivity-related difference. In general, the literature distinguishes between two different types of discrimination: the taste based discrimination (Becker 1971) and the statistical discrimination (Phelps 1972, Arrow 1973 and Aigner and Cain 1977).

The taste-based discrimination assumes that workers do not differ in their productivity but are paid differently (Becker 1971). The difference in payment between the groups results from different taste, according to which one group is favored and preferred over the other group. Becker (1971) emphasizes that different agents on the markets can cause this kind of discrimination resulting in wage inequalities: employers may have taste preferences or already employed workers, who do prefer colleagues similar to themselves and influencing the firm wage policy. Further, also customers may have certain tastes with regard to different groups, which lead to pressure on employers to discriminate.

However, the main implication of this theory is that this type of discrimination is not profit maximizing and not rational, since the firm pays a wage premium to the preferred group (taste cost). Although this group does not provide any advantages in terms of productivity. Accordingly, this type of discrimination is expected to decrease and disappear in a competitive labor market (Arrow 1973): either workers with lower wages would move to another firm or the discriminating firm could not afford the costs of discrimination in terms of wage premiums due to competition (Granato and Kalter 2018).

In contrast, the statistical discrimination theory assumes a different initial situation: workers are heterogeneous with regard to their productivity (Phelps 1972). Firms do not know a priori the individual productivity level of applicants but they can assess it with effort. In order to minimize the effort, employers pay attention to different signals of applicants to classify them. At the same time, firms assume that particular workers, have the same productivity levels as the group average into which they were grouped by the signal (Granato and Kalter 2018; Hunkler 2013). Thus this approach reduces the effort for firms, which therefore focus only on signals (Spence 1973; Phelps 1972; Aigner and Cain 1977) like skin color, migration background, gender, age, education or similar. Hence, this approach results in discrimination if workers have a different productivity level than the group average into which the employer has grouped them based on the signal. According to this, the main implication arises as to which this type of discrimination is rational for firms because it saves efforts and costs. Further, on average workers are paid based on the group average, which means that this type of discrimination is not expected to decrease with increasing competition, as is the case with taste-based discrimination (Phelps 1972).

One important aspect of this theory for the empirical procedure discussed by Phelps (1972), is the variance of the workers emitted signal: risk averse employers prefer applicants from groups with a lower variance of expected productivity, given equal expected values of productivity. This issue is relevant for the empirical approach: if the productivity signal is the educational attainment, the variance of the expected skills of migrants increase, since education acquired abroad may be less possible to compare to natives. Thus, employers would prefer native workers, as they could better assess their expected skills.

Crowding and segmentation theory

Other theoretical concepts frequently mentioned in this context are the crowding theory and the segmentation theory. These theories also relate to the concept of economic discrimination.

The overcrowding model of Bergmann (1974) concentrates on the occupational distribution of workers. The model argues that overall discrimination and rejection of a certain group of workers on the labor market could lead to crowding of these workers in occupations. This overcrowding in a limited number of occupations in which discriminated workers still find work lead to an excess supply of labor and thus to falling wages (Bergmann 1971). Therefore, groups that are not discriminated against face less competition in other occupational fields and thus earn higher wages, which lead to wage inequalities between groups. However, this theoretical model is also able to provide answers to the question, why there might be wage inequalities between groups within

occupations: knowing about the limited job offer possibilities of discriminated groups; employers may pay these workers less because these workers have no other option.

However, this theory alone cannot explain why discrimination occurs. Therefore, the theory must be used as complementary to the previous concepts. Thus, the empirical approach, must not only consider common characteristics such as education or occupation, but has also to take into account the aspect of crowding, selection and glass ceiling as indicated by Hofer et al. (2017) or Ludsteck (2014).

Similar to the crowding theory is the concept of segmentation. After this concept, the labor market consists of several submarkets (segments) with different structures (Granato and Kalter 2018). These different segments can emerge due to various separation aspects, such as language or education. Moreover, they lead to differences: some segments are characterized by stable employment and higher wages and other segments in contrast are defined by unstable employment relationships and low wages (Granato and Kalter 2018). Hence, newly arrived migrants in particular tend to seek work in segments that are more likely to be characterized by precarious conditions, as they might lack language skills and qualifications.

2.3.2 Empirical evidence on migrants in the German labor market and existing gaps in the literature

In the following, I discuss the most relevant and important empirical findings and results on migrants in the German labor market in the context of the following chapters of this thesis. On the one hand, the aim is to briefly summarize the most important results and previous research on the topic. On the other hand, it is particularly important, to elaborate the existing gaps and open questions in the empirical literature. By revealing existing gaps and unsolved questions in the previous literature, the positioning of this thesis and its chapters within the existing literature becomes apparent. However, the answers and discussions are provided in the following chapters.

A substantial part of the empirical and economic research on migrants in the German labor market focuses on the differences and inequality between migrants and natives. As indicated in the previous chapters, the analyses primarily concentrates on wage differentials. But there are also other crucial and related aspects, such as the assimilation of migrants into the German labor market. This occupies a high priority in the literature and thus builds on the theoretical consideration of the acquisition of human capital over time (chapter 2.3.1). Accordingly, the

question arises whether inequality decreases over time and whether migrants show a convergence in wages to the native population (Granato and Kalter 2018). However, this debate is characterized by Chiswick´s (1978) seminal paper, which argues that in the U.S. immigrants show a clear catch-up process over time leading to a convergence of wages.

For Germany, the debate of assimilation and economic integration over time has been going on for almost three decades. In contrast to Chiswick (1978) the results show only a small convergence in wages between migrants and natives (Licht and Steiner 1994; Schmidt 1997; Zibrowius 2012). In this context, this phenomenon is referred to as flat experience curves, i.e. migrants receive a lower reward for labor market experience than natives. Therefore, the wage differential decreases only slightly over time (Bossler 2014). Hence, this relationship has been addressed in the literature for such a long time: why are there flat experience curves for migrants in Germany and what is needed in order to reach wage convergence (chapter 3).

Another crucial aspect in the discussion on (wage) inequality or unemployment dynamics is the role of firms and firm wage setting policies. Although the importance of firms for wage differentials was made evident with the work of Abowd et al. (1999) and has already been taken up in numerous studies (Card et al. 2013; Card et al. 2018), no detailed consideration in the migrant native wage gap literature for Germany has been made. Even in international context, only a few articles exist considering the role of firm in detail for the topic of migrant native wage differentials (Dostie et al. 2020).

Moreover, for Germany, previous articles often are not controlling for any firm information. They only use data on individuals or consider firm size in the analysis leading to biased results: controlling for firm size takes into account differences between firms, but does not adequately control for wage setting policies within firms. Building on the theoretical arguments of Becker (1971), wage setting policy within firms may substantially contribute to wage differentials and is thus an important aspect of wage inequality (chapter 3 and 4).

In addition to wage levels and its analysis, unemployment is the second key variable in labor market research. Accordingly, the linkage and interaction between the two main variables wage and unemployment is relevant to gain an in-depth understanding of the dynamics of the labor market. In this context, the concept of the wage curve has been used for more than two decades to relate these two variables and to explain interdependencies (Blanchflower and Oswald 1994; Bellmann and Blien 2001). The theoretical concept combines both variables in such a way that

regional unemployment has a direct and negative effect on wage levels: employees who are located in a region with high unemployment are themselves at risk of unemployment. They therefore lower their wage demands or even accept wage cuts in order to avoid unemployment. Empirical analyses confirm the theoretical relation for Germany and most international areas (Baltagi et al. 2009; Blien et al. 2013; Rokicki et al. 2020; Nijkamp and Poot 2005): Nijkamp and Poot (2005) estimate the wage curve elasticity to -0.07 in their meta-analysis. An increase in the unemployment rate of 10 percent leads to a wage decrease of 0.7 percent.

However, this concept does not consider the labor market situation i.e. the unemployment in occupations within the region. This is particularly important for occupations with shortages or with high competition, as it directly effects wages as well. Therefore, workers might be employed in occupations with high labor shortages, who are hardly or not affected by regional unemployment levels. These differences are important for the research topic of migrants on the German labor market. One the one hand, migrants have a higher unemployment rate. On the other hand, many migrants work in occupational fields that are characterized by a shortage of skilled workers. In order to shed more light on these interrelations and questions, a complement to the conventional approach is needed (chapter 4).

Another issue that arises in the light of the wage curve concept is the individual consequences of unemployment for future wages. This question is the subject of the scarring literature, which is an individual extension of the wage curve approach. That concept focusses on the future wage effect “scar” caused by an unemployment episode. Theoretically, this is motivated by various explanations: (i) workers might lose human capital or specific firm knowledge due to unemployment (Burdett et al. 2020; Ortego-Marti 2017), (ii) unemployment may lead to stigma or a bad signal (Belzil 1995) or (iii) workers may decrease their reservation wage because of unemployment and thus accept wage cuts (Blien et al. 2012). For Germany, different empirical articles confirm these theoretical predictions and provide evidence for massive and persistent wage declines resulting from unemployment and displacements (Blien et al. 2021; Fackler et al. 2021; Burdett et al. 2020).

In this context, Carrington and Fallick (2017) indicate that the wage effect is not driven by the separation itself, but mainly by the unemployment period. Accordingly, the unemployment duration must be considered as well in such analysis. For Germany, Schmieder et al. (2016) show that one additional month of unemployment lead to a further wage decrease of 0.8 percent, which is in line with the international literature. However, the previous literature for Germany does not

consider long-term scarring and the duration of unemployment parallel. Moreover, migrants are not considered as a special group of workers. Given the situation of migrants in terms of higher unemployment described above, this represents a gap in the literature in answering the question of individual costs of unemployment. Furthermore, previous literature focuses exclusively on displacement or discontinuities, which shows only a minor part of the unemployment dynamic. Thus, it provides only a limited analysis of the whole unemployment dynamics (chapter 5).

Another aspect closely related to individual unemployment episodes is the phenomenon of temporary layoffs or so-called recalls. In this case, firms lay off workers if the demand for goods decreases and rehire them if the demand increases again. This approach is motivated by the cost saving argument (Feldstein 1976, Albertini et al. 2020) and is associated with externalities as the economy bears the costs for temporary unemployed workers. Since this approach is not desirable from a labor market policy perspective, some legal restrictions are intended to prevent or reduce temporary layoffs. However, empirical analyses provide evidence that about 20 percent of unemployed workers are still rehired by their previous firms in Germany (Edler et al. 2019; Liebig and Hense 2006; Mavromaras and Rudolph 1995, 1997, 1998). One method, which is used by firms in order to conduct temporary layoffs and has not been considered in this context for Germany, is the use of temporary employment contracts. This is particularly relevant for the research on migrants, as migrants are more often employed in such unsteady employment relations (chapter 6).

2.4 Data

There are several sources of data containing information on migrants and employees in Germany: data from the German micro-census (*Mikrozensus*), Federal Office of Statistics (*Statistisches Bundesamt)* or the Federal Office for Migration and Refugees (*Bundesamt für Migration und Flüchtlinge)*. These data sets provide different information on migrants on the German labor market over a long period and are used for scientific analyses. In this regard, the German micro-census offers wealth information at the individual level and is very popular for empirical analyses.

However, most of these data sets do not offer any individual level information or in the case of micro-census only a cross-section for each year and one percent of the population. This has severe drawbacks, especially with regard to the previously discussed issues: individual dynamics, which are of key importance in economic assimilation analysis, for example, cannot be estimated correctly (Borjas 1985). Furthermore, fixed and unobserved influences cannot be taken into

account, which can lead to massive biases. Therefore, panel data are required to analyze the previous mentioned issues.

For the German labor market, two data sets or data sources are often used in relevant studies: the German Socio-Economic-Panel (SOEP) data, which is a household based panel survey of around 15,000 households with approximately 30,000 persons. This data contains a wide range of individual and labor market-relevant information on natives and migrants in Germany. However, there are two serious shortcomings of the SOEP data: on the one hand, no substantial information on the firm level is available, which is an essential part of the wage structure. On the other hand, the limited number of cases reduces the possibilities of analyses regarding migrants, as this group represents a minority of the total number of cases.

The other popular data sets and data sources, which is also used for this thesis, are not only the Integrated Employment Biographies (IEB) from the Institute for Employment Research (IAB) but also the Establishment History Panel (BHP). For this thesis, I combine the IEB to the (BHP), to consider various individual and firm information. These data sets, its source, advantages and drawbacks are described below.

2.4.1 Integrated Employment Biographies

The IEB is the main data set of this thesis and is used as the key data basis in all four articles and thus of particular importance. This data stems from different reporting processes, in particular from the statutory required employer reporting or reporting from the Federal Employment Agency in the course of unemployment or job search (Zimmermann et al. 2007). In this administrative process, a wide range of information is recorded and reported to the corresponding public authorities. This includes various information such as gender, wage, reported nationality, place of residence and work, educational attainment, year of birth, a unique firm identifier, which is relevant for merging firm information (chapter 2.4.2), and receipt as well as duration of unemployment benefits or unemployment assistance. With this information, entire employment biographies of workers can be constructed containing information on the actual labor market experience, firm tenure or similar. A special characteristic of this reporting process is that any changes in the information must be reported with the date of the change leading to an information,

which is day accurate. Furthermore, this information is available for the period 1975 to 2017. Therefore, individuals can potentially be observed over their entire employment biographies.[4]

Due to the administrative character of the data and its sources, some special advantages arise: the data is very accurate and reliable in its information through the reporting process, which applies in particular to wage information. At the same time, the administrative nature of the data eliminates problems and biases often linked to survey data gathered from respondent interviews. In addition, the data set gives the possibility analyzing the full IEB, for which all employees in Germany can be taken into account making the analyses particularly reliable and preventing problems in terms of representativeness.

However, there are also some important drawbacks associated with the IEB data that are worth to be mentioned. The IEB only provides information on hired workers (employees) in Germany not containing any information on self-employed, freelancers, civil servants or the like. Although particularly self-employed are an essential part of the work force, the employees considered in the IEB constitute the absolute majority of the work force in Germany. Indeed, employees account for more than 80 percent of the workforce in Germany. Therefore, the analysis of the IEB is still excellently suitable for representative analyses on the German labor market.

Some other restriction, which is of particular importance for this thesis and for wage related analyses, is the right censoring of wages above the social contributing threshold: no information is available on wages earned by employees above this threshold in the IEB. As this affects almost 10 percent of the regular employees, it is a serious limitation for analyses regarding workers with university degrees, because this group is often affected by this restriction. A frequently used and practicable solution for this problem is the wage imputation according to Card et al. (2013). This imputation enables the possibility of estimating wages above the threshold and thus considers the whole wage distribution for wage related analyses.

Another issue concerns the information on the educational attainment in the IEB. The information on educational attainment is often missing in the data, leading to large gaps or inconsistencies in information in this variable. This issue is also the subject of an article by Fitzenberger et al. (2005) providing some imputation rules to improve the quality of the education

[4] This maximum period only applies to western Germany. For eastern Germany, data on employees are only reliably available from the beginning of the 1990s.

variable in the IEB. As a result, after applying these heuristics, the quality of the education variable improves massively enabling the consideration of this information in the analyses.

Other limitation regards the information on the nationality in the data, which is particularly important for the analysis of migrants. As the data does not provide any information on the country of birth or on the birthplace of individual's parents, the migrant status is generated from nationality information. This may be linked to some issues: workers in Germany may have more than one nationality. Therefore, they can be registered with either their German or foreign nationality. However, this issue should be less pronounced for the period prior to 2016. Changes in the law from 2000 onward enabled the possibility of dual nationality by birth to children of migrants and these children appear in the data only earliest from 2016 onward (16 years and older).

Another minor limitation of the data arises with respect to part-time employment. The data does not provide any information on the amount of working hours. Therefore, analyses regarding part-time employment may lead to biases. Hence, many studies restrict the data to full-time employment only, as employees in full-time have considerably less variance in their working time and are thus more comparable.

To sum up, the IEB data is ideally suited for an empirical analyses of the previously discussed research questions and the topic in general. The limitations of the data discussed can often be eliminated or reduced to a minimum by methodological treatments. Therefore, no major biases are to be expected for the previously discussed issues.

2.4.2 Establishment History Panel

As the IEB, also the BHP is an administrative dataset provided by the IAB. However, in contrast to the IEB, the BHP provides information on firms. This dataset consists of annual cross-sections for the years 1975 to 2018, which can be combined to a panel structure enabling longitudinal analyses or consideration of firm information (Ganzer et al. 2020).[5] The data set contains a large amount of information on the firms, such as the exact location (municipality level) or the type of industry. Moreover, the data includes information, which can be derived from the employment structure of the firm: the number of employees (full-time and part-time), the proportion of women or men, the proportion of high, medium and low qualified employees, the proportion of migrants

[5] As with the IEB, the same restriction applies here, according to which this period only applies to West Germany and data for East German firms is only available from the beginning of the 1990s onward.

or the median wage in the firm. This information is available on the reporting date of June 30 for each year and can be merged to the individuals contained in the IEB data using the unique firm identifier.

The availability of the firm information contributes to some crucial advantages of the previously discussed IEB data: on the one hand, the inclusion of firm information in the empirical analysis can control for effects that might otherwise lead to biases if not considered (omitted variable bias), as mentioned in recent empirical discussions (chapter 2.3.2). On the other hand, the firm information enables mitigating shortcomings associated with administrative data: for example, administrative data usually does not provide reliable information on job separation and thus reasons for subsequent unemployment spells. This may lead to biases, because reasons for unemployment could arise due to the individual itself. To address this issue firm information can be used. This data provides the possibility of identifying exogenous variation for separation by using a popular mass layoff approach (Davis and von Wachter 2011).

From this follows the unique value of the IEB for empirical labor market research: the combination of IEB and BHP creates a symbiosis that is particularly well suited for conducting empirical analyses on a variety of topics reducing or avoiding emerging problems. It nevertheless remains crucial how the IEB as well as the BHP information is prepared for the individual projects and research questions, as this can lead to considerable differences in the results. In the following, each chapter contains a short section in which the most important data preparation steps are presented.

3 Wages of skilled migrant and native employees in Germany: new light on an old issue[6]

Joint with Stephan Brunow[7]

Abstract

The German Council of Economic Experts (GCEE) argue for a labor market driven immigration of skilled migrants into Germany to overcome a decline in workforce due to demographic ageing. We pick up this current debate on skilled immigration by analysing the migrant-native wage differential for skilled workers and consider various information on firms. Our results indicate that the wage gap is virtually explained by observable characteristics, especially labor market experience and firm characteristics. However, we find flatter experience curves for migrants, leading to lower rewards for migrant's labor market experience than for natives, which converge in the long run. Moreover, we reveal firms' wage setting policies: firms evaluate the education of a worker independent of migration backgrounds as migrants possess the same productivity levels as their German counterparts in the same occupations and task levels. Due to Germany's heterogeneous immigration structure, we are able to compare the results and thus derive valuable insights into the migrant-native wage structure with a wide reach beyond Germany. This article adds to current debates in various industrialized countries with demographic ageing patterns, as it focuses on an important group for domestic labor markets: skilled immigrants.

Keywords: Migrant pay gap, Mincer wage equation, inequality, Oaxaca-Blinder decomposition

JEL: J31, J60, R2

[6] A very similar version of this chapter is published as: Brunow S.; Jost O. (2022): Wages of Skilled Migrant and Native Employees in Germany: New Light on an Old Issue. International Migration Review, Vol. 56(2), pp. 410-432. DOI:10.1177/01979183211040505. URL: https://journals.sagepub.com/doi/full/10.1177/01979183211040505 This chapter is slightly changed and extended compared to the published version, it contains a more detailed description of the methodological approach as well as a more detailed discussion of the provided findings.

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3.1 Introduction

In the next 15 years, demographic ageing will lead to a noticeable decline in the German workforce (Klinger and Fuchs 2019). The German Council of Economic Experts (GCEE) therefore argues for a labor market driven immigration of skilled workers to Germany to dampen the possible negative effects resulting from a lack of labor (GCEE 2017). According to Miguélez and Moreno (2013), the key to attract skilled immigrants are job opportunities and wage levels. Against this background the question arises: Can skilled migrants expect equal wages as the native population in Germany, regardless irrespective of their migration background? In this regard, we define migrants as persons who have had a non-German citizenship over the course of their life in Germany and use the term synonymously to foreigners.

In fact, various studies for Germany find considerable wage differentials between migrants and Germans to the disadvantage of migrants. Lehmer and Ludsteck (2011, 2015) provide evidence for a notable entry pay gap between migrants and Germans of 56.6 percent which is regarded as particularly high compared to other countries (Dustmann and Glitz 2011). However, the literature on migrant native wage gaps documents various explanations for observed wage differentials: Migrants have lower reservation wages (Nanos and Schluter 2014), face stronger search frictions (Hirsch and Jahn 2015), and show differences in the qualification structure and distribution across occupations (Hofer et al. 2017; Aldashev et al. 2012). Closely related to the occupational choice is the debate on migrants' forced selection or self-selection into low-productive occupations and task levels (Aydemir and Skuterud 2008; Bossler 2014), leading to wage inequalities.

International literature on the migrant-native wage gap emphasizes the potential lack of migrants' experience and assimilation (Chiswick 1978). Studies for Germany indicate lower returns to labor market experience for migrants (Schmidt 1997; Zibrowius 2012), which hampers wage convergence between migrants and Germans. Further studies discuss language barriers and its effect on assimilation and inequality (Barrett et al. 2012; Chiswick and Miller 2002, 2003). For Germany, Himmler and Jäckle (2017) provide evidence for equal wages, once language differences are considered. In addition to the individual-specific differences, recent literature on migrant-native wage differentials focus on firm characteristics and firm wage policies (Gerard et al. 2018; Dostie et al. 2020). According to the results of Dostie et al. (2020), firms might affect the migrant-native wage inequality by two channels: A migrant specific sorting between firms and a relative wage setting effect within firms.

Previous studies on wage differentials, not controlling for firm characteristics (Aldashev et al. 2012) or only in part (Lehmer and Ludsteck 2011, 2015), provide biased results. Accordingly, the unexplained wage differences might result from sorting in firms, differences within firm wage policies or unobserved influences rather than discrimination. Lastly, previous German evidence often focuses on immigration determined by low skilled individuals and is thus inappropriate for the current discussion (Lehmer and Ludsteck 2011, 2015).

We contribute to the existing literature in different ways: By analyzing the migrant-native wage gap for skilled workers, which hold vocational or university degrees, we address the particularly important debate on skilled immigration in the course of demographic ageing. Using a large heterogeneous sample of migrants with respect to individual and job information, we are able to present a general picture not restricted to specific and selective migrant groups. Further, the comprehensive sample provides a large overlap in characteristics between migrants and Germans, leading to particularly valid estimations. Considering observed and unobserved firm information, we precisely determine the effect of firms on wage differences and identify firms' wage setting policies. Furthermore, we assess different aspects of migrants' labor market integration, such as acquiring vocational qualification or naturalization and its effect on migrants' wages and, thus, wage differentials between migrants and Germans. The relevance of our findings goes beyond Germany, as the topic of labor market driven immigration is of great importance for industrialized countries with demographic ageing patterns (Serrano et al. 2011).

Methodically, we employ the threefold Oaxaca-Blinder decomposition and underpin our findings using the quantile decomposition according to Chernozhukov et al. (2013) as well as a matching procedure, and perform substantive sensitivity analysis. Analysing a large high-quality linked employee-employer administrative dataset for Germany with more than 1.3 million individuals, our results show that the majority of the wage gap for skilled workers is explained by observable factors. We find that differences in labor market experience and firm characteristics contribute to the migrant-native wage inequality the most. In contrast to the studies mentioned above, we show negligible differences in returns to characteristics from an economic perspective. Thus, skilled migrant workers, who hold vocational or university degrees, are able to provide the same performance as Germans within the same occupations and task levels, making the migrant status irrelevant. Thus, our results reveal rather equal payment policies by firms as soon as migrants work in the same occupation and task level as Germans. However, we find slight indications for (forced) selection to the disadvantage of migrants. We deepen the discussion on selection and crowding but we cannot identify strong indicators.

Regarding the integration debate, we provide explanations for flatter experience curves of migrants. These flatter experience curves are mainly driven by workers without valid vocational qualification. Indeed, once migrants hold vocational training degrees and acquire more experiences in the German labor market, wages converge to German levels. Moreover, we find an 11 percent wage premium for migrants with a vocational degree compared to migrants without vocational degrees, holding all other variables constant. Furthermore, our results indicate a wage increase of 16.9 percent for naturalized migrants, compared to migrants holding foreign citizenship. Additional analysis for returns in wages resulting from a change from part-time to full-time work is treated rather equally between migrants and Germans.

Based on our results, we derive political implications for immigration policies. As skilled migrants are treated equally and are an important resource for firms' labor demand in the light of demographic ageing, qualification measures for unskilled migrants can reduce migrant-native inequality. Furthermore, efforts in the recognition of qualification acquired abroad should be intensified. These measures contribute to the avoidance of migrants' flatter experience curves and reduce the issue of forced selection or crowding in sectors with lower productivity.

This article is structured as follows: The next section provides a brief overview of immigration to Germany to contextualize and the estimation method and identification-related issues. Data, variables as well as the empirical analyses is discussed in the next step. Finally, the last section of this chapter concludes by providing political implications and a further outllok.

3.2 Migration in Germany

With more than 13 million, Germany has the highest number of foreign-born immigrants in the European Union (EU) and is the second-largest destination for immigrants in the OECD (OECD 2019). Germany's large immigration waves started with the influx of guest workers during the (West) German Economic Miracle from 1955 onwards (Kogan 2011). These guest workers were mainly employed in the industrial sector, performing manual tasks, and were characterized by low education levels (Green 2013). Between 1973 and 1990, net immigration to West Germany was rather limited and low (Kogan 2011). In East Germany, the immigration of migrants was mainly limited to contract workers from Vietnam (Bade and Oltmer 2004).

With Germany's reunification in 1990, new immigration waves arrived, primarily with low-skilled immigrants (Green 2013). Between 1990 and 1999, about 2 million ethnic Germans migrated to Germany, mainly from the former Soviet Union and Poland (Green 2013). Ethnic Germans are migrants with German ancestors who had privileged immigration rights and gained

German citizenship (Green 2013). We cannot identify ethnic Germans in our data precisely, as they obtained German citizenship mostly immediately after arriving in Germany.

During the same period, there was a considerable refugee migration from former Yugoslavia to Germany. The majority of these refugees returned to their home countries as soon as the conflicts in Yugoslavia ended (Bade and Oltmer 2004). The trend of mainly low-skilled immigration ended abruptly after the 2008 global financial crisis. The crisis led to an increased immigration from Greece, Italy, Portugal, and Spain and raised the share of newly arriving migrants holding a university degree to over 45 percent (Seibert and Wapler 2020). At the same time, EU laws on the free movement of labor have increased immigration from Eastern Europe to Germany since 2011 (EU-8)[8] and 2014 (EU-2)[9] according to Seibert and Wapler (2020). In contrast, the most recent immigrants, who immigrated to Germany due to humanitarian reasons, again show considerably lower qualification levels on average (Seibert and Wapler 2020).

This review shows a heterogeneous migrant population in Germany particularly in terms of vocational qualification structure. This heterogeneous structure makes Germany particularly suitable for deriving and comparing various insights on different subgroups, contributing to a wide reach of our results beyond Germany. Other countries may benefit from potential issues and differences between migrant groups in Germany and consider them when developing their integration and immigration policies.

3.3 Estimation issues and research design

To analyse the wage differential between migrants and natives in Germany, we build on the Mincerian wage equation as a theoretical workhorse (Lemieux 2006). The wage equation explains the individual wage by individual characteristics such as age, gender, and education. The wage equation can be augmented by additional factors describing the job and firm, among others (Heckman et al. 2006). In order to analyse the wage differential between migrants and Germans, we employ the Oaxaca-Blinder decomposition (hereafter OB decomposition) according to Oaxaca (1973) and Blinder (1973). The orthodox OB decomposition splits the wage differential between two groups into two parts (twofold decomposition), an explained and an unexplained part. The explained part refers to the observed characteristics while the unexplained part refers to the difference in coefficients and intercepts. This decomposition, as well as its modifications and

[8] The EU-8 countries are: Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, and Slovenia
[9] The EU-2 countries are: Bulgaria and Romania

newer applications are very popular for the analyses of wage differentials and are often applied by related studies (Lehmer and Ludsteck 2011, 2015; Brenzel and Laible 2016; Hofer et al. 2017; Fuchs et al. 2021). For our present study, we slightly deviate from the orthodox twofold decomposition and employ the so-called threefold decomposition according to Jones and Kelley (1984). Further, for robustness purposes, we additionally conduct a quantile decomposition according to Chernozhukov et al. (2013) and therefore consider more recent methodology as well.

In order to illustrate the reasoning for the threefold decomposition and its differences to the orthodox approach, we start below by deriving the twofold decomposition according to Oaxaca (1973) and Blinder (1973). We start with two equations:

$$Y_i^N = ß_0^N + \sum_{j=1}^{n} ß_j^N X_{ji}^N + u_i \tag{1}$$

$$Y_i^M = ß_0^M + \sum_{j=1}^{n} ß_j^M X_{ji}^M + u_i \tag{2}$$

where equation (1) and (2) represent the Mincerian wage equations for natives (1) and migrants (2). Here, *Y* refers to the log daily wage for individual *i,* $ß_0$ is the intercept and $ß_j$ is the coefficient for the j-th individual variable X_j included in the estimation. u_i is the remainder error component with $\mathbb{E}(u_i|X_i) = 0$. In order to analyze the wage differential between natives and migrants, we can write the wage differential between both groups as a difference in both wage equations:

$$Y_i^N - Y_i^M = ß_0^N - ß_0^M + \sum_{j=1}^{n} ß_j^N X_{ji}^N - \sum_{j=1}^{n} ß_j^M X_{ji}^M \tag{3}$$

note that in equation (3) the error component u_i drops out due to $\mathbb{E}(u_i|X_i) = 0$. Equation (3) can be extended by the counterfactual setting of native's coefficients weighted by migrants' characteristics: $\sum_{j=1}^{n} ß_j^N X_{ji}^M$ and $-\sum_{j=1}^{n} ß_j^N X_{ji}^M$ leading to equation (4) below.

$$= ß_0^N - ß_0^M + \sum_{j=1}^{n} ß_j^N X_{ji}^N - \sum_{j=1}^{n} ß_j^M X_{ji}^M + \sum_{j=1}^{n} ß_j^N X_{ji}^M - \sum_{j=1}^{n} ß_j^N X_{ji}^M \tag{4}$$

Further, equation (4) can be reduced to the following form:

$$\Delta Y = \underbrace{ß_0^N - ß_0^M + \sum_{j=1}^{n} X_j^M (ß_j^N - ß_j^M)}_{\text{Unexplained part}} + \underbrace{\sum_{j=1}^{n} ß_j^N (X_j^N - X_j^M)}_{\text{Explained part}} \quad (5)$$

leading to (5), which is the usual twofold Oaxaca-Blinder decomposition and splits the wage differential in two parts. The first part is often regarded as the unexplained part, consisting of differences in intercepts, as well as differences in coefficients between migrants and natives. Note that the unexplained part also refers to information not considered in the data (Hofer et al. 2017), such as differences in language proficiency of migrants, potential labor market experience gathered abroad or similar. In contrast, the explained part consists of differences in characteristics between both groups, such as differences in age, occupational or regional distribution (see chapter 3.4 for a detailed description on the considered characteristics). Note that equation (5) shows the wage decomposition with natives as the reference, since the difference in characteristics is multiplied by the vector of native's coefficients $ß_j^N$. This can be changed, if equation (3) is extended with $\sum_{j=1}^{n} ß_j^M X_{ji}^N$ and $-\sum_{j=1}^{n} ß_j^M X_{ji}^N$ instead (migrants' coefficient vector). However, regardless of the chosen extension and the following reference group, the twofold decomposition shown in equation (5) has one major shortcoming, which is often neglected, as most studies do not discuss the differences in coefficients and characteristics in detail. This shortcoming refers to the different references within the wage decomposition. While differences in coefficients are multiplied by migrant's characteristics, differences in characteristics are multiplied by natives' coefficients. Therefore, a detailed and simultaneous discussion of the coefficient effect (differences in coefficients weighted with the characteristics vector) and endowment effect (differences in characteristics weighted with the coefficient vector) might be restricted, as two different references are employed.

One solution to this issue is the threefold decomposition, which is used by Jones and Kelley (1984). In order to derive this version of the wage decomposition, we refer first to the fact that native workers coefficients and characteristics can be written as migrants' characteristics and coefficients plus the difference in both terms between the groups. This is shown in the following: $X^N = X^M + (X^N - X^M)$ and $ß^N = ß^M + (ß^N - ß^M)$. Including these definitions in equation (1) leads to the following equation:

$$Y_i^N = ß_0^N + \sum_{j=1}^{n} [ß_j^M + (ß_j^N - ß_j^M)][X_j^M + (X_j^N - X_j^M)] \quad (6)$$

Where in equation (6) native workers' wages are written as migrants` wages plus the difference between natives and migrants' wages. Multiplying out all terms in equation (6) can be further written as:

$$= ß_0^N + \sum_{j=1}^{n} ß_j^M X_j^M + \sum_{j=1}^{n} ß_j^M (X_j^N - X_j^M) + \sum_{j=1}^{n} X^M (ß_j^N - ß_j^M) + \sum_{j=1}^{n} (ß_j^N - ß_j^M)(X_j^N - X_j^M) \quad (7)$$

Including equation (7) in equation (3) leads to the so-called threefold decomposition shown in equation (8) below:

$$\Delta Y = (ß_0^N - ß_0^M) + \sum_{j=1}^{n} X_j^M (ß_j^N - ß_j^M) + \sum_{j=1}^{n} ß_j^M (X_j^N - X_j^M) + \sum_{j=1}^{n} (ß_j^N - ß_j^M)(X_j^N - X_j^M) \quad (8)$$

note that the above-depicted decomposition in equation (8) assumes migrants as a reference for the coefficient as well as endowment effect. However, for our empirical analyses, we use native workers as a reference. This case is provided below in equation (9) and results if we employ the definitions $X^M = X^N - (X^N - X^M)$ and $ß^M = ß^N - (ß^N - ß^M)$ in the above equation (2) and conduct the same steps as before (Rahimi and Nazari 2021). This leads to the following wage decomposition for our case:

$$\Delta Y = \underbrace{(ß_0^N - ß_0^M)}_{\text{i}} + \underbrace{\sum_{j=1}^{n} X_j^N (ß_j^N - ß_j^M)}_{\text{ii}} + \underbrace{\sum_{j=1}^{n} ß_j^N (X_j^N - X_j^M)}_{\text{iii}} + \underbrace{\sum_{j=1}^{n} (ß_j^N - ß_j^M)(X_j^N - X_j^M)}_{\text{iv}} \quad (9)$$

Equation (9) shows the final decomposition, which is used below in the analysis. Note that this threefold wage decomposition is also casually referred to as the threefold OB decomposition, although it goes back to Jones and Kelley (1984). In what follows, we will be referring above stated threefold wage decomposition as OB decomposition and follow hence the majority of the literature, and, refer to the idea of explained and unexplained differentials (Oaxaca 1973; Blinder 1973). In equation (9), the first term (i) relates to the difference between both constants and is considered as a part, which is not explained either by differences in characteristics (iii) or

differences in coefficients (ii). However, the first term (i) is usually considered as a part of the second term (ii) (coefficient effect), which is the difference between both groups' coefficients multiplied by the native workers' vector of characteristics. The third term (iii) in the decomposition is the difference in characteristics between migrants and natives (endowment effect), which is multiplied by a vector of natives' coefficients. The fourth (iv) and last term is called the interaction effect and relates to a simultaneous difference effect, emerging from a simultaneous change in both, coefficients *and* endowments. As the first part (i) of equation (9) is usually considered to be a part of the second term (ii), the above shown equation is referred to as threefold decomposition. Note that this three-fold decomposition shown in equation (9) now solves the above-mentioned problem of the orthodox twofold decomposition, which uses different references within the estimation. In the threefold decomposition, both, differences in coefficients and characteristics are now multiplied with natives' vectors and hence has only one reference.

According to the Mincerian wage equation, we relate differences in coefficients as differentials in productivity. If no significant differences in the coefficients can be observed, we conclude that migrants possess the same productivity levels as native workers.

With regard to the choice of native or Germans as the reference group, there might result different issues, as reference group workers should be neither discriminated against nor preferred over migrants. As Ludsteck and Lehmer (2011, 2015), we choose the reference group based on randomly selected native workers who worked in the same firms as migrants (2011, 2015). However, we conducted additional analyses with a second group of German workers as a reference, working in firms having no migrants employed since 2010. This group should ensure no biased coefficients within a firm. The results for this group do not provide any noteworthy changes as shown in Brunow and Jost (2019).

To shed light on the relevance of firms and firm policies on wage differentials, we control for firm covariates related to firm productivity and take firm-specific heterogeneity into consideration. In addition, we use the Card-Heining-Kline (CHK) (2013) firm- and person-specific effects to consider unobserved heterogeneity, such as collective agreements, firm management style, or individuals' personality, respectively. These effects account for firm-specific wage premiums that are not observed by the employees' or employers' endowment levels and thus provide unbiased results.

Moreover, we carefully consider foreigners' potential (forced) selectivity into poorly paid jobs, which is often treated rather superficially in the existing literature for Germany such as by Lehmer and Ludsteck (2011, 2015) or even neglected, as in the study of Aldashev et al. (2012). Several

sensitivity checks are performed, such as selectivity into occupations and task levels. In addition, we examine typical and untypical occupations as comparison groups (Ludsteck, 2014). Furthermore, we compare migrants who exhibit high upward mobility during their employment periods in Germany (i.e., a group of migrants who potentially escaped forced selection or discrimination). Finally, to illustrate the economic relevance of differences in characteristics, we convert the results into wage effects.

3.4 Data source, variables, and descriptive analysis

Data and sample restrictions

We use the Integrated Employment Biographies (IEB) provided by the Institute for Employment Research (IAB), which is generated from administrative processes and is highly reliable due to its administrative character. The IEB contain information on all employees working subject to social security contributions, excluding civil servants and self-employed, and cover over 80 percent of the German labor force. Another frequently used German data set is the Socioeconomic Panel (SOEP), which is provided by the German Institute for Economic Research (DIW). However, this data offers information on considerably fewer employees than the IEB, and therefore no separate analysis on migrant subgroups can be conducted. Additionally, no solid information at the firm level is available, which is of key importance for our analysis, as a lack of firm information leads to a substantive omitted variable bias. We therefore prefer the IEB with regard to our object of investigation.

We examine a cross-section of individuals in employment on 15 September 2015. The sample comprises information on 10 percent of all migrant employees in Germany and an oversampled group of about 20 percent of German employees. The sample covers information on individual employment and unemployment periods from 1975 to 2015. Thus, we can construct individual measures on the basis of the entire employment biographies, such as labor market experience and the proportion of time spent in unemployment.

Although a panel setting can better control for unobserved individual heterogeneity, most of our variables of interest would be collinear with the individual effect or provide little within-variation. We therefore use workers' employment histories to construct measures related to individual heterogeneity. Another disadvantage of a panel structure is that changes in productivity due to technological progress would affect the coefficient effect in the OB decomposition. An unclear picture of wage differentials results: Technological progress may lead to a bias in labor

demand and cannot be separated from discrimination (Card and DiNardo 2002). Lastly, we use CHK individual and firm effects to account for unobserved heterogeneity.

In general, we apply as few restrictions as necessary to our sample and include as many individuals as possible to better represent the labor force. Therefore, in contrast to previous studies (e.g. Lehmer and Ludsteck 2011, 2015), we do not limit our sample to men. Indeed, women are of interest for labor market immigration policies as well, since about one-third of all employed immigrants in Germany in trained positions are women (Graf and Heß 2020). However, we restrict our sample to employees working full time and in regular employment and subject to social security contributions. This results mainly due to the fact, that our data does not provide information on working ours, which increases the deviation in wages of part-time workers. However, we take part-time workers into account in the discussion section. Further, our analysis includes no trainees, interns, or workers who are employed in small scale jobs (mini jobs). Instead, with regard to the current political debate in immigration, we restrict our sample to workers with vocational education and training and individuals with university education, both designated as skilled workers. Nevertheless, to show and compare the importance of recognizing and acquiring vocational degrees, we consider migrants and natives without vocational or university education as well.

Focusing only on full-time employees conveys some important implications that are worthy of discussion. As Wolf (2014) shows for Germany, both male and female persons working full-time exhibit different wage dynamics and earn considerably higher hourly pay rates than their counterparts working part-time. These differences between part- and full-time wages partly results from selection and unobserved individual heterogeneity (Wolf 2014). We assume, thus, that migrants working full-time might be a positively selected group and are less likely to be crowded into specific tasks, occupations, and part-time employment. Their language skills could also be better. Therefore, skilled full-time working migrants are more suitable for our analysis in terms of immigration legislations with higher labor market proximity.

Since most second-generation migrants in Germany are likely to be registered in our data as Germans, our approach is limited to first-generation migrants. However, this limitation does not contradict our research question, as we focus on migrants who did not pass through the German school system. As a result, these migrants not only have a certain “handicap” in terms of knowledge and human capital specific to Germany but are also confronted with language barriers. In this context, our approach enables us to identify potential deviations in the coefficient effect, which can help determine crucial explanations of wage differentials between the migrants and

natives. On the basis of employment histories, we exclude all individuals who entered Germany as foreigners and subsequently acquired German citizenship. Since the group of naturalized employees seems to perform particularly well in our analysis, we use them later as another comparison group to study the integration process. Finally, we apply two important data correction methods. The first relates to the imputation of the education variable, as suggested by Fitzenberger et al. (2005), to correct for implausible and missing information. Therefore, we only use observations with valid information on education attainment. The second correction is suggested by Card et al. (2013) and imputes wages above a truncation value equivalent to the upper earnings limit for social security contributions. This limit is typically exceeded by highly skilled individuals. Therefore, we perform a sensitivity check on a subsample excluding highly skilled employees.

Variables

Table 1: Individual characteristics

Variable	Description
Personal characteristics (INDIVID)	
Gender	Indicator of gender (1=female, 0=male)
Age	Categorical variable representing the individual's age, consisting of five groups: 16-24 years old, 25-34 years old, 35-44 years old, 45-54 years old, 55-64 years old
Educational attainment and vocational training (EDUC)	
School qualification	Categorical variable of highest school qualification, consisting of three groups: no school qualification, intermediate school-graduate certificate and upper secondary school-graduate certificate (Abitur / higher education entrance qualification)
Vocational qualification	Categorical variable of highest vocational qualification, consisting of two groups: vocational qualification and university degree
Labor market experience (Exp)	
Observed time in data	Categorical variable indicating four quantiles of the distribution of years observed in the data
Share of time in data not employed	Categorical variable representing the share of time observed in which a worker was not in employment: <5%, >5% and <10%, >10% and <25%, and >25% and <75%
Ln mean duration	Log of no. of years working per firm
Ln firm duration	Log of years working in current firm
Selectivity-related variables on location, industry and occupation	
Regions (*LM-REGION*)	Categorical variable encompassing 141 labor market regions in Germany according to Kosfeld and Werner (2012).
Occupation (*OCC*)	Categorical variable encompassing 50 occupations according to the occupational classification system KldB-2010 (related to ISCO-08)
Task level (*TASK*)	Categorical variable representing three different task levels of the job. It consists of three groups: auxiliary activity (helper), trained/ professional assistant, and specialist/ expert
Industry (*IND*)	Categorical variable encompassing 96 distinct industries at the 2-digit level according to the German classification scheme WZ-2008 (NACE Rev. 2.)
Supervisor	Dummy variable indicating if an employee is a supervisor
Executive	Dummy variable indicating if an employee is an executive
Characteristics for robustness checks	
Card-Heining-Kline individual FE	Individual-specific and firm-specific effects defined by Card, Heining and Kline (CHK) (2013) that capture all unobserved characteristics. By using the CHK effects, our sample is shortened so that we use this information as robustness.
Life-course wages	Log of the average inflation adjusted wage earned during the life course as an alternative measure on individual performance.
Individual FE	Estimated using the entire employment history of each individual on the basis of a Mincerian Wage equation, corrected for experience, occupation and education related variables, fulltime/part-time employment, region and industry FE, and gender. Used as an alternative of the CHK effects.

Table 1 reports the individual characteristics such as gender, age, or vocational qualification. With regard to workers age, we prefer the inclusion of a categorical classification encompassing 5 age categories. In contrast to the inclusion of numerical age information, this approach can better capture sharp changes in effect monotony of workers age on workers wage. This might be the case for transitions from junior positions to senior job positions or other related threshold linked to age groups, which counteract effect monotony of workers age on workers wage. We discuss an alternative approach in the discussion sector.

Furthermore, for our analysis we use information from employment biographies and construct variables containing time in employment and unemployment. The variable considering the time in unemployment is particularly important to account for differences between migrants and natives, as migrants are usually more often unemployed during their biography (see chapter 5). The same applies for employment duration in the current firm and average employment duration per firm in the employment biographies, which provides a further insight into potential differences. The latter variable, average duration per firm, helps us to identify workers who frequently change employers during their employment biographies, which might affect wage growth (Jinkins and Morin 2018).

In order to account for regional influences, we control for labor market regions. This approach enables us to consider e.g. larger labor markets, which might be relevant for workers and their job possibilities than the usual NUTS-3 region. This is particularly important to consider workers living in e.g. rural areas but commuting over NUTS-3 region borders into metropole areas. Further, we control for occupational information using a classification encompassing 50 different occupations. We tried two different alternatives, which are mentioned in the discussion section but did not improved nor changed the provided conclusion. Furthermore, we include a categorical variable encompassing information on 96 industries (2-digit level), which provides detailed information on the industry sector. An alternative classification is discussed in the discussion sector as well. In addition, we consider information on task levels and whether the worker is a supervisor or executive.

To account for unobserved heterogeneity, we include CHK individual and firm effects (Card et al. 2013). Moreover, we compute individual effects and life-course wages, both estimated on the entire employment biographies for each individual as an alternative to the CHK effects for robustness purposes.

As shown by Dostie et al. (2020), wage differentials might result not only due to differences in individual characteristics but also due to differences in firm performance. Therefore, we consider several firm variables in our decomposition, as shown in Table 2. Important variables contain

information on firm size and human capital intensity, as these variables have a considerable impact on firm productivity (Brunow and Nijkamp 2018) and, consequently, potentially on individuals' wages. To capture workforce diversity, we add information on the share of females and youth within the firm, as these shares might have an effect on workers' overall productivity. Lastly, we consider firm age as a measure of a firm's established status. For robustness purposes, we take into account CHK firm effects and the proportion of foreigners, as these variables provide information on possible segregated ethnic communities.

Table 2: Firm characteristics

Variable	Description
Key firm variables (FIRM)	
Firm size	Categorical variable representing the number of employees and consisting of four groups: 1-9 employees, 10-49 employees, 50-249 employees and above 250
Females	Proportion of females employed in the firm
Youth	Proportion of employees under 35 years of age
Human capital intensity	Two variables capturing the human capital intensity of the firm: first, the proportion of professional assistants employed, and second, the proportion of specialists/experts employed, each as a share of total employment in the firm
Firm age	Categorical variable representing the firm age in years, consisting of the groups: under 5 years old, 5-10 years old, 10-25 and over 25 years old
Characteristics for robustness checks	
Card-Heining-Kline effects	Firm-specific effects defined by Card, Heining and Kline (2013) that capture all unobserved characteristics. As this information is not provided for all firms in our sample, we use this for robustness purposes.

Descriptive Analyses

Table 3 provides a descriptive overview of the gross wage distribution between migrants and natives. German workers earn a daily median wage of € 124.82, whereas migrants have a median wage of € 98.66. Therefore, migrants earn on average 21 percent less. The wage disadvantage for migrants does not change if we differentiate employees according to their age structure, gender, task levels, and vocational training degrees. German workers earned considerably higher wages than migrants.

Table 3: Distribution of daily gross median wages for full-time employees (in €)

Gross daily wage in €	Migrants	Germans	Wage gap Migrants/Germans
Median wage	98.66	124.82	0.79
Females	89.56	108.95	0.82
Males	100.75	132.90	0.75
<25 years	70	88.80	0.79
25-34 years	96.25	111.01	0.87
35-44 years	102.84	132.56	0.78
45-54 years	99.66	136.75	0.73
55+ years	100.98	130.15	0.78
Task levels			
Auxiliary (helper)	69.77	83.95	0.83
Trained/professional	91.41	111.15	0.82
Specialist/expert	153.74	168.33	0.91
Vocational Qualification			
Vocational Training	87.43	113.21	0.77
University degree	150.27	187.05	0.80

Notes: Source IEB, only full-time workers with valid information on educational attainment and vocational Qualifications.

Wage differentials might result from differences in firm size as Table 4 reports. Accordingly, migrants are more often employed in smaller firms, whereas Germans are more often employed in larger firms. The wage gap decreased to about 9 percent and was smallest in large firms with more than 250 employees. Moreover, no noteworthy difference in human capital intensity and the proportion of females can be observed. Note that high skilled are defined as workers with an academic qualification, while skilled workers are defined as workers with a vocational training.

Table 4: Descriptives of firm characteristics within each group

	Germans	Migrants	Germans	Migrants	Wage gap
Firm size (No. of workers)	Distribution in %		Gross daily median wages in €		in %
<10	11.6	25.0	77.59	70.65	91.1
10 to 49	39.6	35.2	90.48	82.88	91.6
50 to 249	34.2	29.3	106.48	93.51	87.8
>=250	14.6	10.5	138.59	132.58	95.7
Other firm characteristics					
	share high skilled	share skilled	share females		
Germans	23.8 %	55.9 %	38.1 %		
Migrants	22.6 %	56.8 %	33.5 %		

Notes: Source IEB, only full-time workers with valid information on educational attainment and vocational Qualifications.

3.5 Results

Oaxaca-Blinder decomposition

We start by estimating the Mincerian wage equation for each group separately and testing OLS results' validity because the OB decomposition builds on these equations. As we use normalized coefficients for categorical variables, our results can be interpreted as deviations from the mean and are, thus, not dependent on reference categories (Yun 2005). This approach of normalized coefficients is important for interpretation of categorical variables, where the usual approach is to omit a category, which might lead to outcomes subject to individual decision. Further, we carry out our analysis from the perspective of German workers. This perspective is a matter of choice and does not affect the results. In the main analysis, we focus only on skilled workers holding vocational qualifications or university degrees, which results mainly due to large policy discussion on skilled labor. However, results for workers without vocational qualification are provided as well in the appendix and discussed below. For the sake of brevity, in the following we refer only to the main outcomes and drivers of the wage decomposition. Further, for a better interpretation we report estimates in exponential form since we use the logarithm of daily wages for the decomposition.

3.5.1 Main results

Table 5 presents the decomposition for the log wage differential between German and migrant workers based on equation (9) derived above. Our main model in column 1 includes all variables listed in Table 1 and Table 2 (without variables mentioned for robustness purposes). In column 2, we estimate the model from column (1) but omit task levels, and in column 3, we omit both task levels and occupation indicators. This approach takes into account a potential glass ceiling and

workers being forced into specific tasks and occupations, as the between-task and between-occupation variation potentially increases. Lastly, column 4 excludes firm characteristics.

Table 5: Threefold wage decomposition for mean wages: Main specification

	(1)	(2)	(3)	(4)
Wage Migrants/Germans	0.779	0.779	0.779	0.779
Endowments	0.790***	0.795***	0.817***	0.820***
	(0.003)	(0.003)	(0.003)	(0.003)
Coefficients	0.982***	0.977***	0.956***	0.942***
	(0.002)	(0.002)	(0.002)	(0.002)
Interaction	1.004*	1.004*	0.997	1.008***
	(0.002)	(0.002)	(0.002)	(0.002)
Task FE	yes	no	no	yes
Occupation FE	yes	yes	no	yes
Firm controls	yes	yes	yes	no
N	1.344.478			
No. migrants	96.334			
No. Germans	1.248.144			

Notes: Source IEB, only full-time workers with valid information on educational attainment and vocational qualifications. * 10%, ** 5%, *** 1%, cluster robust s.e. at firm level in ().

Results of our first decomposition (column 1) reveal that migrants earned 22.1 percent lower wages than Germans. This difference is almost fully explained by differences in observable endowment levels. Adjusting German workers' endowment levels to migrants' endowment levels (evaluated in terms of German productivity levels) would lead to a decrease in German workers' wages by 21 percent (equivalent to € 26.21 gross wage per day). This wage decrease roughly amounts to the wage differential. According to this decomposition, an unexplained wage differential in favor of German workers of 1.1 percent (0.79 – 0.779) exists (€ 1.38 gross wage per day). The coefficient effects, which are related to productivity differentials, indicate significant differences of -1.8 percent (column 1). The economic extent of this effect in monetary terms is rather negligible (€ 2.25 gross wage per day). Finally, the interaction term represents a simultaneous effect of differences in endowments and coefficients and is negligible since its effects is almost not present (0.004).

The decomposition in columns 2 and 3 shows that the unexplained premium for German workers increases if we omit both the task level and occupation fixed effects from the endowment vector. This increase can be traced to growing differences in the coefficient effects, resulting due to the omission and indicating disadvantages for migrants accounting for approximately € 3.25 gross daily wage. This increase in coefficients might indicate discrimination through the channel

of forced selection. We therefore conclude that policy programs for preventing discrimination should aim to prevent forced selection into specific tasks and occupations, as this downgrading may potentially result due to discrimination. We deepen this discussion about potential crowding in robustness checks but can hardly find further and stronger indicators for it.

In column 4, we stress the importance of the firm side in the considered wage differential and exclude firm controls. The coefficient effect in column 4 becomes pronounced (-5.8%). Furthermore, omitting firm controls, tasks, and occupation fixed effects, the coefficient effect becomes even more negative, with -8.9 percent (estimation not shown). As studies on the migrant-native wage gap often do not control for firm characteristics (e.g. Aldashev et al. 2012), or not in such detail (Lehmer and Ludsteck 2011, 2015), the estimates may suffer from a serious omitted variable bias.

Detailed analyses of endowment and coefficients

To gain a deeper insight into the wage decomposition, we disentangle the overall effects of Table 5 in Table 6 and group the characteristics according to the variable groups listed in Table 1and Table 2. It is noteworthy that due to the large data set, statistical significance does not necessarily imply economic relevance. We therefore express the wage differential measured in gross Euros per day for the average wage.[10]

Starting with the detailed analysis of the endowment effect, as shown in Table 6, column 1 based on the reference decomposition (i.e., Table 5, column 1), our results reveal that the wage differential's main drivers are lower levels in endowments in labor market experience (EXP) and differences in firm characteristics (FIRM). Differences in labor market experience are linked to a younger age structure of migrants. Adjusting the level of labor market experience of German workers to that of average migrant workers would lead to a wage decline of 10 percent (€ 12.5 gross wage per day), holding all other variables constant. Migrants are more frequently employed in smaller firms, as shown in Table 4. Therefore, differences in endowments account for € 8.11 in firm characteristics (FIRM), € 3.49 in industry (IND), € 3.37 in occupation (OCC), and € 3.25 in task levels (TASK). The wage differential is not substantially explained by the regional

[10] We are confronted with the OB decomposition's path dependency (Fortin et al. 2011). According to this path dependency, each effect's size varies across different orderings in the estimation, i.e. the effect of education might change if is included as the last variable into the regression instead of first. Since there is no satisfactory solution to this problem, we compute the change in daily gross wages for each of the 40,320 possible combinations of orderings. The results vary in magnitude, but the interpretation remains the same leading us to the conclusion, that path dependency does not lead to other interpretations.

distribution (RAM), individual characteristics (INDIVID), or educational attainment (EDUC). The latter results from of our research design, as we consider only skilled employees for the decomposition in our main decomposition leading to less variation in education between both groups.

The detailed decomposition of the coefficient effects in Table 7, column 2 provides evidence that most coefficients do not deviate in any noteworthy fashion. They are insignificant for industries (IND) or rather small (RAM, TASK, INDIVID) and cannot account for more than € 2.40 gross daily wage. Positive differences occur for occupations (OCC, € 1.25) and education (EDUC, € 2.37), which might result from over-qualification. We recognize this aspect and discuss it in more detail in the next section.

However, the firm-related coefficient effect (FIRM) leads to a distinct positive effect for migrants (€ 13.85). This outcome is mainly driven by established firms with > 250 employees and exhibit a higher youth share, which might indicate a more open culture towards migrants. In contrast, coefficient for the labor market experience (EXP) is rewarded less (i.e., € 6.99) for migrants. The lower experience coefficient indicates flatter experience curves for migrants compared to Germans, which is discussed in the next section.

Table 6: Detailed decomposition of the reference model

	Endowment Effect	Coefficient Effect
Characteristics	(1)	(2)
RAM	1.014***	0.981***
	(0.001)	(0.003)
IND	0.972***	0.998
	(0.001)	(0.004)
OCC	0.973***	1.010***
	(0.001)	(0.003)
TASK	0.974***	0.982**
	(0.001)	(0.007)
INDIVID	0.998***	0.997***
	(0.000)	(0.001)
EDUC	1.005***	1.019***
	(0.001)	(0.004)
EXP	0.900***	0.944***
	(0.002)	(0.003)
FIRM	0.935***	1.111***
	(0.001)	(0.015)
Constant		0.950***
		(0.015)

Notes: Only full-time workers with valid information on educational attainment and vocational qualifications. Combined characteristics as reported in Table 1 and Table 2; * 10%, ** 5%, *** 1%, cluster robust s.e. at firm level in ().

3.5.2 The role of experience, qualification and related labor market integration aspects

The puzzle of flat experience curves has been discussed for over 20 years in the literature on migrants' assimilation in Germany without satisfactory explanations (Schmidt 1997; Zibrowius 2012). To consider this issue in more detail, Table 7 reports the coefficient effect for the experience variables for several subgroups (organized in lines). Note that the coefficient effect refers to differences in coefficients between both groups, which are weighted by natives' characteristics. Line 1 in Table 7 shows the reference model, as described above. The restriction to several age cohorts in lines 2 to 6 reveals much lower coefficient effects, and especially from 35 years onwards, these differences become insignificant. However, the age structure itself is not equivalent to the experience structure. The coefficient effect becomes smaller the longer migrants collect experience in Germany (lines 7 to 9). These effects are mainly driven by migrants holding vocational educational training degrees (lines 10 to 12). Considering migrants who attained

vocational training for at least one year in Germany, the experience curves do not differ anymore (line 13).

Table 7: Coefficient effect for experience, age categories and subsamples

		Coefficient Effect		Observations	
		Variable Set: EXP	(s.e.)	Germans	Migrants
(1)	reference model	0.944***	(0.003)	1248144	96334
Separated by age groups					
(2)	<25 years	0.962***	(0.009)	65108	5096
(3)	25-34 years	0.958***	(0.005)	314346	28508
(4)	35-44 years	0.990	(0.006)	281130	30861
(5)	45-54 years	0.981*	(0.010)	398869	22097
(6)	55+ years	0.972	(0.019)	188691	9772
Separated by years of experience in Germany					
(7)	<=10 years	0.940***	(0.004)	234882	45731
(8)	>10 years	0.971***	(0.004)	1013262	50603
(9)	>15 years	0.993	(0.006)	820510	35834
Separated by years of experience in Germany and Education					
(10)	<=10 years; Voc. Tr.	0.957***	(0.005)	154759	27988
(11)	>10 years; Voc. Tr.	0.967***	(0.004)	801991	43224
(12)	>15 years; Voc. Tr.	0.967***	(0.004)	666816	32077
(13)	Voc. Tr. Degree in GE	1.028	(0.047)	730208	23726
(14)	<=10 years; University	0.952***	(0.008)	80123	17743
(15)	>10 years; University	0.997	(0.013)	211271	7379
(16)	>15 years; University	1.015	(0.021)	153694	3757

Notes: Only full-time workers with valid information on educational attainment and vocational qualifications. Combined characteristics as reported in Table 1 and Table 2; * 10%, ** 5%, *** 1%, cluster robust s.e. at firm level in ().

Lastly, for university degree holders, the differences in coefficients vanish after 10 years labor market experience in Germany (lines 14 to 16). Thus, differences in experience curves emerge due to migrants' lack of labor market experience in Germany and decrease in the long run. However, for migrants with vocational degrees, somewhat flatter experience profiles can still be observed after 15 years in the German labor market.

Forced downward mobility is another integration aspect and might indicate discrimination (Borjas 1987). Table 5 shows slightly increasing unexplained differences omitting both task and occupation indicators. All characteristics, especially education-related variables that are correlated with these indicators, will be biased and point toward over-qualification and forced downward mobility. We therefore compute the difference in the OLS estimates for migrants in the two models – one including, the other excluding, task and occupation effects – in a seemingly unrelated estimation setting. The hypothesis on significant parameter differentials can be rejected with 95

percent. Therefore, a bias in parameters is not present in our case. We further follow Ludsteck's (2014) approach and compare outcomes of a decomposition for occupations with large and small proportions of migrants in Germany (results not shown). Larger deviations would indicate a certain selectivity into these occupations. Our results show that the wage differential is still explained by endowments and that the coefficient effect remains similar to the main decomposition. Thus, we find little evidence of forced downward mobility.

Our results so far show that the migrant-native wage differential results from differences in endowments. These outcomes, however, are limited to our selected group of skilled workers with vocational degrees and do not provide any information on potential labor market integration processes. We assess the effect of the presence of vocational qualification for migrants and decompose the wage differential between migrants with and without vocational degrees (not shown). This decomposition results in an overall wage differential of 16.9 percent in favour of skilled migrants and is especially driven by considerable differences in coefficients for task levels and occupations. Further, the constant, which represents all unobserved effects accounts for 11.7 percent. This result implies, holding all other variables constant, vocational qualification is related to a wage increase of 11.7 percent (€ 10.22 daily wage). The effect is even stronger for younger migrant groups between 25 and 44 years, at 12.9 percent. We therefore conclude that firms have difficulties evaluating migrants' productivity without vocational degrees.

Another aspect that we identify as crucial in the debate on integration is migrants' naturalization. We conduct a decomposition for migrants who were not (yet) naturalized with migrants who had changed their citizenship to German during their employment biographies. The results show a wage gap in favour of naturalized migrants of 16.5 percent, of which 14 percentage points are explained by endowments (7% by experience, 6.5% by firm characteristics, and 0.5% by other characteristics). Another decomposition between naturalized migrants and regular German workers further reveals almost no differences in coefficients (results in Appendix A). Even differences in experience coefficients decrease to a negligible amount (1.7%). We therefore conclude that this special group has a particularly high labor proximity and is, thus, fully integrated into the German labor market.

3.6 Discussion

With regard to the discussion of our results, we divide the discussion section into two parts. First, we discuss our results with regard to the provided insights and potential policy implications as

well as further outlooks. In the second section, we discuss our empirical estimation procedure and provide additional sensitivity checks.

Policy Implications and Insight

The detailed consideration of the firm variables in the decomposition reveals that firm differences explain a considerable part of the wage differential and, further, provide an insight into the firm wage setting policy. Firms consider migrants equally in jobs and tasks as long as they provide equal educational levels and pay comparable wages. Because educational qualification degrees are essential for firms evaluating migrants' productivity and labor market integration, our results are especially important for debates on the recognition of educational qualification acquired abroad (Brücker et al. 2021). Further, the results provide evidence that naturalized migrants are fully integrated into the German labor market with similar outcomes as German workers. This leads us to the conclusion that migrants obtain rather equal opportunities regarding economic labor market integration in Germany.

Nevertheless, opportunities for further studies remain. Although the omission of task and occupation fixed effects in the reference decomposition did not change the provided picture, our results indicate a slight increase in the coefficient effect. Although we find little evidence for hidden discrimination in the detailed robustness analysis, it still might be present. Referring to Baert et al. (2015) and Weichselbaumer (2016), an analysis of migrants' job application behavior could deepen insights into potentially forced downward mobility and thus hidden discrimination, for instance, to avoid unemployment.

Additionally, our results show solid explanations for migrants' flat experience profiles, mainly due to unrecognised vocational degrees. However, we cannot fully resolve this puzzle, as especially the remaining effect of lower returns of labor market experience could be driven by unobserved language barriers. Since migrants' flat experience curves have been mentioned frequently (Schmidt 1997; Zibrowius 2012), we believe that a different approach is necessary to provide further explanations for this phenomenon. The application of qualitative research could be especially fruitful for examining the issue of hidden discrimination through forced selection, as well as flat experience curves for migrants.

Empirical Approach

In general, we tried various different empirical specifications for the wage equation and hence decomposition of wage differentials. This regards particular to adding or omitting information in the estimation, which did not changed the provided picture nor the insights. However, there are several modifications as well as additional sensitivity analyses, which are worth of being discussed. We start below by discussing general modifications or information included in the estimation procedure.

Modification

As already indicated in the variable description section (chapter 3.4), we tried different classifications of various control variables. This regards occupations, workers age and industry information. We used two different alternative occupational classifications, (i) encompassing 13 categories (Blossfeld-Occupations) according to Schimpl-Neimanns (2003) and (ii) the 5-digit occupational information, which is the most detailed information on occupations. These changes do not lead to noteworthy changes nor different outcomes. We therefore conclude that due to the detailed information used on industries and task levels, there is no bias or information loss with regard to our occupational classification. Similar applies to the included industrial classification, which we changed to a classification of nine categories according to Eberle et al. (2011). This change of industrial classification did not changed our provided insights as well.

Another issue regards the included information on workers age, as we use a categorical variable encompassing 5 categories instead of a numerical variable and its square. Using a categorical variable provides the advantages as to which it better captures changes in effect monotony as already mentioned in chapter 3.4. We tried to include alternatively workers age and its square and cubic, but it did not change our results in a noteworthy fashion. We relate this robustness to the inclusion of our other variables related to workers employment time, such as time observed in the data, average time working per firm, time working in the current firm and time employed in the observation period. Time related variables are usually correlated to changes in workers age and thus controls for such effects on workers wage.

To further strength our provided results, we conduct several sensitivity checks focusing on gender, nationality, immigration cohort, age, education or differences between East Germany and West Germany. For the sake of brevity, we discuss below the most important additional estimations but provide further results in the Appendix section as well as in Brunow and Jost

(2019). Below in Table 8, we provide decomposition results related to different nationalities working on the German labor market. The considered groups in the table are often mentioned in migration related analyses and are strongly represented in terms of numbers.

The results show considerable wage differentials between these groups compared to native worker. However, with regard to the overall endowment effect and the wage differential, almost all wage differentials are fully explained by differences in endowment levels. These differences in endowments particularly relates to firm characteristics but also to a different distribution in jobs and lower educational attainments. The largest unexplained wage differential appears for Turkish workers, which mainly results due to lower coefficient levels for experience related variables as well as task levels. This additional analysis confirms our previously provided results and picture as wage differentials are almost fully explained by differences in endowment levels and the remaining part often results due to lower rewards for labor market experience. We further conclude that our results can be generalized to the group of migrants, as there are no noteworthy differences for further nationalities (Brunow and Jost 2019).

In order to consider large differences in observable characteristics, which might lead to a small overlap in observed characteristics between migrants and Germans and thus to identification issues, we employ a matching approach. We use coarsened exact matching (CEM) according to Blackwell et al. (2009) and Iacus et al. (2011) to consider structural differences in distributions of characteristics. The CEM matching provides two possible matching feature, (i) an exact matching on certain defined variables but also (ii) a coarsened exact matching based on an automatic algorithm provided by Iacus et al. (2011). Due to the large data set, we use the coarsened exact matching algorithm instead of exact matching, as this fasten the calculation. We match on the following variables: gender, educational attainment, labor market experience as well as workers age as these variables are important on individual level. The results are provided in Appendix B and show a similar picture to the previously provided results apart for differences in the coefficient effect for labor market experience, which is negligible for this wage decomposition. This, however is also provided by the results in Table 7 and indicate that particularly over large periods of time on the German labor market, differences in coefficients especially in experience become negligible.

Table 8: Wage decompositions for different nationalities

	Turkey		EU-15		Greece, Italy, Portugal, Spain	
Wage Migrants	90.579***		108.270***		96.266***	
	(0.699)		(0.738)		(0.682)	
Wage Germans	125.203***		125.203***		125.203***	
	(0.777)		(0.777)		(0.777)	
Wage Migr./Ger.	0.723***		0.865***		0.769***	
	(0.005)		(0.004)		(0.004)	
endowments	0.750***		0.859***		0.785***	
	(0.005)		(0.003)		(0.004)	
coefficients	0.929***		1.006*		0.982***	
	(0.005)		(0.003)		(0.004)	
interaction	1.039***		1.001		0.997	
	(0.005)		(0.003)		(0.003)	
	Endowments	Coefficients	Endowments	Coefficients	Endowments	Coefficients
RAM	1.019***	0.965***	1.023***	0.984***	1.028***	0.963***
	(0.001)	(0.006)	(0.001)	(0.006)	(0.001)	(0.005)
IND	0.981***	0.994	0.983***	0.986***	0.975***	0.994
	(0.002)	(0.005)	(0.001)	(0.004)	(0.002)	(0.005)
OCC	0.929***	1.011	0.975***	1.000	0.956***	1.005
	(0.002)	(0.007)	(0.001)	(0.004)	(0.001)	(0.005)
TASK	0.938***	0.948***	0.981***	0.996	0.960***	0.983
	(0.001)	(0.018)	(0.001)	(0.010)	(0.001)	(0.015)
INDIVID	1.021***	0.989***	1.008***	1.004**	1.008***	0.997
	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)
EDUC	0.925***	0.999	0.989***	1.011***	0.961***	1.007**
	(0.001)	(0.004)	(0.001)	(0.003)	(0.001)	(0.004)
EXP	0.955***	0.956***	0.945***	0.921***	0.940***	0.928***
	(0.002)	(0.006)	(0.001)	(0.004)	(0.002)	(0.005)
FIRM	0.954***	1.166***	0.948***	1.083***	0.937***	1.089***
	(0.002)	(0.019)	(0.001)	(0.017)	(0.002)	(0.018)
Constant		0.916***		1.029		1.023
		(0.026)		(0.021)		(0.025)
No. Migrants	29.033		40.315		26.150	
No. Germans	1.379.013		1.379.013		1.379.013	
No. of firms	107.646		109.271		107.918	

Note: Source IEB, only full-time workers with valid information on educational attainment and vocational Qualifications. * 0.1, ** 0.05, *** 0.01; cluster robust s.e. at firm level in (), threefold Oaxaca-Blinder decomposition

Further additional estimates regarding workers without university degree (Appendix C), in order to ensure that our results are not driven by high wages or the used wage imputation. As the results do not change the provided picture, we consider that there is no issue related to high wage workers. The same applies, if we conduct a decomposition for each educational attainment (Appendix D) as it does not provide noteworthy differences in most parameters. However, this additional analyses provides an interesting insights, as the coefficient effect and thus differences in labor market experience is largest for workers without vocational education. This finding indicates that workers with low educational attainments contribute massively to these differences.

As we consider in our analysis both genders and thus deviate from most previous literature (e.g. Lehmer and Ludsteck 2011; 2015), we conduct a separate decomposition. The results are shown in Appendix E and confirm mainly the previous findings and conclusion but show that migrant women work more often in firms with lower productivity levels compared to migrant men. This might particularly result due to selectivity issues, as migrant males work more often regions with better economic outcomes and particularly in larger firms with higher productivity levels (Brunow and Nijkamp 2016).

Quantile decomposition

A further point regards our empirical design, as we use a decomposition approach, which might be considered as outdated. In order to take such considerations into account and apply a more modern empirical approach for the analyses of wage differentials, we follow related literature such as Barrett et al. (2012) as well as Lehmer and Ludsteck (2011, 2015) and use a quantile decomposition. We apply the decomposition method according to Chernozhukov et al. (2013) and provide the estimated results in Table 9 below. Note that due to computational restrictions, we are unfortunately not able to provide standard errors and no detailed insight into endowments and coefficients as shown previously.

Table 9 provides estimates, where log wage differentials $Y^N - Y^M$ are explained by differences in endowment and coefficient distributions between both groups. This approach estimates in our case a counterfactual distribution with native's log wage Y^N as the dependent variable on migrant's endowment levels X^M. Therefore, the interpretation of the endowment effect refers directly to changes in the wage differential for the counterfactual case when migrants would possess the same endowment levels as native workers. For this estimation, we use a similar estimation specification as for our baseline estimation in model (1), where all relevant variables are included.

We start by focusing on the 0.5 (50) percentile (Table 9), which is the most similar case to our baseline scenario providing estimates on arithmetic averages. The log wage differential amounts to 0.44 (top of the table). This different is almost fully explained by differences in endowment levels since the endowment effects amounts to 0.43, which implies that of the 0.44 differential (log wage) 0.43 is explained by endowment differences. Accordingly, there is only a small coefficient effect (0.006), which is usually related to the unexplained residual. Similar results are provided for the 0.9 (90) percentile wage decomposition. The difference amounts here to about 0.36, where 0.33 is explained by differences in endowments.

However, the case for the 0.1 (10) percentile provide somewhat different results. The difference in log wages between migrants and Germans amounts to 0.43, while the endowment effect is 0.54. Accordingly, migrants in the 10 percentile would earn higher wages by about 0.11 log daily wage (0.54 – 0.43) than natives, if migrants would have similar endowment levels as natives. This finding might point towards a disadvantage for migrants in lower distributions. However, this relates particularly to migrants in the 0.1 (10) and 0.2 (20) percentile. The majority of the results provided for the entire wage distribution are more in line to our previous findings. This regards particularly to the fact, that especially migrants with low labor market experience levels (Table 7) as well as migrants with lower educational attainments (Appendix D) suffer the largest disadvantages in terms of lower coefficient levels and hence disadvantaged with regard to their wage levels. We therefore consider these results as a further evidence for our previously provided conclusion and discuss potential policy implications.

Table 9: Quantile Decomposition

Percentile	Difference in log wage	
0.1	.432765	
0.2	.434190	
0.3	.443005	
0.4	.446360	
0.5	.440499	
0.6	.425121	
0.7	.401626	
0.8	.374127	
0.9	.357766	
	Endowments	Coefficients
0.1	.536740	-.103974
0.2	.492530	-.058340
0.3	.473872	-.030867
0.4	.456636	-.010277
0.5	.434757	.005741
0.6	.407398	.017724
0.7	.376492	.025134
0.8	.347824	.026303
0.9	.331218	.026548
N reference	1.021.307	
N counterf.	252.272	

Note: We decreased the number of German workers in order to speed up the calculation. Method according to Chernozhukov et al (2013), based on the rqdeco package by Blaise Melly.

3.7 Conclusion

Because Germany's labor force is expected to decrease in the next 15 years, the immigration of skilled labor is discussed by policy makers as a way to counter the associated negative consequences (GCEE 2017). Fair and equal wages of natives and migrants are important to be attractive for immigration in a world-wide competition among skilled labor. We therefore consider the migrant-native wage gap in Germany and contribute to the literature in several important aspects. First, we consider skilled employees and therefore add to the discussion on the necessity of skilled immigration in the course of demographic ageing. Second, using a large heterogeneous sample of migrants with respect to individual and job information, we present a general picture not restricted to a selective migrant group. The comprehensive sample provides large overlaps in

individual characteristics between migrants and natives. Considering observed and unobserved firm information, we precisely determine a firm's effect on wage differences and wage setting policies. Hence, the overlap in characteristics as well as controlling for observed and unobserved individual and firm heterogeneity provides particularly unbiased estimates. Third, we assess different aspects of migrants' labor market integration, such as acquiring vocational qualification or naturalization. Lastly, given the heterogeneous structure of migrants and natives, the relevance of our findings might be generalized to other countries that discuss labor market driven immigration.

An important finding is that most of the wage differential between skilled migrants and skilled natives is explained by observable characteristics (endowments); especially by individual experience and firm characteristics. However, for migrants we find slight indicators for crowding in less-paid occupations as well as flatter experience curves leading to lower wages. These findings particularly regard migrants with lower educational attainments, lower levels of labor market experience and hence lower wage levels. We identify three key adjustment channels to achieve wage convergence: first, a long and active time period of at least 10 years within the German labor market, second, acquiring vocational qualification, and third, naturalization.

Our estimates provide evidence for no structural differences in coefficients for occupations and task levels between migrants and Germans for skilled workers. We therefore assume that skilled migrants and skilled natives are remunerated equally for the same job and task. However, wage differences are still possible, which might be caused by lower labor market experience, and, by crowding into certain jobs.

Further, our results indicate a considerable wage premium for migrants in larger firms and firms with higher youth share, reflecting a different firm culture. This is a highly interesting finding, which might be considered by further (qualitative) research as it points towards a more open culture in such firms.

Based on our results, we suggest a key policy measures which aims for a reduction in wage inequality: the recognition of foreign vocational degrees accompanied by occupation-specific training courses. This results particularly on the one hand due to the fact, that the wage differential between skilled migrants and skilled natives is substantially lower and indicates a rather fair remuneration. On the other hand, our results indicate less potential crowding and selectivity in low-wage occupations if migrants with vocational qualification are considered. We assume hence that such measures based on vocational training and qualification prevent forced selection by decreasing information asymmetries between migrants and firms, leading to less crowding into

lower task levels or less productive occupations. Moreover, these measures avoid the occurrence of flatter experience curves and contribute to better job opportunities and equal wage levels, which are key to attracting skilled immigration in the light of demographic ageing patterns. Moreover, these measures would substantially decrease the overall wage-differential between migrants and natives and contribute to less disadvantages for low skilled migrants.

3.8 Appendix of Chapter 3

Appendix A: Naturalized Migrants

	Overall results	
Wage Migrants	106.576***	
	(0.540)	
Wage Germans	125.203***	
	(0.777)	
Wage Migr./Ger.	0.851***	
	(0.002)	
endowments	0.865***	
	(0.002)	
coefficients	0.997**	
	(0.001)	
interaction	0.987***	
	(0.001)	
	Endowment	Coefficients
RAM	1.005***	0.991***
	(0.001)	(0.002)
IND	0.981***	0.998
	(0.001)	(0.003)
OCC	0.968***	1002
	(0.001)	(0.002)
TASK	0.972***	0.990**
	(0.001)	(0.005)
INDIVID	1.012***	0.991***
	(0.001)	(0.001)
EDUC	0.967***	1003
	(0.001)	(0.002)
EXP	0.984***	0.970***
	(0.001)	(0.003)
FIRM	0.969***	1.072***
	(0.001)	(0.011)
Constant		0.983
		(0.012)
N	1568734	
No. Migrants	189721	
No. Germans	1379013	
No. of firms	128623	

Note: Source IEB, only full-time workers with valid information on educational attainment and vocational Qualifications. * 0.1, ** 0.05, *** 0.01; cluster robust s.e. at firm level in (), threefold Oaxaca-Blinder decomposition.

Appendix B: CEM Matching and wage gap

	Overall results	
Wage Migrants	92.144***	
	(0.478)	
Wage Germans	110.164***	
	(0.682)	
Wage Migr./Ger.	0.836***	
	(0.003)	
endowments	0.860***	
	(0.004)	
coefficients	0.986***	
	(0.002)	
interaction	0.987***	
	(0.003)	
	Endowment	Coefficients
RAM	1.002***	0.987***
	(0.001)	(0.003)
IND	0.980***	0.994
	(0.002)	(0.005)
OCC	0.970***	1.011***
	(0.001)	(0.004)
TASK	0.970***	0.987
	(0.001)	(0.009)
INDIVID	1.000	0.988***
	(0.000)	(0.001)
EDUC	0.992***	0.995
	(0.001)	(0.004)
EXP	0.990***	0.980***
	(0.001)	(0.003)
FIRM	0.948***	1.115***
	(0.003)	(0.018)
Constant		0.937***
		(0.018)
N	1516352	
No. Migrants	141362	
No. Germans	1374990	
No. of firms	124647	

Note: Source IEB, only full-time workers with valid information on educational attainment and vocational Qualifications. * 0.1, ** 0.05, *** 0.01; cluster robust s.e. at firm level in (), threefold Oaxaca-Blinder decomposition

Appendix C: Excluding individuals with University degree

	Overall results	
Wage Migrants	82.848***	
	(0.394)	
Wage Germans	111.536***	
	(0.595)	
Wage Migr./Ger.	0.743***	
	(0.003)	
endowments	0.754***	
	(0.003)	
coefficients	0.972***	
	(0.002)	
interaction	1.014***	
	(0.002)	
	Endowment	Coefficients
RAM	1.020***	0.979***
	(0.001)	(0.002)
IND	0.963***	0.992*
	(0.002)	(0.005)
OCC	0.956***	1.005
	(0.001)	(0.003)
TASK	0.959***	0.997
	(0.001)	(0.009)
INDIVID	1.010***	0.991***
	(0.000)	(0.001)
EDUC	0.979***	1.004
	(0.001)	(0.002)
EXP	0.908***	0.934***
	(0.002)	(0.003)
FIRM	0.932***	1.114***
	(0.002)	(0.013)
Constant		0.965**
		(0.015)
N	1204802	
No. Migrants	117183	
No. Germans	1087619	
No. of firms	117263	

Note: Source IEB, only full-time workers with valid information on educational attainment and vocational Qualifications. * 0.1, ** 0.05, *** 0.01; cluster robust s.e. at firm level in (), threefold Oaxaca-Blinder decompositio

Appendix D: Separation by skill groups

	No apprenticeship		With apprenticeship		University degree	
Wage Migrants	75.333***		88.094***		149.116***	
	(0.362)		(0.479)		(1.157)	
Wage Germans	89.479***		114.949***		192.745***	
	(0.636)		(0.611)		(1.318)	
Wage Migr./Ger.	0.842***		0.766***		0.774***	
	(0.005)		(0.003)		(0.004)	
endowments	0.845***		0.789***		0.771***	
	(0.005)		(0.003)		(0.004)	
coefficients	0.980***		0.976***		0.988**	
	(0.003)		(0.002)		(0.005)	
interaction	1.017***		0.996**		1.015***	
	(0.003)		(0.002)		(0.005)	
	Endowments	Coefficients	Endowments	Coefficients	Endowments	Coefficients
RAM	1.013***	0.992*	1.019***	0.982***	1.003**	0.988**
	(0.001)	(0.005)	(0.001)	(0.003)	(0.001)	(0.006)
IND	0.972***	0.995	0.967***	0.992*	0.984***	1.004
	(0.002)	(0.008)	(0.002)	(0.005)	(0.002)	(0.008)
OCC	0.976***	1.011	0.963***	1.004	0.995***	1.070***
	(0.002)	(0.008)	(0.001)	(0.004)	(0.001)	(0.013)
TASK	0.974***	1.011	0.968***	0.995	0.979***	0.917***
	(0.002)	(0.020)	(0.001)	(0.010)	(0.001)	(0.015)
INDIVID	1.017***	1.000	1.007***	0.992***	0.961***	0.984***
	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.005)
EDUC	0.990***	1.006***	0.999***	1.011***	0.999***	0.984
	(0.001)	(0.002)	(0.000)	(0.004)	(0.000)	(0.017)
EXP	0.945***	0.916***	0.919***	0.966***	0.889***	0.963***
	(0.002)	(0.005)	(0.001)	(0.003)	(0.003)	(0.007)
FIRM	0.948***	1.114***	0.929***	1.110***	0.941***	1.166***
	(0.003)	(0.013)	(0.002)	(0.015)	(0.002)	(0.037)
Constant		0.947**		0.932***		0.933*
		(0.026)		(0.017)		(0.036)
No. Migrants	45971		71212		25122	
No. Germans	130869		956750		291394	
No. of firms	54427		105534		39701	

Note: Source IEB, only full-time workers with valid information on educational attainment and vocational Qualifications. * 0.1, ** 0.05, *** 0.01; cluster robust s.e. at firm level in (), threefold Oaxaca-Blinder decomposition.

Appendix E: Decomposition for females and males separately

	Male		Female	
Wage Migrants	95.521***		82.760***	
	(0.546)		(0.402)	
Wage Germans	134.378***		106.859***	
	(0.919)		(0.435)	
Wage Migr./Ger.	0.711***		0.774***	
	(0.003)		(0.003)	
endowments	0.719***		0.778***	
	(0.003)		(0.003)	
coefficients	0.974***		0.987***	
	(0.002)		(0.003)	
interaction	1.015***		1.009***	
	(0.002)		(0.003)	
	Endowments		Coefficients	
RAM	1.013***	0.979***	1.020***	0.975***
	(0.001)	(0.003)	(0.001)	(0.004)
IND	0.963***	1.004	0.976***	1.009
	(0.002)	(0.005)	(0.001)	(0.008)
OCC	0.957***	1.017***	0.970***	0.998
	(0.001)	(0.004)	(0.001)	(0.006)
TASK	0.954***	0.978***	0.971***	1.001
	(0.001)	(0.008)	(0.001)	(0.013)
INDIVID	0.998***	0.995***	0.998***	0.999
	(0.000)	(0.001)	(0.000)	(0.001)
EDUC	0.966***	1.003	0.998**	1.009*
	(0.001)	(0.002)	(0.001)	(0.005)
EXP	0.894***	0.924***	0.910***	0.933***
	(0.002)	(0.003)	(0.002)	(0.004)
FIRM	0.936***	1.133***	0.915***	1.028*
	(0.002)	(0.014)	(0.002)	(0.017)
Cons		0.954***		1.038
		(0.015)		(0.025)
N	1057476		463842	
No. Migrants	104021		38284	
No. Germans	953455		425558	
No. of firms	103234		74196	

Note: Source IEB, only full-time workers with valid information on educational attainment and vocational Qualifications. * 0.1, ** 0.05, *** 0.01; cluster robust s.e. at firm level in (), threefold Oaxaca-Blinder decomposition.

4 Occupational specific wage curve in Germany: Evidence from linked employer-employee data

Joint with Stephan Brunow[11] and Mark Partridge[12]

Abstract

Germany will suffer a sharp workforce decline resulting from demographic change in the near future. To avoid negative consequences related to this decline, further influx of migrants is required. Yet, it is not clear how an economic deterioration would differentially affect labor-market conditions for natives and migrants. This paper analyses how migrant and native wages respond to changes in occupational unemployment rates by developing an augmented occupational wage curve. We use an extensive dataset covering 10 percent of all German employees, which we expand with administrative firm data and regional characteristics, providing the most comprehensive examination of regional wage curves that we are aware of. Our results indicate that changes in a region's unemployed/employed ratio within an occupation produces strongest wage responses for naturalized migrants compared to natives and non-naturalized migrants. Further, the results show that if both measures, regional as well as occupational unemployed/employed ratio is considered, regional unemployment effects becomes rather small.

Keywords: Occupation specific wage curve, foreigner-native differences

JEL: J31, J30, J60, R23

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4.1 Introduction

The retirement of the baby-boom generation is expected to accelerate in the next decade, increasing demands for workers to fill potential labor shortages. Yet, succeeding cohorts will be insufficient to fill the labor-force needs because fertility rates have declined since (circa) 1970. Since the 1950s, immigration has been a key avenue to meet such German labor-market needs. According to the latest estimates, annual immigration of around 400,000 people is required over the next decade to meet these demands (Fuchs et al. 2019).

An implicit assumption behind this labor-force shortage scenario is that the economic situation will not substantially deteriorate, a risky assumption as the recent Covid downturn is just the latest example of how unexpected events can intervene. Similarly, technological progress and productivity growth can reduce labor needs (ceteris paribus), eliminating the necessity for workforce immigration. Nonetheless, most expectations are still that the German labor market will require more workers than what can be expected from natural labor-force growth, and even shortly after the financial crisis, the unemployment rate sharply declined. In sum, while a deep recession in the medium-term cannot be ruled out, large numbers of migrants will likely be attracted to Germany to fill labor-market demand.

The likely scenario is then that labor-shortages will push German wages higher, which in turn attracts new migrants. However, migrants are often viewed as having lower skills and qualifications on average, meaning they will generally sort into lower-paid jobs. Low-paid jobs are typically routine in nature, or they are the most exposed positions for substitution by technology (Autor et al. 2003; Autor 2015; Acemoglu and Autor 2011). Further, low-paid jobs are usually at the highest risk for layoffs, because firms are predisposed to hoard higher-skilled workers when they are laying off workers (Bachmann et al. 2019). This raises the question of how an economic deterioration would potentially affect new migrants, and in turn, what are the ensuing spillovers on native workers?

We assess this question employing a wage-curve model that dates back to Blanchflower and Oswald (1994, 1995). The wage curve model relates to the link between regional unemployment rates and changes/levels of regional wages assuming a regional segmentation of labor markets. A number of German studies find a negative link between regional unemployment and wages (Bellmann and Blien 2001; Baltagi et al. 2009; Blien et al. 2013). Although these studies use individual level data, they are typically more aggregate - e.g., how are aggregate regional wages affected by the region's overall unemployment. However, segmentation can also occur along occupations leading to further wage effects since changes in

occupations are linked to high costs (qualification, forgone income) if conditions in their occupational field worsen. Further, there is often no in-depth analysis of differences between natives and migrants. Thus, these studies miss significant labor-market heterogeneity that needs to be understood in order to fully develop policy responses. For example, as we noted above, because migrants possess different labor market skills, they may be differentially affected by economic shocks compared to natives and the affects across occupations may be considerably different than the regional average uncovered in past work. Such shortcomings are especially relevant for occupations that face severe shortages because providing economic relief for these occupations is often the motivation for subsequent immigration legislation.

Traditional wage curve analysis is usually at the regional level and typically does not consider different industry- or occupation responses, though there are exceptions of pooled studies that use industry- or occupational-level data to develop wage-curve estimates. Some examples of studies that estimated German wage curves using industry or occupation data include: Longhi et al. (2006), Blien et al. (2013) or Baltagi et al. (2012). Compared to past German studies using occupations, this study adds an important dimension on wage elasticity, as we not only consider regional unemployment and occupational distribution but also the second dimension of occupational unemployment levels. Labor-market heterogeneity across occupations (or industries) can be crucial for occupations with labor-market characteristics considerably different than average. For instance, Kunaschk (2020) provides evidence for substantial differences in the hairdressing sector across regions in Germany, which is particularly often discussed with regard to its low wage. Moreover, even regional labor-market responses by occupation (industry) can differ between natives and immigrants given that immigrants may have an especially elastic regional labor-supply response.[13] Together, our significantly-more detailed data allows us to separately estimate disaggregated occupational wage curves for natives and immigrants that more directly account for the specific labor-market conditions affecting individual workers.

Our estimates of occupation-specific wage curves employ administrative data with

[13]The labor supply of immigrants at the regional level can be more elastic than natives because beyond the regular labor-supply responses of natives (e.g., change occupations, move to a different region, exit/join the labor force, etc.), immigrants have additional margins that affect their labor supply. For example, (1) new immigrants can select to reside in different regions upon arrival in Germany, (2) they can choose to not immigrate to Germany in the first place, and (3) immigrants already live in Germany can emigrate back to their home country. Likewise, immigration legislation further shapes immigrant labor-market decisions that can have a different bearing than for natives.

information for a large set of employees in Germany. We develop several measures to proxy for regional and occupational labor-market tightness in constructing our wage-curve estimates that link labor-market tightness and wages. Our results provide evidence that unemployment by occupation has considerably larger effects on wages beyond what a traditional aggregate wage-curve would suggest. Further, we show that aggregate wage curves obscure key information uncovered by occupation-specific wage curves. Therefore, our results complement traditional wage-curve analysis that focuses more on an average region-wide response.

We add several contributions to previous literature. First, to the best of our knowledge, we are the first to more directly develop occupation-specific regional wage curves in order to assess this type of labor market segmentation and add hence an important dimension to the classical wage curve approach. Further, we analyses in-depth how immigrant and native workers have differing structural labor-market responses. Second, in contrast to the previously mentioned studies, which focus mainly on West Germany and thus only on a certain part of Germany, we consider entire Germany for our analysis. This approach considers the contemporary fact that Germany is nowadays often regarded as grown together as discussed by Fuchs et al. (2018). Third, we consider the period 2012 to 2018, which reflects a strong economic upturn and therefore clearly deviates from previous studies as we identify the wage elasticities mainly by wage growth. These contributions lead to the fact that this analysis would better inform policies aimed at addressing Germany's oncoming labor-shortage. Finally, such analysis would help settle the debate as to the optimal numbers of immigrants that are necessary to fulfil expected labor demand.

The paper is structured as follows. The next section provides a literature review and discusses the conceptual challenge of the wage-curve estimation. The data and estimation strategy are discussed in the next step. The last section of this chapter presents the conclusion.

4.2 Literature Review

The wage curve represents the long-established negative-relationship between local unemployment and wage levels.[14] Starting with the work of Blanchflower and Oswald (1990, 1994, 1995), who claimed to find an empirical law by providing evidence for a stable wage curve estimate of -0.1, many papers have re-estimated this relationship considering different

[14] The wage curve differs from the Phillips Curve, which postulates a negative relationship between *changes* in wages and the unemployment rate.

methodology or institutional structures (see Nijkamp and Poot 2005 for a meta-analysis). For Germany, various studies are available estimating the wage-curve as a function of local unemployment rates such as Bellmann and Blien (2001), Baltagi et al. (2009), Baltagi et al. (2012) or Blien et al. (2013). However, these studies show a common finding: using the same estimation approach as proposed by Blanchflower and Oswald (1994) leads to statistically insignificant estimates of the wage curve for Germany (Bellmann and Blien 2001). Therefore, Bellmann and Blien (2001) deviates from the approach proposed by Blanchflower and Oswald (1994) and use establishment level data in order to identify a wage curve elasticity. The authors estimate an elasticity of -0.1 and confirm Blanchflower and Oswald (1994), however, they do not control for regional fixed effects, which are important in order to consider regional heterogeneity (Blien et al. 2013). In this regard, Baltagi et al. (2009) choose as well a different approach for estimating the elasticity in Germany and estimate a dynamic model of the wage-curve. They use a two-stage estimation procedure and incorporate region-specific effects and region-specific time trends and hence explicitly consider the autoregressive character of wages (Baltagi et al. 2009) providing evidence for a considerably lower elasticity of -0.02 to -0.04. A similar two-stage estimation procedure is also used by Baltagi et al. (2012). In this study, the authors explicitly consider spatial effects across regions in their model and hence account for wage effects, which might be driven by neighboring regions due to spatial interdependences. They provide low estimates as well, which are in the range of -0.016 to -0.037 and hence similar to previous findings. Blien et al. (2013) focus on one of the main reasons, which might be responsible for the low wage-curve elasticity in Germany: collective and sectoral wage agreements. Although the authors do not find a wage-curve for firms without collective agreements, they assume that these firms voluntarily orientate them self on different wage agreements leading to wage rigidity.

Though the provided coefficients for logarithmic unemployment in Germany in these studies are found to be considerably lower than -0.1, local unemployment is negatively related to wage levels in most studies. In Nijkamp and Poot's (2005) meta-analysis of over 200 wage-curve studies from around the world, the authors find that the typical elasticity was -0.07 and hence more in line to Oswald and Blanchflower (1994). Nevertheless, not all studies show the negative wage/unemployment-rate relationship predicted by the wage-curve. For example, Partridge and Rickman (1997a; 1997b) find a positive link between a U.S. state's long-run "*equilibrium*" unemployment rate and its average wage. In that, Partridge and Rickman note that there can be a negative Philip's Curve link between state unemployment rates and *wage changes*, the

corresponding link with *wage levels* is positive. Such a finding is consistent with the classical Harris-Todaro (Todaro, 1969; Harris and Todaro, 1970) result that a region with *persistently* high unemployment rates will need a positive-wage compensating differential in equilibrium—i.e., workers need to be compensated to accept a greater than average likelihood of unemployment.

One key reasoning for the traditional "Blanchflower and Oswald" (1994) wage-curve is the regional segmentation of labor markets. In particular, this implies that with raising unemployment levels, workers are not able to immediately migrate into regions with better labor market conditions and hence compensate for wage declines. This segmentation may result due to various reasons such as family or social ties, homeowner ship and regional amenities leading to high costs for migration leading to regional different labor markets and persistent differences. The traditional wage-curve does not directly consider different wage-curve relationships across industries and/or occupations, although some papers incorporate industry and/or occupation data in deriving their estimated wage curve relationship (Longhi et al. 2006; Blien et al. 2013; Rokicki et al. 2020). However, the focus of such studies is not so much on a given industry's or occupation's individual wage-curve, but rather in constructing more precisely-estimated regional wage-curves using panel-data approaches. Therefore, the classic approach does not consider that labor markets might be segmented not only regional but across occupations as well leaving an important gap in the literature.

4.3 Motivation and challenge

One main motivational aspect is as already mentioned above the consideration of occupational segmentation in addition to the regional dimension outlined above the classical wage-curve approach. We take the traditional wage-curve approach and apply it to more directly estimate differences by occupations. Such segmentation is reasonable since workers in occupations, which might be affected by worsening economic conditions can not immediately switch to other occupations. This particularly results due to the fact that different jobs require different vocational qualifications and hence a change in occupation is linked to high costs. Workers changing their occupations would need to accept forgone income during qualification periods making occupational changes very costly. This is particularly evident for the hairdressing sector (Kunaschk 2020), which is often mentioned in this regard as it is characterized by low wages, which would be a reason for hair dressers to change into other occupation. As the low wages in the hairdressing sector persist over long periods, we can assume that such changes are indeed

linked to high costs and not always possible. This segmentation is confirmed by Table 10 in the following, which presents the average occupational unemployment shares in one-digit occupations. Note that the values provided in the table below might be considerably higher than officially reported numbers, as we use a different approach, which is described in chapter 4.4.1 in detail.[15]

Table 10: Unemployment shares by Occupations (1-digit)

Occupations in	Unemployment share
agriculture, forestry, farming, and gardening	0.37
production of raw materials and goods, and manufacturing	0.19
construction, architecture, surveying and technical building services	0.09
natural sciences, geography and informatics	0.15
traffic, logistics, safety and security	0.04
commercial services, trading, sales, the hotel business and tourism	0.15
business organization, accounting, law and administration	0.12
health care, the social sector, teaching and education	0.05
philology, literature, humanities, social sciences, economics, media, art, culture, and design	0.06
Military	0.11

Source: IEB, own calculation. Note, that these are aggregated values as we actually use a two-digit occupational classification for our analysis as described in the following chapters.

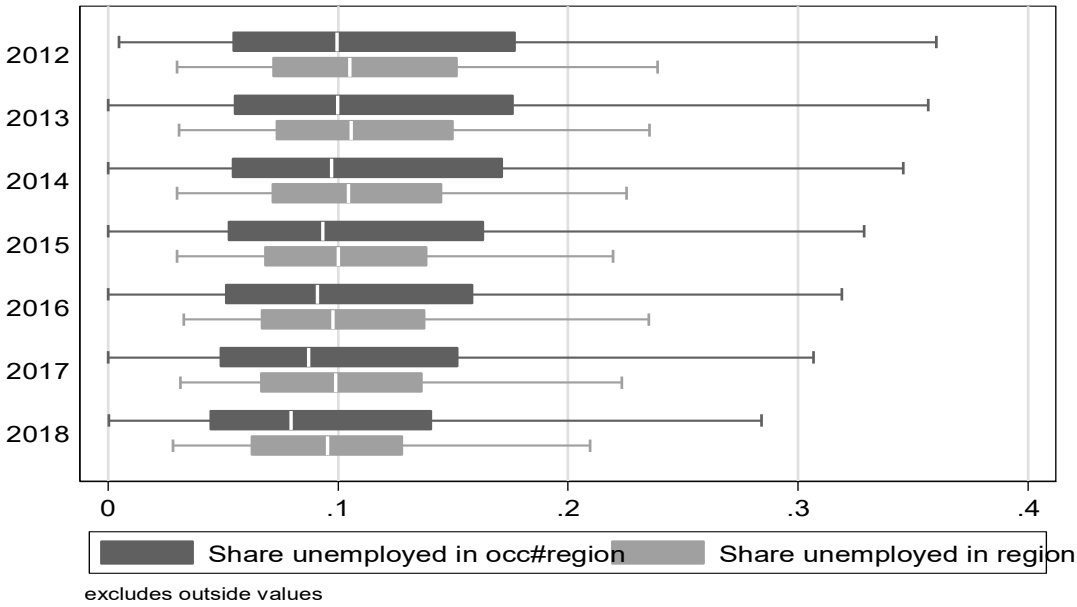
According to the table, there are substantial differences in unemployment between the considered occupational clusters, which confirms our hypothesis of segmented labor markets across occupations. For example, the unemployment share in occupations in agriculture, forestry, farming, and gardening is 0.37 and hence more than seven times larger than in occupations in health care, the social sector, teaching and education. These differences lead us to the conclusion that (not all) workers affected by unemployment cannot immediately switch to other occupational sectors in order to improve their labor market conditions leading to certain rigidities.

In order to consider both unemployment measures, the regional and occupational unemployment shares, and its differences, we show in the next figure (Figure 4) the distribution

[15] In short: This might be particularly driven by the fact, that we identify many workers unemployed in certain occupations, which might change their occupation after unemployment, leading to a bigger numerator. Further, the number in the denominator is smaller than in official figures, as our denominator consists only of employed workers employed in jobs subject to social security and not all working population.

of both unemployment measures. The figure shows the box-plot of the respective unemployment shares, which are defined as the number of unemployed in region divided by the number of workers employed in each region (regional unemployment) and the number of unemployed in each occupation in each region divided by the number of workers employed in each occupation in each region (occupation-specific unemployment).

Figure 4: Distribution of unemployment shares by year



Source: IEB, own calculations. Note that for this plot we use two-digit occupational clusters as is used for our empirical analysis.

The figure provides evidence that both unemployment measures, the occupational and the regional unemployment shares are strongly correlated on average. However, it becomes clear that the variance for occupation-specific unemployment is substantially higher than for regional unemployment. Accordingly, for the year 2012, there are some occupations in some regions with an unemployment share larger than 0.3 implying very high unemployment levels in certain occupation-region combinations. Although both unemployment shares decrease over the years, the difference in variance remains clearly emphasizing our two-dimensional consideration of regional and occupational situation.

Our approach, which is described in the following chapters in details, enables us to address both unemployment measures and hence consider both important segmentations across regions and occupations. This is particularly valuable for policy issues regarding migrants and the factors that might lead migrants to potentially sort into low-paying occupations relative to natives as some occupations have high shares of migrants (Jost and Bogai 2016). Low-wage

occupations typically have a greater risk of becoming unemployed, meaning migrants may be more sensitive to changes in their occupation's regional-unemployment rate. Thus, it is necessary to develop separate occupation-based wage curves for migrants and natives in order to assess whether there are differential labor-market responses.

4.4 Data

We use a 10 percent sample of German workers from the Integrated Employment Biographies (IEB) provided by the Institute for Employment Research (IAB). The IEB is an administrative data set obtained through mandatory employer reporting to public agencies. Employees that are subject to social-security contributions are included in the sample, which covers over 80 percent of the German workforce. Government civil servants, self-employed and contract/temporary workers are not included. For all included workers, the dataset includes characteristics such as wages, age, region, occupation, education, gender, and nationality.

We then augment the IEB data by including regional and occupational distributions of unemployed workers. We next merge firm-level characteristics using unique firm identifiers from the Establishment History Panel, which is another administrative dataset. This dataset provides firm characteristics such as its total employment, median wage, and shares of low-, medium-, and high skilled workers in the firm's broader industry.

4.4.1 Data Preparation and sample construction

Our sample is restricted to the 2012 to 2018 period because data regarding each job's skill requirements are not reported before 2012. Further, we restrict the sample to workers between 18 and 65 years who are in "regular" full-time employment. This restriction allows us to more-specifically focus on the prime-age workforce employed full-time, which simplifies our modelling because we do not have to address multiple selectivity issues related to those with less-attachment to the workforce. Hence, temporary/contract employees, apprentices, and internships are not included. Moreover, our dataset does not report hours of work for part-time workers, further justifying their omission from our sample. Furthermore, we omit the relatively small share of individuals without valid citizenship information, firm identifier, occupation, and region.

Traditional wage-curve analysis typically involves estimating the relationship between average regional wages with (overall) regional unemployment rates. Though some studies

employed individual data in the way that we do (Baltagi et al. 2009: Blien et al. 2013; Rokicki et al. 2020), most simple use regional average wage levels and regional average unemployment rates, and then incorporate a set of average regional characteristics as controls—e.g., average regional educational attainment (see Nijkamp and Poot, 2005 for a survey). Using regional averages has the advantage of averaging away individual idiosyncrasies and annual individual wage fluctuations due to cyclical changes that can introduce noise into the regression. Yet, if the underlying key factors that are primarily driving individual wage levels relate to individual characteristics - using averages as the general norm can obscure important individual heterogeneity. Even worse when individual characteristics are associated with labor-market tightness - e.g., university graduates typically experience much smaller unemployment increases during downturns. In such cases, using regional averages may lead to biased or misleading estimates. Similarly, if an economic shock hits a subset of industries that employ disproportionate shares of certain skill levels, the regional response for this subgroup can greatly vary from average. In such cases, using the underlying individual micro data as we do is essential to examine these heterogeneities within a local labor market.

Another feature of using individual data is differentiation between natives and immigrants. In this case, we use the worker's citizenship status provided by employers. We define a worker as an immigrant if they had foreign citizenship throughout their employment history. Individuals whose citizenship status changed to German are considered "naturalized".

Approximately 60% of the sample does have reported individual educational attainment levels. In those cases, the imputation procedure proposed by Fitzenberger et al. (2005) is utilized. For workers with annual earnings above the social security contribution cutoff of 78,000 Euros (2018, West Germany), Card et al.'s (2013) wage imputation procedure is used to derive estimates on wages above the cutoff threshold.

In constructing the key labor-tightness measure - the region's occupational unemployment rate - the complete IEB dataset for all German employees is employed. Therefore, we are able to consider all unemployed workers in Germany for our occupational unemployed measure. For the traditional wage-curve variable, the regional unemployment rate is calculated using the officially recorded employed and unemployed individuals. The occupational unemployment rate derivation is more complicated because individuals can change occupations after being unemployed. We use the worker's occupation before becoming unemployed, exploiting our data's panel structure. Further, we use the two-digit level occupation classification, which

allows us to assume that the unemployed (at least initially) focuses the employment search on positions with similar job tasks as the prior employment.

In cases with no information regarding prior occupation, because the first-observation for the worker is the unemployment spell, we use the occupation following unemployment. Another issue arises in differentiating being employed or unemployed when workers have relatively low earnings because they are drawing unemployment benefits as a supplement (so-called "*Aufstocker"*). These individuals are assigned as being employed if the firm reported them as full-time workers subject to social security contributions. In addition, such individuals are categorized as unemployed if they work in temporary employment while receiving parallel unemployment benefits to sustain them searching for regular employment.

4.4.2 Empirical Model

With a general overview of the sample, we can now summarize the basic empirical model. Below, we discuss the specific variable groups. The sample is over the 2012 to 2018 period, in which we have annual data for over 22 million German observations in our sample. The dependent variable is the log daily wage for individual *i,* employed in occupation *o* at firm *j,* residing in region *r* in year *t*. The traditional wage-curve econometric model (using individual data) can be written as:

$$lnW_{ijot}^{r} = ß^{r} lnU_{t}^{r} + \lambda \mathrm{LABMKT}_{jot}^{r} + \alpha INDIVID_{ijot}^{r} + \sigma FIRM_{jt}^{r} + \omega CHK_{i} + \Theta CHK_{j} + \phi_{r} + \tau_{t} + \varepsilon_{ijot}^{r}$$

where, the main coefficient of interest is β^{r}, which is the elasticity of wage levels W^{r}_{ijot} with respect to U^{r}_{t}, the region's unemployment rate in year *t*. It is measured as an elasticity because both the dependent variable *W* and the unemployment rate are in log form. The other variables groupings are LABMKT, INDIV, and FIRM, which are respectively structural labor-market characteristics, individual traits, and employer attributes, described below. At this stage, it is important to note that LABMKT also includes a vector of occupation fixed effects and FIRM also includes a vector of industry fixed effects. The two *CHK* variables are measures of unobserved characteristics, respectively for the individual and the firm (described below). Roughly, the two CHK variables serve the role of individual and firm fixed effects. The variable coefficients are the λ, α, σ, ω, and θ terms.

Moreover, the model includes regional fixed effects Φ_r. The regional fixed effects account for specific unobserved traits of each region influencing local labor-market productivity and wage levels. Year fixed effects τ_t are included to control for annual common effects that affects all regions equally across the entire sample. These factors include inflation, business cycle, changes in national policy, exchange rates, etc. The residual term ε^r_{ijot} is adjusted to produce clustered standard errors at the occupational-regional level.

The empirical model that is of most interest is the one that adding the annual regional unemployment rate for occupation *o*, lnU^{ro}_t to the model. Unfortunately, we cannot use the log form because some occupational unemployment rates are zero. In this case, the regression coefficient of interest is now β^{ro}, which is defined as the elasticity wage levels in region *r* with respect to changes in the occupation's unemployment rate in region *r*.

In the empirical model discussion, a key goal is to assess the differences between the wage-curve elasticity for natives and immigrants, as well as between naturalized and non-naturalized immigrants. In practice, all that is necessary to interact the unemployment rate variable with an indicator immigrant worker and an indicator for naturalized citizen.

4.4.3 Variable Construction

Now we turn to the key variables and classifications. Table 11 and Table 12 list the variables and their definitions. The two-digit occupational categories are defined by the KldB2010 scheme, which is similar to the ISCO-08 classification. The 141 local labor-market regions we use have been extensively taken into account by prior studies (e.g., see Jahn and Neugart 2020; Haller and Heuermann 2020). The consideration of labor-market regions offers the advantage for a consideration of the situation for the individuals relevant labor market instead of relying on NUTS-3 borders. This is particularly important for cases, where individuals tend to live in rural regions but work in urbanized areas as already mentioned in chapter 3.

Most of the control variables listed in Table 11 and Table 12 are commonly used in regional labor-market research. Although the reasons for including most of these variables are rather straightforward, more explanation for most variables used and expected effects can be found in Blien and Bellmann (2001), Longhi et al. (2006); Blien et al. (2013) and Rokicki et al. (2020).

Table 11: Main explanation variables

Unemployment related variables	Description
Share unemployed in occupation in region	The labor-market`s region share of unemployed by occupation (i.e., the variable's regression coefficient is the key wage-curve elasticity)
ln Regional unemployment rate	The labor-market´s region unemployment rate, which is derived from the unemployment rate for each NUTS-3 region
Share short-term unemployed	The labor-market's short-term unemployment (< 1 year) share of all unemployed individuals
Share of immigrants unemployed	Proportion of foreigners who are unemployed in either the labor-market occupation (first variable) and the entire labor-market (second variable)
Basic control variables	
Regional occupational importance	Share of total local labor-market employment in a given occupation.
HC intensity	The employment shares of the labor-market occupation workforce or overall local labor-market workforce possessing high human-capital.
Proportion young workers	The employment shares of the labor-market occupation workforce or the overall local labor-market workforce under 35 years old.
Proportion of foreigners	The employment share of immigrants in the labor-market occupation or overall local labor-market
Related structural characteristics	
Regions	Categorical variable encompassing 141 labor market regions in Germany.
Industry	Categorical variable encompassing 96 distinct industries at the 2-digit level according to the German classification scheme WZ 2008 (NACE Rev. 2.)
Year fixed effects	Calendar year dummies to account for macroeconomic trends
Personal characteristics	
Gender (Female)	Indicator variable for gender (1=female, 0=male)
Age	Five different categorical indicator variables for the individual's age: 16-24 years, 25-34 years, 35-44 years, 45-54 years, 55-64 years
Migrant	Indicator variable for foreign-born (0 – German native, 1 – foreign-born even if naturalized German citizen)
Naturalized	Indicator variable for immigrants that obtained German citizenship
CHK individual effects	Individual specific effects using the Card, Heining and Kline (CHK) (2013) approach to reflect unobserved individual characteristics.

Table 12: Main explanation variables

Unemployment related variables	Description
Educational attainment and professional training	
School Certificate	Three categorical indicator variables for highest-school degree: none, secondary-school certificate, and Abitur (higher education entrance qualification)
Professional Training	Three categorical indicator variables for highest professional training: without vocational training, vocational training and university degree
VET training	Indicator variable for individuals that received German vocational educational training (VET)
Labor Market Experience	
LM Experience	Four categorical indicator variables for falling in one of the four quantiles for the annual number of days at work.
Share of the sample period not employed	Series of categorical indicator variables for the share of the entire sample period not actively employed: <5%; >5% and <10%; >10% and <25%; >25% and <75%; over 75% is the omitted group.
Ln mean duration	Log of the firm's average employee tenure
Ln firm duration	Log of the individual's tenure working in current firm
No. of employers	The labor-market's number of different employers listed in the dataset. This measure reflects labor-market flexibility or local labor-market competition
Occupation, job tasks, and job characteristics	
Occupation	Occupation fixed effects for 50 occupations
Task level	Task-level fixed effects for auxiliary activity, trained/professional assistant, and specialist/expert
Supervisor	Dummy variable indicating if an employee is a supervisor
Executive	Dummy variable indicating if an employee is an executive
Firm related variables	
Firm size	Four indicator variables for firm total employment: 1-9, 10-49, 50-249, and over 250 employees
Females	Female share of firm employment
Youth	Share of firm employment under 35 years old
Human capital intensity	Two measures of the firm's human-capital intensity: (1) firm's employment share of professional assistants and (2) firm's employment share of specialists/experts
Immigrant employment share	The firm's immigrant employment share. The measure accounts for firm experience in employing immigrants and may also reflect segregated ethnic communities that are associated with lower productivity levels
CHK firm effects	Firm specific effects estimated using the Card, Heining and Kline (CHK) (2013) approach to measure unobserved characteristics.

In the LABMKT vector, two particularly important factors are accounting for the relative importance of employed and unemployed immigrants in order to appraise how large spillovers will be on native German workers. Specifically, employed and unemployed immigrant shares are measured at either the occupational level for the local labor market when we are estimating occupational wage curves or for the entire local labor-market when estimating traditional regional wage curves. The relative degree of knowledge spillovers, localization externalities, and urbanization effects are accounted for by the occupation and human-capital regional concentration variables described in Table 11 and Table 12. Structural labor-market features are captured by a variety of measures such as the share of short-term unemployed workers-those who have been unemployed for under one year—and the total number of firms in the local labor market. These variables control for structural effects: the general persistence of local unemployment or overall labor-market competitions.

We further control for a range of characteristics of the individual workers. These include controls for: age, labor market experience (both with the current firm and overall), foreign born, naturalization, educational attainment, industry, and occupation (among others). These measures ensure that we account for individual human capital, skills, and other factors help determining an individual's productivity and wage levels, aside from the labor-market tightness (wage-curve) and immigrant measures that are of most interest. Yet, even though we control for a complete range of individual characteristics, there is still scope for unobserved effects that can influence their wage and productivity. Thus, we control for an estimate of the unobserved individual effects (akin to an individual fixed effect) following the procedure described by Card et al. (CHK) (2013). If we control for CHK instead of utilize individual (or firm) fixed effects, we do not have to omit variables that do not vary over time such immigrant status or gender. Given that such variables are a key part of our research, using CHK's approach is very helpful.

We further control for firm-specific characteristics influencing the individual wage levels. These variables account for features such as overall firm employment, for which there is the well-known positive relationship between firm size and wage levels (Fox 2009; Card et al. 2018). Likewise, we control for the firm's employment share of young workers (<35) to account for more recent-vintage human capital and the average educational attainment level and related skills of the firm's workforce. These firm-level skill variables help accounting for firm-level knowledge spillovers. Of course, there is an additional selectivity process as we observe an individual worker and firm employment match, for which there could be additional selectivity match effects that influence individual productivity and observed wages (aside from

unobserved individual effects described above). Closely related are unobserved firm-specific effects that influence firm productivity and wages such as quality and professionalism of firm management. To measure these unobserved effects, we include firm CHK firm effects to account for unobserved firm effects following CHK (2013).

4.4.4 Summary statistics

Table 13 summarizes the sample's key features. In total, our sample has over 22.3 million observations, of which about 17.4 million are native Germans and nearly 4.9 million are foreign-born immigrants. About 2.2 million immigrants have become naturalized German citizens.

Table 13 shows that native workers have the highest average gross daily wage followed by naturalized immigrants and then immigrants without German citizenship. These differences are largely due to different educational attainment between immigrants and native Germans (Brunow and Jost, 2019). In addition, Immigrant workers without German citizenship have (by far) the lowest share of vocational degree holders, or barely one-third of the native German share. Similarly, non-citizen immigrants have the lowest share of vocational educational training (VET). That wages of naturalized immigrants are higher than wages of non-naturalized may be explained in part by the fact that they are, on average, older. Older age is likely related to the length of German residence to obtain naturalized citizenship. However, older age can reflect more labor-market experience, training, and a longer period to assimilate into the German labor market. Of course, another explanation for naturalized citizens having higher average wages is selectivity related - i.e., those immigrants who "succeed" in the German labor market tend to be those willing to remain in Germany and in turn become citizens. This naturalized/non-naturalized wage pattern has also been observed for U.S. immigrants (Crown and Faggian, 2019).

Table 13: Overview of the sample and individual characteristics

	All	Germans	Migrants	
			total	naturalized
No. Obs	22,273,643	17,374,947	4,898,696	2,152,586
Mean wage	103.12 €	106.83 €	89.97 €	97.71 €
(s.d.)	(51.90 €)	(52.58 €)	(47.13 €)	(48.25 €)
share of females	32.9%	34.3%	27.7%	30.3%
School Attainment				
no degree	2.3%	1.2%	6.8%	3.4%
intermediate degree	71.5%	71.5%	71.8%	77.9%
Higher school	26.2%	27.3%	21.5%	18.7%
Vocational degree				
no degree	13.8%	10.2%	28.8%	20.9%
Vocational training	71.6%	74.7%	58.6%	68.9%
Academic degree	14.5%	15.0%	12.5%	10.1%
Foreman	5.6%	6.1%	4.0%	6.3%
age structure				
<25	9.0%	9.3%	7.9%	3.8%
25-34	27.2%	27.8%	24.9%	16.7%
35-44	22.3%	21.6%	24.6%	19.2%
45-54	26.0%	26.7%	23.4%	27.1%
55+	15.6%	14.6%	19.1%	33.3%

Source: IEB, own calculations.

4.5 Econometric Results

4.5.1 Estimation results

Our estimation results using the variables introduced in chapter 4.4.3 and shown in Table 11 and Table 12 are provided in Table 14. The model in column 1 shows results for the traditional wage curve including regional, time and industry fixed effects as well as individual level, regional level and firm level variables shown in Table 11 and Table 12. Further, the model controls for the CHK unobserved individual and firm heterogeneity but omits occupation related information as in previous literature. In column 1, the (logarithmic) regional unemployment rate coefficient is -0.071 and equal to Nijkamp and Poot's (2005) meta-analysis estimate -0.07. Omitting CHK (Card et al. 2013) effects in column 1, which controls for unobserved individual and firm heterogeneity leads to a large increase of the wage-curve elasticity to -0.21 (results not shown). This remarkable difference provides two important insights: (i) unobserved individual and firm heterogeneity are important considerations, that are likely to affect wage-curve estimates. Further, (ii), much higher increases in size suggests a

much more flexible labor-market in which wages highly respond to labor-market conditions - i.e., there is less need for government intervention and recessions would be of shorter durations as wages would recover better as unemployment levels falls. Yet, when using the preferred approach of including unobserved heterogeneity effects, the labor-market appears notably less flexible, meaning intervention is now more warranted when making appropriate econometric adjustments. The economic interpretation seems to be that individuals with the lowest unobserved heterogeneity wage effects are more likely to become unemployed during economic downturns. In other words, during a downturn, the composition effect just described means that those with positive unobserved wage effects would become a larger share of the active workforce during the downturn, working to increase average wages. This shift has to be offset by the unemployment rate having a larger negative effect to offset the "favorable" composition effect on wage - i.e., omitting individual unobserved wage effects biases the results. In what follows, we will include the individual and firm unobserved heterogeneity variables, as they seem to be much more accurate.

Table 14: Empirical results of the regional and occupational unemployment elasticity

Variable	(1)	(2)	(3)	(4)	(5)	(6)
log(UE)	-0.071***	-0.041***				
	(0.004)	(0.010)				
log(UE) without own occupation				-0.009***	-0.012***	-0.012***
				(0.002)	(0.002)	(0.001)
log(UE) w/o own occupation*migrant					0.002	0.002***
					(0.001)	(0.001)
log(UE) w/o own occupation *naturalized					-0.001	-0.001
					(0.001)	(0.001)
Occ.-regional UE						
log(UE) in occupation in region			-0.011***	-0.011***	-0.008***	-0.005***
			(0.001)	(0.001)	(0.001)	(0.001)
log(UE) in occupation in region*migrant					0.001	0.000
					(0.001)	(0.000)
log(UE) in occupation in region*naturalized					-0.005***	-0.005***
					(0.001)	(0.001)
N	20.281.690	20.281.690	20.281.682	20.281.575	20.281.575	20.281.575
Adjusted R2	0.811	0.811	0.811	0.811	0.812	0.812
N Grouped	2.661.457	2.661.457	2.661.457	2.661.448	2.661.448	2.661.448

Notes: OLS estimation; cluster robust s.e. at the level of region and occupation in () for model 1, 3, 4, 5. Cluster robust s.e. at the worker level for model 2 and 6; * 0.1, ** 0.05, *** 0.01. All models contain measures for unobserved individual and firm heterogeneity (Card et al. 2013) and all models control for time, region and industry fixed effects.

However, one major discussion and objection against the estimation in column (1) is the potential endogeneity of unemployment as discussed by Blanchflower and Oswald (2005). Unemployment and wages may be determined simultaneously leading to estimation issues and a biased coefficient. Further, a reverse causation according to which decreasing wages in a region may demotivate workers and hence increase unemployment can brought up as an argument against the estimation. In order to deal with such objections, we estimate the model in column (1) and use the five-year lagged regional unemployment level from *t-5* as an instrument in the model shown in column (2). The instrument-variable estimation in column (2) shows a smaller but still highly significant coefficient of -0.041. Note that this coefficient is somewhat contradicting previous findings, as Blanchflower and Oswald (2005) show a doubled coefficient if regional unemployment is instrumented with lagged unemployment levels. However, it seems that this decrease in our model results mainly due to the inclusion of firm controls and detailed individual level variables, particularly labor market experience. If we exclude firm and individual level measures, the instrument variable coefficient is about -0.12 to -0.15 and hence twice as large as in column (1) (not shown). Note that the model in column (1) is rather robust and do not change noteworthy, if these variables are omitted. We see the estimation in column (2) as a further robustness of the estimation in column (1) and consider it as a confirmation of our previous findings, since it provides highly significant and negative estimates for different specifications.

In order to consider our above-mentioned contribution, we use the previous specification (column 1), and, include the (logarithmic) unemployment level in occupation in the region instead of the logarithmic regional unemployment. The results are shown in column 3 (Table 14). Note, that although some occupations in regions have no unemployed, which are omitted in the estimation if logarithm is applied, this regards only an absolute minority. We therefore prefer to use the logarithm of the unemployment measure to consider for nonlinearities.[16] The estimation shows a negative coefficient of -0.011 implying wage declines if unemployment raises within occupations in regions. However, this effect is considerably smaller in its magnitude compared to the regional unemployment effect shown in column (1).

In order to determine, if the effect of occupational unemployment is still present and to determine its magnitude if regional unemployment is considered, we estimate a further model

[16] In the baseline estimations, there are only 8 cases which are omitted due to the logarithmic transformation of the occupational regional unemployment shares.

in column (4) where both measures are included. However, including both unadjusted unemployment measures would lead to serious collinearity issues, as unemployed workers would be considered twice, (i) unemployed in region and (ii) unemployed in occupation in region. We therefore adjust the regional unemployment levels for individual *i* in occupation *o* by subtracting the number of unemployed workers in occupation *o* from regional unemployment for all individuals in this occupation. Accordingly, the regional unemployment levels for e.g. mechanics are adjusted (subtracted from regional unemployment) for all unemployed mechanics since this information is considered by our second key variable: the occupation-region unemployment measure.

Column 4 (Table 14) reports the augmented wage results that now adds the adjusted (logarithmic) region's unemployment rates to the (logarithmic) occupational-regional wage curve. Further, the model in column (4) contains the previous mentioned covariates in order to make it more comparable to previous estimations. In column 4, the log regional unemployment term is -0.009 and of considerably smaller magnitude compared to column 1. Yet, the occupational unemployment coefficient remains -0.011, illustrating that occupational labor-market tightness provides an additional effect on individual wages.

With regard to our topic of interest, we estimate in the next model (column 5) both measures with an interaction for migrants and naturalized migrants (Table 14). In addition, we include in column (5) some further control variables controlling for occupation related information, as well as the share of short-term unemployed (< 1 year) and the share of migrants among unemployed. The model in column (5) shows that due to the inclusion of various further information, the coefficient of the wage curve slightly increased to -0.012. Further, the interaction for the logarithmic regional unemployment measure reveals no differences in the wage curve coefficient for migrants or naturalized migrants. Thus, migrants are not differently affected by the wage curve than native workers. With regard to the logarithmic occupational unemployment, the coefficient is provided with -0.008 and hence somewhat lower than the wage curve effect. The interaction for migrants is not significant, however, the interaction term for naturalized migrants is significant and -0.005. Accordingly, the effect for naturalized migrants is -0.13 (-0.008 for the basis and -0.005 for the interaction).

We tried different variations of the model shown in column (5). In the first case, we omitted occupation fixed effects and task related job information, (ii) in a second version, we excluded insignificant covariates, i.e. share of occupation in region, share of native workers in occupation in region, and, (iii) we dropped certain unemployment measures such as share of short-term

unemployed (<1 year) in the region and the share of unemployed migrants in region in order to account for effects related to unemployment dynamics. Each of the models provided results very similar to the coefficients shown in column (5) and hence had a negligible impact on the estimates (not shown). We conclude therefore that the provided results are very robust to objections related to the model specification.

However, one key objection regarding the empirical model shown in column (5) might be, as outlined before with regard to the model in column (1), the endogeneity of the occupation-specific unemployment. Accordingly, such occupation-specific unemployment could be endogenous, when individual decisions were met on the basis of occupation-specific expectations. For instance, lower unemployment in nearby occupations could influence the decision to change into such low-unemployment occupation. Also, better growth perspectives in such occupations are reasonable, making the focus variable endogenous as well. Neglecting such problems, could lead to biased estimates and hence question the provided results.

We therefore estimate an IV model using the five-year lagged unemployment measure (unemployment from *t-5*) for occupational unemployment as an instrument. This previous unemployment would take such future considerations and job selection decisions into account, which might drive future job taking decisions. The results are presented in column (6) in Table 14. The result for the occupation-specific unemployment indicate that the coefficient decreases slightly to -0.005 (-0.008 in previous model), however the interaction with naturalized migrants remains significant and in the same magnitude, compared to the previous model. We tried additionally the 10-year lag unemployment (unemployment from *t-10*), which did not change the provided conclusion. The IV estimation also confirms our previous results and patterns and provide evidence for robust findings of our measures. However, we consider further objections in the next chapter and provide particular analysis of potential selectivity in tasks and occupations.

4.5.2 Discussion and sensitivity analysis

Comparison with previous studies

Our findings provided in Table 14 are rather surprising in view of different previous studies for Germany as (i) often the coefficient for regional unemployment rate becomes insignificant once region fixed effects are included, or/and, (ii) the provided coefficient is often considerably lower than provided in the model in column (1) in Table 14. Therefore, previous papers, such as Baltagi et al. (2009, 2012) or Rokicki et al. (2020) often rely on a two-stage regression

procedure in order to identify significant effects. In the following, we discuss several potential reasons as well as differences to previous studies in order to provide potential explanations for such differences in findings.

West and East Germany

Previous studies analysing the German wage curve are restricted to a regional part of Germany, mainly West Germany (Baltagi et al. 2009; 2012 or Blien et al. 2013). As already mentioned in the introduction, we instead consider both regions, West and East Germany because Germany has grown together in the past as discussed by Fuchs et al. (2018). This major difference might lead to substantial differences in the provided estimates compared to previous literature. We therefore estimate in the following the baseline estimation for the regional unemployment as in the previous table and interact the unemployment measure with an indicator for East Germany.

In Table 15, we re-estimate the model from column (1) from Table 14. We focus on this model, as this is more comparable to the previous literature and is thus more comparable to previous outcomes. Interacting the wage curve with East Germany provide evidence that there are considerable differences between West and East Germany, as the coefficient for West Germany is -0.023 while it is -0.077 for East Germany (-0.023 + (- 0.054)). As this large finding for East Germany provides a novel insight into the labor dynamics between East and West, we instrument it in the next column (2) in Table 15 with the previous unemployment rate from *t-5*. The instrument variable estimation in column (2) shows very similar results as the East German wage curve elasticity is estimated to -0.77 as well (-0.021 + (-0.056). Including further fixed effects, such as controls for occupations or other regional related information do not provide any different patterns nor insights with regard to the provided results. We assume that this major difference between East and West might be driven by large differences in collective agreements, as this instrument is rather more often used in West Germany and contributes to a flatter wage curve as it prevents volatile wage adjustments (Blien et al. 2013). Accordingly, the analysis of both regions is one of the key explanations for the differences between the provided estimates in this paper compared to previous literature.

Table 15: Wage curve elasticity for West and East Germany

Variable	(1)	(2)
log(UE)	-0.023***	-0.021***
	(0.005)	-0.005
log(UE)*east	-0.054***	-0.056***
	(0.005)	-0.005
N	20.281.690	20.281.690
Adjusted R2	0.811	0.811
N Group	2.661.457	2.661.457

Notes: OLS estimation; cluster robust s.e. at the level of region and occupation in (); * 0.1, ** 0.05, *** 0.01. The model includes measures for unobserved individual and firm heterogeneity as well as regional, time and industry fixed effects.

In order to account for potential convergence over time, we additionally tried a triple interaction, where we interacted the logarithmic unemployment with an indicator for East Germany and calendar year dummies in order to focus if and to what extent the coefficients of the wage curve change over the considered period. However, the results for this triple interaction are insignificant indicating no statistically difference over the years compared to the base year 2012 (results not shown). We assume hence, that there is no further convergence in our considered period between 2012 and 2018 with regard to the wage curve.

Further potential reasons for such differences in findings might result due to various differences in sample selection. Compared to most previous studies, we do not restrict our sample to males only, which might lead to further differences. However, it seems that this difference does not drive our results as shown in the Table 16. The results are very similar to the previous estimation.

Table 16:Wage curve for West and East Germany – males only

Variable	(1)
log(UE)	-0.024***
	(0.006)
log(UE)*east	-0.044***
	(0.006)
N	13.663.416
Adjusted R2	0.831
N Group	1.700.227

Notes: OLS estimation; cluster robust s.e. at the level of region and occupation in (); * 0.1, ** 0.05, *** 0.01. The model includes measures for unobserved individual and firm heterogeneity as well as regional, time and industry fixed effects.

Similar applies to age groups: we restricted our sample to workers to 24-54 years, as often done by different studies, which do not change the provided results at all (results not shown). In addition, and of particular importance, our analysed period considers the years 2012 to 2018. To the best of our knowledge, this period was yet not analysed by other authors regarding regional unemployment effects, and, is characterized by a massive economic upturn. Therefore, our coefficients are mostly derived by growing wages and decreasing unemployment levels.

Based on these additional estimates, we conclude that particularly the consideration of West and East Germany lead to pronounced differences to previous literature.

Robustness

In order to exclude potential issues or biases resulting due to misspecification or data preparation, we conduct several robustness checks. We have tried omitting, adding, recoding and transforming information included in our estimations. For instance, the results are robust if we add or omit various information into the above shown wage equation, which do barely affects our estimates. Further, we tried including different classifications of variables such as workers age and its square instead of age groups or NUTS-3 regions instead of labor-market regions. Moreover, we tried alternative data preparations like omitting wage imputation procedure or restricting only to certain groups (e.g. skilled labor), which do not changed the provided insight. Nevertheless, there are some aspects and implications that are worth being discussed. One crucial issue is the selectivity in workers considered in our sample. As we only keep workers working full-time, this might lead to a group of workers and migrants that tend to be closer to the labor market. In particular, the group of migrants considered in the analysis might thus be less representative for migrants in general working on the German labor market. However, we consider this kind of selectivity to be appropriate for our paper, as we are interested in migrants that have a higher labor market attachment that are most germane for the immigration debate to overcome German demographic shortages. Lastly, with the fulltime employment restriction we still focus on about 70% of all migrants employed in Germany.

It is still possible that our results are affected and driven by selectivity issues i.e. migrants might be crowded in certain occupations, task levels or working overqualified (Hofer et al. 2017). We take this up by performing additional models provided in Table 17. Column (1)-(3) report models similar to column (4) in Table 14 but omit task fixed effects in (1), occupation fixed effects in (2) and both, tasks and occupations in (3). This approach considers thus potential selectivity by increasing the between variance in the omitted control variables (similar to Hofer

et al. 2017). For the wage curve effect and its interactions, we provide almost identical coefficients to the previous estimation in column (4) in Table 14. We see this as an additional robustness for the previous wage curve findings.

Table 17: Empirical results for robustness purposes omitting task levels, occupations and both

Variable	(1)	(2)	(3)
log(UE) without own occupation	-0.013***	-0.011***	-0.010***
	(0.002)	(0.002)	(0.002)
log(UE) w/o own occ.*migrant	0.003**	0.001	0.002
	(0.001)	(0.001)	(0.001)
log(UE) w/o own occ. *naturalized	-0.002	-0.001	-0.001
	(0.001)	(0.001)	(0.001)
Occ.-regional UE			
UE in occupation in region	-0.007***	-0.010***	-0.012***
	(0.001)	(0.001)	(0.001)
UE in occupation in region*migrant	0.000	0.001*	0.001
	(0.001)	(0.001)	(0.001)
UE in occupation in region*naturalized	-0.005***	-0.005***	-0.005***
	(0.001)	(0.001)	(0.001)
N	20.281.575	20.281.575	20.281.575
Adjusted R2	0.812	0.812	0.812
N Group	2.661.448	2.661.448	2.661.448

Notes: OLS estimation; cluster robust s.e. at the level of region and occupation in () for model (1)-(3).; * 0.1, ** 0.05, *** 0.01.

The results of occupational-spcific labor-market tightness coefficient and its interactions show only differences in model (2) and (3), when occupational fixed effects are omitted, which can be explained by an increase in variance in this regard. However, the interactions of this occupational unemployment measure are also very similar to the previously provided results. Accordingly, our previous findings still hold as to which migrants are not differently affected than native workers by occupational unemployment while naturalized migrants have the steepest occupational-regional wage curves.

To sum up, we provide weak evidence that the regional wage curve is equal for migrants and native workers. The effect of the occupation-specific regional unemployment does not differ for migrants compared to Germans but is somewhat stronger for naturalized migrants. From a policy perspective, obviously, migrants do not differ to Germans with regard to the occupation-specific regional unemployment. For naturalized migrants, again, the occupation-specific wage curve is relatively steeper than for Germans and might be thus interesting to consider for further research.

4.6 Conclusion

Our study picks up regional occupation-specific unemployment in order to identify possible wage effects due to shortages in occupations. Doing this, we apply the traditional concept of the wage curve and augment the occupation-specific unemployment. Our results for the traditional wage curve are in line to previous estimations shown by international literature as we find a coefficient of -0.07 for the regular estimation (-0.41 for IV estimation). This coefficient implies that an increase of 100 percent in regional unemployment leads to a wage decrease of 7 (4.1) percent. However, these findings are substantially larger than what is shown by previous literature analyzing the German wage curve elasticity (Baltagi et al. 2009, 2012; Blien et al. 2013). We find that these differences to previous literature are mainly driven by the inclusion of East German regions, which were not considered by previous studies yet. Further, to the best of our knowledge, we are the first considering East Germany in such an analysis. Additional estimates show that the East German wage curve coefficient is estimated to -0.077 and is hence substantially larger than the coefficient for West Germany (-0.23), which is confirmed using an IV estimation strategy (-0.077). This large coefficient for East Germany might be particularly driven by the lower share of collective agreements in East Germany, which might be an important driver as outlined by Blien et al. (2013). These presented coefficients for the traditional wage curve are very robust and provided for various model specifications as well as instrumental variable estimations.

In addition to the previous wage curve analyses, our results indicate that the traditional wage curve is not sufficient in explaining regional wage dynamics. Estimating a model where both, the regional unemployment as well as the occupational unemployment is included provide evidence that occupational unemployment has a considerable effect on individual wages as well Using the logarithm of the occupational unemployment in each region, our estimates show that an increase in occupational unemployment of 100 percent causes an 0.8 percent fall in wages (0.13 percent for naturalized migrants). However, it must be considered here that occupational unemployment has a considerably higher variance compared to regional unemployment with possible differences of 300 or even 500 percent. Accordingly, an increase of 300 or even 500 percent in occupational unemployment may lead to an additional wage penalty of 2.4 or 4 percent, which is even higher for naturalized migrants. This wage effect must be considered additionally to the regional overall unemployment effect. However, the estimates show that once both unemployment measures are included the effect of regional unemployment decreases

substantially to -1.2 percent if regional unemployment is doubled. This indicates that previous estimates tend to overestimate the regional unemployment effect as a large part of the effect results due to occupation-specific unemployment.

Furthermore, our results indicate that the regional occupation-specific wage curve is steepest for naturalized migrants followed by Germans and migrants. Naturalized migrants' wages decrease by 1.3 (instead of 0.8) percent if occupational unemployment is doubled. Following the previous example and consideration of larger variance in occupational unemployment, these results imply wage decreases of 3.9 and 6.5 for naturalized migrants if occupational unemployment raises by 300 and 500 percent. These results are very robust and not driven by endogenous occupational choices as confirmed by our instrument variable estimation strategy. Particularly with regard to the findings provided for naturalized migrants, we assume that our results might be driven by the analyzed period of 2012 to 2018. Since this period is subject to a large economic upturn, our estimates are identified by decreasing regional as well as occupational unemployment and wage growth. Accordingly, the steepest occupational wage curve for naturalized migrants indicate that this group gains largest wage gains if economic conditions improve.

Based on the provided results, we conclude and argue for a complementary consideration of the occupational wage curve as this measure provides new insights in this topic. Our results indicate that a large part of the wage effect is driven by occupational unemployment, which was not discussed by previous studies. Our results provide a potential starting point for additional research focusing on interactions related to unemployment, occupations and wages. Further, our insights can help in the application of policy relevant advice particularly regarding immigration legislation.

5 Unemployment and its scarring effect on wages in Germany: Evidence from linked employer-employee data[17]

Abstract

I use linked employer-employee data to analyze the effect of unemployment and its duration on future wages in Germany. Using administrative data on workers and firms in Germany and considering registered and unregistered unemployment episodes, the results show long-lasting wage losses caused by unemployment incidences. Further, the estimations indicate that unemployment duration as well as selectivity into firms paying lower wages is of particular relevance for the explanation of wage penalties of re-employed workers. Different sensitivity analyses including a mass layoff design confirm the provided results. This article adds to the knowledge on long-term unemployment scarring by considering unemployment duration and firm heterogeneity and takes thus a relevant and important discussion up on the costs of unemployment.

Keywords: unemployment, scarring, unemployment duration, firm heterogeneity

JEL: J31, J64, J31

[17] This chapter is a slightly changed version of the following publication: Jost, O. (2022), "Unemployment and its scarring effect on wages in Germany: evidence from linked employer-employee data", International Journal of Manpower, Vol. 43 No. 5, pp. 1126-1143. https://doi.org/10.1108/IJM-02-2021-0065

5.1 Introduction

In a dynamic and evolving economy, unemployment is an essential part of the ongoing process. However, unemployment and its duration are linked to substantial negative consequences for regions and affected individuals. This paper examines the long-term unemployment scarring effect on future wages focusing mainly on individual unemployment duration and firm selectivity.

Existing studies such as Couch and Placzek (2010) or Davis and von Wachter (2011) show substantial and persistent effects for individual's earnings due to displacement, which are confirmed for Germany by Burdett et al. (2020). However, Carrington and Fallick (2017) discuss several studies indicating that it is not the separation itself but the following unemployment period, which is mainly responsible for the negative effect on labor market outcomes. Theoretical literature takes this up and provides various different explanations: Ortego-Marti (2017) or Burdett et al. (2020) show that unemployment may cause human capital depreciation or foregone experience, which increases with the length of the unemployment spell. Belzil (1995) instead stresses that long unemployment spells can lead to stigma in a sense of a bad signal and thus lower re-employment outcomes. Further arguments relate to health issues, loss of networks or decrease of reservation wages, which may be linked to increasing unemployment durations and thus decrease re-employment wages.

Empirical studies, considering unemployment, its duration and long-term scarring confirm these theoretical predictions (Gregory and Jukes 2001; Arulampalam 2001; Cooper 2013; Guvenen et al. 2017). These studies provide evidence that unemployment not only causes long-lasting scarring effects but that its duration is also crucial for the magnitude of the effect. Gregory and Jukes (2001) and Arulampalam (2001) show results for the U.K according to which individuals suffer a wage loss between 6 to 10% for the first year when re-entering the labor market, which, however, increases with the unemployment duration. Each month of unemployment is found to decrease re-employment wages by further 0.8% (Gregory and Jukes 2001). Similar results are provided for the U.S. by Ortego-Marti (2017) with 1.2% for each additional month unemployment, for Portugal by Lopes (2018) with 0.5% or for Germany by Schmieder et al. (2016) with 0.8%. However, because of data limitations or the focus on certain periods and age groups due to discontinuity designs, these studies provide restricted insights. They either offer results on unemployment duration effects on re-entry wages (Lopes 2018; Schmieder et al. 2016), which do not account for any long-term effects or provide estimates on

rather short periods after re-employment (Arulampalam 2001; Gregory and Jukes 2001). Further, previous studies on long-term effects of job losses for Germany such as Burdett et al. (2020) (i) do not consider unemployment duration in their estimation and (ii) use an empirical design aimed to identify the overall effect of job loss. Thus, their approach do not account for unemployment duration, which is an essential part of the long-term effect and, further, do not consider changes in covariates after unemployment i.e. changes in occupation, regions or similar. Particularly the control for changes in covariates due to unemployment incidence is important for the identification of the unemployment scarring effect as considered by the unemployment scarring literature (Arulampalam 2001; Gregory and Jukes 2001; Cooper 2013).

This paper takes these discussions into account and provides various important contributions to the literature. First, I provide results on the long-term unemployment scarring effect for Germany by considering individual unemployment duration, which is, to the best of my knowledge, not yet available to this extent in the literature for Germany. Second, I extend the analysis of unemployment scarring to the discussion on firm heterogeneity and its relevance for unemployment scarring by including not only individual level information but also observed and unobserved firm heterogeneity. This discussion provides a further insight into the relevance of firm heterogeneity for wage dynamics and on firm selectivity of workers affected by unemployment incidence. Third, I use comprehensive administrative data for Germany with vast information on individuals and firms and a possible analysis period from 1978 to 2017. Accordingly, my analysis is not restricted to a certain period and age group of workers as in Schmieder et al. (2016) and hence provides a more general picture of the topic. Further, the long period enables me to assess the entire scarring effect and allows controlling for various effects associated with unemployment, such as changes in job, industry, firm and particularly regional influence. Fourth, I use all unemployment episodes and thus deviate from most literature, as related articles use often only unemployment caused by mass layoffs in order to identify exogenous variation in administrative data. However, according to Flaaen et al. (2019), this exogenous shock is true in only about half of the cases and can even contribute to selectivity, as more productive workers tend to leave the firm before the layoff begins (Carrington and Fallick 2017). I therefore provide results that are more consistent with the natural labor market dynamics as mass layoffs are only a limited and minor part of the entire unemployment dynamic. Further, I consider registered and unregistered unemployment episodes and thus take into account the most recent findings for Germany namely that

unregistered unemployment is an essential part of unemployment duration for males (Burdett et al. 2020; Carrillo-Tudela et al. 2021; Schmieder et al. 2016).

With regard to the empirical approach, I build on the literature and use a fixed effects estimation controlling for unobserved individual heterogeneity. Furthermore, I employ a matching approach to reduce selectivity in observables. My results show that an unemployment spell leads to persistent and substantial wage penalties, which increases with unemployment duration. The initial wage penalty for re-employed workers is about 7% and additionally increases with individual unemployment duration. This wage penalty is persistent and leads to high cumulated deficits in the long-term. I use different robustness checks, including a mass layoff approach, which confirms my result. This indicates the high relevance of this topic for the political arena as unemployment periods contribute massively to wage inequality.

The paper is structured as follows. The next section deals with the theoretical motivation of the topic. In the next step, I describe the data and the sample construction. Finally, I present the research design and results including a sensitivity analysis and a conclusion.

5.2 Theoretical Motivation

Numerous authors have developed different arguments why unemployment and its duration may lead to persistent wage losses after re-employment. Drawing on the meta-analysis provided by Carrington and Fallick (2017), often used theoretical explanations in this context build on loss of human capital by which unemployment can destroy knowledge. This is related on the one hand to firm-specific knowledge, which workers cannot transfer to new firms and thus have to climb up the ladder again if re-employed. On the other hand, workers lose human capital with increasing unemployment duration as e.g. their knowledge become outdated, which is incorporated in a search framework by different authors, such as Ortego-Marti (2017) or Burdett et al. (2020). Another explanation for the negative effect is based on the revelation of information through unemployment or the related stigma. Such stigma theories focus on the signal of unemployment, and discuss its negative effect as shown by Belzil (1995). According to these models, the negative signal increases with larger unemployment durations. This is justified by the assumption that capable workers find immediately new firms and hence only the low-productive workers remain unemployed. Accordingly, employers decrease their wage offers with increasing unemployment durations.

However, there are some shortcomings in these theoretical motivations. With regard to the human capital theory, e.g., findings by Burdett et al. (2020) show a stronger negative wage

effect for the low skilled than for the highly skilled workers. Furthermore, this negative effect for the low skilled remains twice as long as for the high skilled. This is difficult to defend on the grounds of the loss of human capital during unemployment, as it should in particular affect skilled workers. At the same time, for low skilled workers who often work in semi-skilled jobs with low intensity of human capital, wages are expected to recover faster after unemployment. The same regards the information revelation theory, according to which unemployment is a negative signal. In particular, Atkinson et al. (1996) find in their employer survey that employers do not interpret unemployment per se as a negative signal or stigma. Instead, it is more important why someone became unemployed or did during the unemployment period. Further theories explaining wage losses consider health problems (physical and mental) or loss of networks due to unemployment as discussed by Carrington and Fallick (2017) in their comprehensive meta-analysis. These theories however focus on particular issues and thus do not constitute a general or comprehensive framework.

One theoretical consideration, which is not discussed in this regard, is the concept of the wage curve as it directly relates to the topic of interest. This framework considers regional unemployment levels as a further determinant for individual wages (Blien et al. 2012). According to this theory, an increase in regional unemployment levels and hence a worsening economic situation will lead to lower wage claims of workers, as workers are aware of higher unemployment risk due to normative considerations. Further, this consideration can also be applied to individual reservation wages of unemployed workers intending to re-enter the labor market as shown and discussed by Blien et al. (2012). The authors show that unemployed workers consider the economic situation in their region, which is reflected in their reservation wages. Accordingly, higher regional unemployment levels lead to decreases in reservation wages. This is particularly relevant in the light of this paper as this mechanism of decreasing reservation wages and lower wage claims can also be a result of an own unemployment experience. Workers experiencing unemployment would therefore tend to decrease their reservation wage with ongoing unemployment due to normative considerations being aware of the low-income situation due to unemployment. This in turn would be linked to lower re-employment wage levels for workers experiencing higher unemployment spells. The resulting negative re-employment wage effect would hence represent the wage penalty accepted by workers in order to avoid the negative effects linked to unemployment.

For the purpose of this paper, I draw mainly on two outlined theoretical concepts. With regard to ongoing unemployment duration and its effect on future wages, I rely on the

mentioned human capital depreciation as well as on theoretical considerations often used by Blien et al. (2012). These theories provide a reasonable and comprehensive explanation of this issue referring to long-term scarring effects.[18] Further, with regard to initial re-employment wages, I relate particularly to the theoretical considerations developed by Blien et al. (2012), which links reservation wages to the regional economic situation.

5.3 Data and sample construction

In order to determine the scarring effect of unemployment on subsequent wages, detailed information on individual and firm characteristics are required. For this purpose, I use the Sample of Integrated Labor Market Biographies (SIAB), which is a 2% sample of the Integrated Employment Biographies (IEB) provided by the Institute for Employment Research (IAB). This dataset results from social security notifications and the internal processes of the employment agencies in Germany and contains information on employees working subject to social security excluding self-employed and civil-servants (Müller and Wolter 2020). It contains various individual characteristics, such as unemployment benefit receipt, employment information, daily wage, occupation, education, nationality, gender or age. This information is provided for the years 1975 to 2017 or whenever individuals joined the labor market in this period. Due to the administrative character, the data is accurate in most entries especially with regard to wage details. One key information provided by the SIAB for all workers is the unique firm identifier.

The firm identifier allows the merge of firm information from the Establishment History Panel (BHP), which is the second administrative dataset used for this article. The BHP dataset contains annual firm information on all firms in Germany for the years 1975 to 2017. It provides various information on every firm, such as the number of employees, the industry classification, median wage in the firm or the share of females. This firm information is particularly valuable for the topic of unemployment scarring as differences in wage effects might result due to different sorting across firms. Further, linking both datasets allows constructing individual employment biographies by considering firm transitions and enables an accurate long-term analysis of wage effects. Moreover, the information on the number of employees allows

[18] See Burdett et al. (2020) for a discussion of this concept in an elaborated search framework.

identifying mass layoffs as shown by Burdett et al. (2020) or Jarosch (2021) for the same data, which are used for this article for robustness purposes as well.

Sample Construction

In what follows, I describe the most important preparation steps of the sample construction and try to follow the related literature as far as possible. For this article, I try to analyze the largest possible period from 1978 to 2017 in order to capture any long-term scarring effects of unemployment. Note that the data have some missing information on employment status in the period 1975 to 1978. Therefore, I consider information from 1978 onwards only. However, for discussion purposes I use the firm effects according to Card et al. (2013), which shortens the period to 1985 to 2017, as this information is not available for the entire period. Further, I conduct separate analyses for different periods in order to consider differences in the scarring effect over time.

For the basic preparation of the data and the merge between the IEB and BHP, I use the preparation guide provided by Dauth and Eppelsheimer (2020) and create a yearly panel with the key date on 30 June. Following the literature, I only consider males in full-time employment, which is a convention in the literature and in articles using the IEB data (Schmieder et al. 2016; Burdett et al. 2020). This results on the one hand due to potential unsteady labor market participation of women, which is often affected by parenting or the household situation. On the other hand, the data does not provide any information on working hours meaning that part-time employment is subject of high-variance in working hours and wages. Further, I restrict my sample only to workers who are employed in regular employment subject to social security activity. This is important, because the information on e.g. student trainees or marginally employed individuals is incomplete and for the most part not available until 1999. In terms of age-restriction, I refer to Guvenen et al. (2017) and limit the sample to individuals who are between 25 and 60 years old. With regard to wages, I stick to the convention and consider observations that have a positive wage. Since wages in the data are censored above the social contribution threshold, I use the wage imputation according to Card et al. (2013). In addition, I conduct an inflation adjustment for wages with 2015 as the base year for price levels.

I drop all observations without information on occupation, industry or wage. Moreover, I restrict my sample to West Germany, because of the lack of data availability on East Germany before the fall of the Wall.

One key element required for the estimation of unemployment scarring effects is the identification of unemployment and its duration. Since the data contains information only on registered unemployment benefit recipiency, it represents a lower bound of actual unemployment episodes and job search duration (Fitzenberger and Wilke 2010). This results because many workers do not immediately register for unemployment receipts after losing their job and the transition of unemployment insurance to unemployment assistance after the entitlement period is associated with numerous requirements on wealth and income situation (Schmieder et al. 2016). Therefore, Burdett et al. (2020) chose to consider both, registered and unregistered unemployment episodes using the SIAB by relating non-participation episodes up to 36 months as unemployment. I follow this approach and consider episodes up to 36 months between two employment spells without information on firm identifier as unemployment episodes. Carrillo-Tudela et al. (2021) back up this approach by analyzing the SIAB data and providing evidence that both registered and unregistered unemployment have to be considered in job loss analyses. Note that this approach of using registered and unregistered unemployment is restricted to male workers only (Burdett et al. 2020; Carrillo-Tudela et al. 2021).

5.4 Research Design and identification

The empirical strategy of this article is designed to identify unemployment scarring effects on future wages. Therefore, a number of issues related to unemployment and wages needs to be addressed by the estimation design. In the following, I discuss several potential problems and strategies in order to deal with such issues.

Since workers differ in their abilities, motivation and willingness to make sacrifices, the unemployment incidence may be linked to the worker itself. Therefore, not considering these individual traits would lead to biased results, as low productive workers would tend to be more often affected by unemployment episodes. Assuming, that these worker capabilities and motivation have a time invariant effect on the wage, the fixed effects estimator controls for this effect and provides unbiased estimates. Further, this estimation design controls for the fact that workers might have unemployment episodes abroad or before becoming observed in the data. Due to the fixed effects estimation, these unemployment periods have no effect on the estimation, as, like all other previous influences, they are kept constant.

Another selectivity issue regards workers with unstable employment relationships or fixed-term contracts, as they might be more often unemployed. In order to reduce this problem, I only consider workers, who are employed for at least 3 years at the same firm without any

unemployment incidence in these 3 years before becoming unemployed. This restriction filters a large part of unemployment caused by fixed-term contracts or voluntary changes, as only stable employment relations remain. Further, I consider only workers as unemployed, if the unemployment episode is larger than 31 days (similar to Burdett et al. 2020), since shorter unemployment spells indicate transitions with already existing perspectives. Moreover, I restrict the analysis to workers with at least 8 employment observations (similar to Ortego-Marti 2017). This approach is in line with the research subject of long-term unemployment scarring and excludes discontinuous and short employment biographies.

Further, to reduce selectivity into unemployment based on observable characteristics, I apply two strategies. First, I use the vast information on individuals provided by the SIAB and information on firms provided by the BHP and control for various observables. Second, I employ the Coarsened Exact Matching (CEM) procedure according to Iacus et al. (2011). This matching approach reduces imbalances in covariates between workers affected (treated) and not affected (control group) by unemployment incidence (see e.g. Blien et al. 2021). The main motivation for the additional matching procedure is to account for potential differences in observable characteristics between the treated and control group. Structural differences in characteristics between both groups could lead to different labor market behavior and thus selectivity issues, which may bias the results. The CEM procedure creates weights, according to (i) an algorithm described by Iacuas et al. (2011), which creates meaningful groups of specified variables or (ii) an exact matching, which is specified by the user on selected variables. For the matching procedure, I use the coarsened exact matching on firm size and age and exact matching on education, occupation, labor market experience and industry. Note that the provided results are robust to the inclusion of these weights. However, they are additionally included in the estimation in order to account for the above mentioned issue and provide more meaningful results. Therefore, this matching feature can be regarded as a tool to further reduce selectivity issues related to differences in observable characteristics. A detailed description on the matching specification as well as the matching outcome is provided in Appendix F.

Estimation

For the empirical specification, I use a generalization of the difference-in-difference estimation as is often used in related literature. I follow Arulampalam (2001) and Cooper (2013) and estimate the following wage equation:

$$\log w_{it} = a_i + \gamma_t + X_{it}ß + D_{it}\delta + \mu_{it} \quad (1)$$

where w_{it} is the average daily wage of worker *i* in year *t*. The parameters a_i and γ_t capture the time invariant individual fixed effect of worker *i* and year fixed effects (calendar year dummies), respectively. X_{it} is a vector of individual and firm controls containing age, firm tenure, individual labor market experience, the industry sector, occupation, labor market region and the individual unemployment duration. For the latter variable, I consider (i) the last unemployment duration and (ii) the cumulated unemployment duration in the employment biography (unemployment history). The variable on unemployment history contains all unemployment episodes of each individual minus the last unemployment spell, measured in both months and intervals. With regard to the firm controls, which are important for the discussion on selectivity into firms and the relevance for unemployment scarring, I use two variables. First, I include a category for firm size, which is important to capture wage growth differences in long-term analysis and second, I include unobserved firm effects according to Card et al. (2013) (hereafter CHK firm effects). The latter captures all unobserved firm heterogeneity such as the management style or wage setting policy, which is important for the identification of the wage effects.[19] See Appendix G for a detailed description on the variables used for the wage regression. D_{it} is a dummy indicating if the worker came from unemployment into this employment spell and provides thus estimates compared to the control group of workers not affected by unemployment. With regard to the control group, I do not restrict to workers without any unemployment episodes as this might be a selective group. Instead, workers in the control group may become unemployed in later periods as well, which prevents an overestimation of the scarring effects (Krolikowski 2018). Finally, μ_{it} represents the remainder idiosyncratic error component.

However, in order to provide a more detailed insight I estimate different variations of the above described wage equation. I use variations of D_{it} to consider fading of the unemployment scarring over the following years as shown by Gregory and Jukes (2001) and often used in

[19] As I use a randomized 2% sample of the IEB, the identification of unobserved firm effects may be linked to issues as the effect is identified by workers employed within the same firm in the sample. This could be associated with problems in cases where only a small number of workers per firm are in the sample. Therefore, I use firm effects estimated according to Card et al. (2013) and provided by the IAB for the SIAB sample.

related job loss literature (Burdett et al. 2020, Jarosch 2021). This approach reveals long-term effects on subsequent wages and provides thus estimates on the scarring effect.

5.5 Results

The results for the baseline estimation for all employees in the sample is provided below in Table 18.

Table 18: Unemployment Scarring - men working full-time (Coefficients)

	(1)	(2)	(3)
Came from UE			
	-0.069*** (0.002)		
Time since last UE			
< 1 year		-0.086*** (0.002)	-0.061*** (0.002)
1-2 years		-0.056*** (0.002)	-0.039*** (0.002)
2-3 years		-0.055*** (0.002)	-0.039*** (0.002)
3-4 years		-0.047*** (0.003)	-0.034*** (0.002)
4-5 years		-0.039*** (0.002)	-0.028*** (0.002)
5-6 years		-0.038*** (0.002)	-0.029*** (0.002)
6-7 years		-0.032*** (0.003)	-0.024*** (0.002)
7-8 years		-0.025*** (0.003)	-0.019*** (0.002)
8-9 years		-0.020*** (0.003)	-0.017*** (0.002)
9-10 years		-0.016*** (0.003)	-0.014*** (0.002)
Last UE Duration			
<3 months	(-)	(-)	(-)
3-6 months	-0.024*** (0.002)	-0.022*** (0.002)	-0.016*** (0.002)
>6-12 months	-0.045*** (0.002)	-0.042*** (0.002)	-0.029*** (0.002)
>12-18 months	-0.050*** (0.003)	-0.047*** (0.003)	-0.036*** (0.002)
>18-24 months	-0.101*** (0.005)	-0.098*** (0.005)	-0.070*** (0.004)
>24-36 months	-0.110*** (0.005)	-0.106*** (0.005)	-0.079*** (0.004)
Individual FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Industry	Yes	Yes	Yes
Region	Yes	Yes	Yes
Occupation FE	Yes	Yes	Yes
Age	Yes	Yes	Yes
Experience	Yes	Yes	Yes
Firm Tenure	Yes	Yes	Yes
Firm Size	No	No	Yes
CHK Firm Effects	No	No	Yes
N Observations	3.411.812	3.411.812	2.938.550
N Workers	170.064	170.064	169.139
R2 Adjusted	0.202	0.203	0.269

Source: SIAB 7517, own calculation. Standard errors are clustered at the level of person ID, * 10%, ** 5%, *** 1%. Matching weights included. Note that the observation period for the model (3) is slightly shorter as the information on the CHK firm effects are provided from 1985 onwards, which leads to somewhat less observations of workers.

All models control for individual fixed effects as well as time, region, industry and occupation fixed effects. The model estimated in column (1) (Table 18) relates to equation (1) but omits firm controls. The model includes a categorical specification for the last unemployment duration, which is intended to account for any nonlinearities. Further, the categorical specification of the unemployment spell considers different possible unemployment insurance eligibilities as discussed by Cooper (2013).

The model in column (1) contains an indicator variable for workers, whose last spell was an unemployment episode. The result for this wage effect -unemployment to employment transition- is assumed to be constant over time in this model and amounts roughly 7%. This transition effect is very similar to Arulampalam (2001), as she finds a coefficient of -0.070 for British data. Further, the result for unemployment duration in column (1) shows that larger unemployment spells are associated with larger wage penalties for re-employed workers, as an unemployment duration between 3 to 6 months decreases wages by further 2.4% compared to the reference category of <3 months. Note that both effects, the effect of unemployment incidence as well as individual unemployment duration, must be considered additionally. Therefore, re-employed workers suffer the wage penalty resulting due to unemployment incidence and individual unemployment duration.

In column (2), I change the unemployment incidence indicator to annually dummies, which allows the effect to fade over time and provides information on long-term scarring. Note that not all workers are observed for the entire period or might even lack observations, meaning that the showed profiles are derived from separate workers. The results lead to marginal changes for the effect of unemployment duration and show a wage penalty of roughly 9% in the first year after re-employment. The dummies for the following periods indicate that this effect diminishes over time, but is still present in the period 9-10 years after the unemployment incidence. According to these results, unemployment episodes in Germany lead to long lasting wage penalties even though the model considers unemployment duration and controls for various changes associated with unemployment, such as changes in occupation, region or drawbacks in experience and firm tenure. Burdett et al. (2020), analyzing job losses in Germany, provide evidence for even longer lasting effects of up to 15 years. However, due to another focus of the article, the authors do not take unemployment duration nor various controls into account except for time fixed effects and a cubic of potential experience. Gregory and Jukes (2001) in contrast, who use a similar model to the estimation in column (2), find a much faster wage recovery for British males, where the wage penalty declines to about 3% after 2 years. Nevertheless, it is

difficult to compare the results in spite of the long-term effects provided by other studies, as most papers only analyze data on rather short periods.

To discuss the relevance of firm heterogeneity and firm selectivity for unemployed workers for the estimation of unemployment scarring, I include firm controls in the estimates in column (3). I use a categorical variable for firm size as it may affect wage growth, which is important to capture long-term effects. Further, I include the CHK firm effects to consider any effects related to unobserved firm heterogeneity. The results in column (3) show considerable changes to the previous model in column (2). The inclusion of firm heterogeneity decreases the estimates for the wage penalty caused by the last unemployment duration by roughly one third. The same applies for the initial effect of unemployment incidence for the first year. Note that this difference in the wage penalty between model (2) and model (3) should be rather interpreted as a further explanation due to firm heterogeneity and less as a reduction in unemployment scarring. However, these large differences between those models in column (2) and (3) diminish in the long-run as the coefficients converge. These results provide two important insights. (i) A large extent of the unemployment scarring effect in the initial period after re-employment results due to unemployed workers selectivity into firms paying lower wages. This finding highlights one key mechanism of how previous unemployment episodes affects wages, as it reduces options of being employed by higher wage firms. (ii) The results indicate that in the long-run workers affected by previous unemployment incidences improve their situation as the relevance of the initial firm selection becomes negligible. This speaks for the finding provided by van den Berg (1992), as to which workers improve their situation rather by on-the-job search and might hence change to firms with higher wages in subsequent periods. In addition, the importance of firm heterogeneity becomes evident if the value for the adjusted *r2* is considered as well. Including firm fixed effects increases the adjusted *r2* in column (3) by about one third from about 20 to roughly 27 percent. This increase in adjusted *r2* becomes also evident if comparable studies are considered. The paper of Gregory and Jukes (2001), which is the most similar to my work regarding the estimation approach and included controls, show values of about 20 percent for adjusted *r2* in their models, which is very similar to the models in column (1) and (2). Accordingly, previous articles on unemployment scarring have yet not considered the discussion on firm fixed effects and firm selectivity in this context and its relevance. Thus, they lack a large part of important discussion on unemployment scarring.

In order to compare the results shown in Table 18 to existing studies focusing on unemployment duration, I change the coding of the variable last unemployment duration from

a categorical variable as in Table 18 to a linear (squared) term and consider last unemployment duration in months (squared). The results are provided in Table 19.

Table 19: Last unemployment duration in months – men working full-time (coefficients)

Variable	(1)	(2)
Last UE in months	-0.00535*** (0.00029)	-0.00388*** (0.00026)
Last UE in months squared	0.00004*** (0.00001)	0.00003*** (0.00001)
N Obs.	3.411.812	2.938.550
N Worker	170.064	169.139
Adjusted R^2	0.203	0.27

Source: SIAB 7517, own calculation. Standard errors are clustered at the level of person ID, * 10%, ** 5%, *** 1%. Matching weights included. Controls in model (1): Time FE, Industry, Region, Occupation, Age, Experience and Firm Tenure. Controls in (2): Same as in (1) and additionally Firm size and CHK firm effects.

The table provides two estimates (1) and (2), which relate to the models in column (3) and (4) in Table 18, respectively. Accordingly, model (1) in Table 19 shows that one additional month of unemployment duration leads to a wage decline of further 0.5%. Including firm heterogeneity in column (2) in Table 19 decreases this effect to about 0.4%.

In order to compare these estimates to the international literature, I relate to model (1) in Table 19, as this model does not account for firm heterogeneity, which is similar to other studies on this topic. The provided coefficient of -0.5% is somewhat lower compared to previous findings for Germany provided by Schmieder et al. (2016), who find a wage penalty of 0.8%. However, this difference results due to differences in the analyzed sample. Adjusting the sample to similar restrictions regarding the analyzed period and age of workers, provides similar estimates to Schmieder et al. (2016).[20] Further, the results are also in line provided by international literature, such as -0.8% for Great Britain (Gregory and Jukes 2001), -1.2% for the U.S (Ortego-Marti 2017), -0.5% for Portugal (Lopes 2018) or -0.7% for China (Knight and Li 2006).

However, as already mentioned previous estimates from the literature usually do not account for firm heterogeneity. Thus, they lack a considerable part of the explanation of unemployment scarring related to reduced options of unemployed workers in the initial periods.

[20] Schmieder et al. (2016) use a discontinuity design considering only male workers between age 40 to 46 and a time period between 1987 and 1999. Adjusting the sample to similar restrictions provides an estimate for one additional month in unemployment of -0.77% by model (1) in Table 19, which is a similar model and estimate to Schmieder et al. (2016).

5.6 Discussion, Selectivity and Endogeneity

The model shows in general robust results with regard to the inclusion of further information or recoding of variables. However, there might be objections regarding the research design. Recent papers focusing on long-term effects of job loss choose a design controlling only for fixed individual heterogeneity, year fixed effects as well as a polynomial of workers age. This relies mainly on the argument, as to which changes in other variables such as tenure or job might result due to the job loss incidence itself. This is a different framework and intends to provide estimates on the overall effect of job loss incidence and not only the unemployment scarring as in this paper or in similar scarring literature (Arulampalam 2001, Gregory and Jukes 2001 or Cooper 2013). However, in order to make sure that my data preparation as well as general empirical approach is in line to such recent literature, I regress log earnings -the cumulated yearly income- instead of log wages on year fixed effects, a cubic of workers age and the unemployment incidence dummies while considering individual fixed effects (see Burdett et al. 2020; Illing and Koch 2021). The results are provided below in Table 20 for the unemployment incidence dummies and confirm the mentioned studies and findings. I assume thus, there is no bias with regard to data preparation or empirical approach.

Table 20: Job loss and earnings – men working full-time

	(1)
Time since UE	
< 1 year	-0.348*** (0.003)
1-2 years	-0.195*** (0.003)
2-3 years	-0.168*** (0.003)
3-4 years	-0.152*** (0.003)
4-5 years	-0.134*** (0.003)
5-6 years	-0.124*** (0.003)
6-7 years	-0.112*** (0.003)
7-8 years	-0.101*** (0.003)
8-9 years	-0.093*** (0.003)
9-10 years	-0.092*** (0.003)
N Observations	6.572.342
N Workers	343.481
R2 Adjusted	0.16

Source: SIAB 7517, own calculation. Standard errors are clustered at the level of person ID, * 10%, ** 5%, *** 1%. No matching weights included (similar to literature). Model contains year fixed effects, a cubic of workers age and controls for unobserved individual heterogeneity.

Migrants

The provided results in this paper raise further the question as to which there exist differences in unemployment scarring for other groups, particularly with regard to migrants as already discussed by Illing and Koch (2021). The authors show a higher loss in earnings for migrants, defined as workers with a non-German nationality, compared to Germans affected by mass layoffs. However, this finding is restricted to the approach made by the authors, namely (i) the estimation design, which omits other covariates and (ii) using (log) earnings as the dependent variable instead of wages.[21] Using (log) daily wages instead of yearly earnings show contrasting results, according to which the wage penalty effect is even lower for migrants than for natives (results not shown). Further, including covariates as in the baseline estimation in Table 18 in model (3), I find no noteworthy differences to the above-mentioned results between migrants and natives (Table 21). This finding highlights two crucial points: first, the use of daily wages instead of earnings provides estimates that indicate less penalty for migrants and, second, controlling for covariates explains differences in unemployment scarring between both groups. With regard to the dependent variable, yearly earnings or daily wages, the differences between Illing and Koch (2021) and the present analysis, indicate that this might arise due to differences in unemployment duration. While ongoing unemployment duration decreases yearly earnings, this does not necessarily imply a reduction in wages (to the same extent). Indeed, regressing wages only on yearly fixed effects, a cubic of workers age and unemployment incidence dummies show clear differences in wage effects, which decrease between both groups substantially if controls for unemployment duration are included. This refers particularly to the consideration of unemployment duration as well as individual unemployment duration history and leads to a considerable equalization of difference between migrants and natives. In order to exclude potential other drivers, which might affect the results shown in Table 21, I tried different setups for the matching procedure as well as other variables. However, the interaction effect remains mostly insignificant or only marginal significant, which indicates a high sensitivity particularly in the long-term and thus strength the conclusion to which there are only small indicators for differences between both groups after considering differences in unemployment duration.

[21] I estimated the model used for Table 20 with a (double) interaction for migrants and can thus confirm the results of Illing and Koch (2021) (results not shown).

Table 21: Migrants and natives – men working full-time

	(1)
Time since UE	
< 1 year	-0.061*** (0.002)
##migrant	-0.003 (0.006)
1-2 years	-0.037*** (0.002)
##migrant	-0.016** (0.007)
2-3 years	-0.038*** (0.002)
##migrant	-0.009 (0.006)
3-4 years	-0.033*** (0.002)
##migrant	-0.012* (0.007)
4-5 years	-0.027*** (0.002)
##migrant	-0.008 (0.006)
5-6 years	-0.028*** (0.002)
##migrant	-0.010 (0.007)
6-7 years	-0.023*** (0.002)
##migrant	-0.019** (0.008)
7-8 years	-0.018*** (0.003)
##migrant	-0.017** (0.007)
8-9 years	-0.016*** (0.003)
##migrant	-0.008 (0.007)
9-10 years	-0.013*** (0.003)
##migrant	-0.013* (0.008)
N Observations	2.938.550
N Workers	169.139
R2 Adjusted	0.269

Source: SIAB 7517, own calculation. Standard errors are clustered at the level of person ID, * 10%, ** 5%, *** 1%. Matching weights included. Model contains all variables as in Table 18 in (3) as well as individual fixed effects. The table provides the results for the interaction with a dummy indicating migrant status (=foreign nationality).

Females

A further question arises to females, which are of major importance for the German workforce and are often neglected by similar literature due to parenting and an increased part-time share. I conduct an estimation with an interaction for females in order to identify potential differences between males and females. I use the same specification as for the baseline estimation in Table 18 in (3) and provide the results below in Table 22.

Table 22: Females and males in full-time

	(1)
Time since UE	
< 1 year	-0.054*** (0.002)
##female	-0.030*** (0.005)
1-2 years	-0.031*** (0.002)
##female	-0.018*** (0.005)
2-3 years	-0.031*** (0.002)
##female	-0.018*** (0.005)
3-4 years	-0.026*** (0.002)
##female	-0.014*** (0.005)
4-5 years	-0.020*** (0.002)
##female	-0.012** (0.005)
5-6 years	-0.021*** (0.002)
##female	-0.007 (0.005)
6-7 years	-0.017*** (0.002)
##female	-0.004 (0.005)
7-8 years	-0.013*** (0.002)
##female	-0.003 (0.005)
8-9 years	-0.011*** (0.002)
##female	0.002 (0.005)
9-10 years	-0.010*** (0.002)
##female	0.012** (0.005)
N Observations	4.014.589
N Workers	245.466
R2 Adjusted	0.255

Source: SIAB 7517, own calculation. Standard errors are clustered at the level of person ID, * 10%, ** 5%, *** 1%. Matching weights included. Model contains all variables as in Table 18 in (3) as well as individual fixed effects. The table provides the results for the interaction with a gender dummy.

Interacting the female indicator with the post-unemployment periods (unemployment scarring effect) shows substantial differences between males and females. Accordingly, the unemployment scarring effect is considerably larger for females and amounts to -0.084 (-0.054 + (-0.030)) conditional on being employed within the first year after unemployment. This effect and hence difference between genders is precisely estimated as the interaction is highly significant. Moreover, the results indicate that differences between women and men become insignificant after 5 years after the unemployment incidence. Accordingly, women suffer greater wage penalties in the short to medium run. This difference between women and men is not explained by differences in the considered covariates, which is surprising. Further, for sensitivity analysis, I changed the matching setup by considering information on gender, which did not change the provided conclusion. However, I consider this outcome as potentially driven by my sample preparation, as I refer to non-employment episodes as periods of unemployment.

This approach is however restricted to males only according to Carrillo-Tudela et al. (2021) and may thus provide biased results for females.

Regional unemployment levels (Wage Curve)

Related to the theoretical motivation in the first section of this chapter, the framework of the wage curve postulates negative effects on wages resulting from unemployment. As discussed in chapter 5.2, it is expected that this pattern particularly affects re-employment wages, according to which raising regional unemployment levels depress individual re-employment wages by negatively affecting wage claims and reservation wages. In order to consider this issue, I use a specification similar to model (3) in Table 18 including firm information and interact the unemployment scarring effect with regional unemployment levels. For this estimation, I use one unemployment incidence dummy as in model (1) in Table 18 for the interaction, as this provides information on the entire future employment biography and the wage penalty effect caused by unemployment. Note that my approach deviates by previous work on the wage curve as I control for individual fixed effects, which is not considered in traditional wage curve literature. However, this approach of considering individual fixed effects is very similar to the specification estimated in chapter 4. For information on regional unemployment levels, I use the log of yearly average unemployment rate between for each year from 1985 to 2017 and on for each NUTS-3 region.

Table 23: Unemployment scarring and regional unemployment levels for men in full-time

	(1)	(2)	(3)	(4)	(5)
Came from UE	-0.055***	-0.056***	-0.106***	-0.058***	-0.058***
	(0.009)	(0.009)	(0.011)	(0.009)	(0.009)
##logRegionUE	0.004	0.004	-0.007	0.005	0.004
	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)

Source: SIAB 7517, own calculation. Standard errors are clustered at the level of person ID, * 10%, ** 5%, *** 1%. Matching weights included in model (1), (2) and (3). Results are robust to different setups of matching and do not change with regard to significance. The table provides the coefficients for the interaction with regional unemployment levels.

Model (1) contains covariates similar to model (3) in Table 18 and shows an insignificant interaction effect with the log of regional unemployment levels. As this issue might particularly result due to the inclusion of regional fixed effects, I estimate the same model in (2) but omit regional fixed effects, which allow for more variance in this regard. However, the interaction remains insignificant. The same applies to model (3), which is very similarly specified to the

model used for the estimates in Table 20 and contains only year fixed effects, a categorical for workers age and the interaction of unemployment incidence with regional unemployment levels. Further, in model (4) and (5), I re-estimate model (1) and (2), respectively and use previous regional unemployment levels from the past year as an instrument for current unemployment levels. The interaction terms remain insignificant as well. As the specification contains individual fixed effects in all estimation and is hence different from traditional wage curve estimations, I estimate the model from column (1) without individual fixed effects, which does not change the previous insignificant interaction (not shown). Further, omitting both, individual and regional fixed effects, do not change these results as well (not shown).

In order to test whether the regional unemployment levels may have an impact on the coefficient for individual unemployment duration, I estimate two further models shown in the Table 24. In this table, I provide estimates on the interaction between the individual unemployment duration as previously discussed in Table 18 . Model (1) regress the interaction on all covariates as model (3) in Table 18, while model (2) omits region fixed effects. The results indicate that the interaction effect is insignificant for all categories apart of the last category, which shows the effect for workers, who were unemployed between 24 to 36 months compared to the reference (below 3 months). Accordingly, regional unemployment levels affect only long-term unemployed workers negatively.

Table 24: Individual unemployment duration interacted with regional unemployment – men in full-time

Last UE Duration ##log Region UE	(1)	(2)
<3 months	(-)	(-)
3-6 months	0.003 (0.003)	0.003 (0.003)
>6-12 months	0.002 (0.003)	0.002 (0.003)
>12-18 months	-0.001 (0.003)	-0.001 (0.003)
>18-24 months	-0.009 (0.007)	-0.010 (0.007)
>24-36 months	-0.020*** (0.006)	-0.021*** (0.006)

Source: SIAB 7517, own calculation. Standard errors are clustered at the level of person ID, * 10%, ** 5%, *** 1%. (-) Reference category. Matching weights included. The table provides coefficients for the interaction between regional unemployment levels and last unemployment duration. Model (1) uses the same specification as model (3) in Table 18 but includes the unemployment incidence dummy instead of dummies for the future wage effect. Model (2) is similar to model (1) but omits regional fixed effects.

These findings are somewhat surprisingly in the light of the effects presented in chapter 4, which presents precisely estimated and throughout negative coefficients for regional unemployment levels on individual wages. However, these differences in findings might result due to the different estimation design as well as the substantially larger sample used for the estimates shown in chapter 4. Furthermore, the considered time periods deviate substantially, while the analysis in chapter 4 regard the time period 2012 to 2018, the presented estimates in the above tables refer to the period 1985 to 2017. Further, the analysis in chapter 4 takes West and East Germany into account, while the present analysis is restricted to West Germany only.

Issues linked to long observation periods

Due to the long analysis period and different labor market reforms, there might be differences in unemployment scarring within the considered period. Further, the assumption of fixed unobserved individual effects may not be appropriate over long periods, as motivation or similar may change over longer periods. In order to consider such variations, I conduct an estimation of model (3) in Table 18 for 3 separate time intervals for the period between 1985 to 2017. Note that due to the changed periods, some workers are observed for less than 8 periods compared to the baseline estimations. Further, there might be workers considered only with their last observations, depending on when they joined the sample. These effects are intended in order to make sure that the provided baseline results are not driven by changes in unobserved characteristics during longer or different observation periods. The results are provided in Table 25. Note that there are some differences with regard to the initial effects, which are, if averaged, not in line to Table 18. This is driven by changes in worker composition, which results because workers can be observed only e.g. with their first or last observation restricted by calendar years specification. However, the estimates in column (1) and (2) do not change noteworthy to the baseline model provided in Table 18. However, there is a slight decrease in the unemployment scarring effect in column (3) compared to the baseline estimation. Further, the results in (3) indicate that the persistence of unemployment scarring decreases slightly. An interaction of unemployment incidence dummies with calendar year dummies indicate that this decrease in persistence is mainly due to the period between 2004 to 2009. This period is dominated by labor market reforms (Hartz reforms) and is often omitted in related analyses (Burdett et al. 2020). This, however, does not change the provided patterns or lead to different conclusions.

A further discussed problem in the literature is the inclusion of unemployment duration in the regression. As unemployment periods may lead to declining reservation wages, workers are

willing to reduce their reservation wage in order to re-enter the labor market. This is linked to a problem in which reservation wages may determine the unemployment duration leading to reverse causation. To fully control for this issue, information on reservation wages is needed, or alternatively, a discontinuity approach as discussed by Lopes (2018) or Schmieder et al. (2016). This issue is however rather relevant for studies that focus in particular on re-entry wages and less in long-term scarring analysis as mentioned by Cooper (2013). Especially during long-term observations, wages depend on different influences such as collective agreements or individual and firm productivity. Therefore, this issue becomes negligible with following periods in re-employment. In addition, employees have the possibility to change employers in subsequent periods after re-entering the labor market. This fact reduces the above-mentioned problem as well. As my results for unemployment duration are in line to the above named literature in particular for Germany, I assume that this issue does not affect my results and conclusion.

Table 25: Unemployment scarring by different time period – men working full-time (Coefficients)

	(1)	(2)	(3)
Period	1985-1993	1994-2004	2005-2017
Last UE Duration			
<3 months	(-)	(-)	(-)
3-6 months	-0.010*** (0.002)	-0.011*** (0.003)	-0.009*** (0.003)
>6-12 months	-0.024*** (0.004)	-0.028*** (0.004)	-0.020*** (0.003)
>12-18 months	-0.032*** (0.005)	-0.032*** (0.003)	-0.024*** (0.004)
>18-24 months	-0.051*** (0.008)	-0.058*** (0.008)	-0.049*** (0.007)
>24-36 months	-0.065*** (0.008)	-0.079*** (0.007)	-0.043*** (0.007)
Time since last UE			
< 1 year	-0.053*** (0.005)	-0.059*** (0.004)	-0.055*** (0.004)
1-2 years	-0.036*** (0.005)	-0.035*** (0.004)	-0.031*** (0.004)
2-3 years	-0.033*** (0.005)	-0.031*** (0.004)	-0.029*** (0.004)
3-4 years	-0.025*** (0.005)	-0.033*** (0.004)	-0.024*** (0.004)
4-5 years	-0.026*** (0.005)	-0.023*** (0.004)	-0.018*** (0.003)
5-6 years	-0.026*** (0.005)	-0.020*** (0.004)	-0.018*** (0.004)
6-7 years	-0.030*** (0.006)	-0.017*** (0.004)	-0.009*** (0.003)
7-8 years	-0.027*** (0.006)	-0.014*** (0.005)	-0.005 (0.003)
8-9 years	-0.025*** (0.006)	-0.015*** (0.004)	-0.005 (0.003)
9-10 years	-0.016** (0.007)	-0.012*** (0.004)	-0.001 (0.003)
Time FE	Yes	Yes	Yes
Industry	Yes	Yes	Yes
Region	Yes	Yes	Yes
Occupation	Yes	Yes	Yes
Age	Yes	Yes	Yes
Experience	Yes	Yes	Yes
Firm Tenure	Yes	Yes	Yes
Firm Size	Yes	Yes	Yes
CHK Firm Effects	Yes	Yes	Yes
N Observations	681.492	949.489	1.037.779
N Workers	103.673	122.884	105.593
R2 Adjusted	0.247	0.156	0.220

Source: SIAB 7517, own calculation. Standard errors are clustered at the level of person ID, * 10%, ** 5%, *** 1%. Matching weights included.

Another issue, which is often discussed and might arise due to lack of exogenous variation, is selectivity in workers. Therefore, related studies on job loss often use mass layoff events in order to exclude the worker herself as a cause for unemployment incidence (Blien et al. 2021; Burdett et al. 2020; Jarosch 2021). Since the data provides enough observations, I follow largely the approach of Davis and von Wachter (2011) in order to identify mass layoff or plant closures and displaced workers. Detailed information on the identification of these events and displaced workers are provided in Appendix H.

I re-estimate the models in Table 18 for the sample of workers affected by mass layoffs or plant closures and provide the results in Appendix H. The results for model (1) and (2) are similar to previous outcome with regard to the penalty for unemployment duration and unemployment incidence provided in Table 18 and show the same long-term patterns. However, with regard to model (3), the estimates for displaced workers are somewhat lower compared to the baseline estimation. The effect for short unemployment episodes up to 6 months and the initial penalty for unemployment incidence are lower than in Table 18. Further, the unemployment scarring effect diminishes faster over the following periods. As the previous models do not deviate noteworthy from the baseline estimations, I conclude that differences in model (3) result due to the inclusion of firm characteristics and thus differences in firms compared to model (3) in Table 18. Therefore, displaced workers tend to select even more in firms linked to lower wages, since controlling for firm heterogeneity decreases the estimates for unemployment scarring. Nevertheless, these results are in line to estimates shown in Table 18, as unemployment episodes lead to higher wage penalties and unemployment incidences lead to long-term scars on future wages.

5.7 Conclusion

This paper estimates the unemployment scarring effect on future wages for male workers in Germany by considering the individual unemployment incidence, its duration and firm heterogeneity. This approach of analyzing individual unemployment experience and its effect on re-employment wages may thus be considered as an individual extension of the wage curve framework discussed and analyzed in chapter 4. Accordingly, it provides an important insight into individual wage dynamics and individual costs of unemployment. The results show various important insights as workers affected by unemployment suffer on the one hand long-term wage penalties of up to 10 years after re-employment. On the other hand, the results reveal that these wage penalties increase with unemployment duration which is in line to previous literature. Furthermore, the results indicate the relevance of firm selectivity for re-employed workers on the extent of unemployment scarring: unemployed workers tend to be re-employed by firms associated with lower wages. Taking these firm differences into account, the effect for unemployment duration as well as the re-employment wage penalty decreases by one third. Moreover, using mass layoffs in order to identify displaced workers does not change the previous conclusion. Moreover, these results and findings hold for various changes in relevant observables, indicating the robust character of the mentioned findings.

With regard to the reasoning of the shown findings, I particularly refer to two theoretical considerations mentioned in chapter 5.2. Considering the theoretical motivation of the wage curve framework and its extension provided by Blien et al. (2012), the large decrease in re-employment wages is mainly caused by a fall in reservation wages due to the unemployment incidence. Accordingly, workers are aware of the negative (income) situation caused by unemployment and are willing to sacrifice individual wage by decreasing reservation wages in order to find in employment again. This decrease in reservation wages enlarges with ongoing unemployment periods leading to a larger penalty for workers with long unemployment spells. Further, as indicated by Burdett et al. (2020), workers might additionally suffer human capital depreciation while being unemployed, which affects their wage recovery in later periods.

These findings are of great importance for the political arena, as unemployment and its scarring effect on wages is linked to high costs not only for re-employment but also in the long-run as aggregate costs for individuals and the economy. Given that such unemployment incidence has a long-lasting effect and thus contribute to wage inequalities or even poverty, the focus of labor market policies must be on preventing unemployment in every way possible. Further, programs considered for unemployed workers should focus on a reduction of unemployment duration and ease re-entry into the labor market, as ongoing unemployment duration contributes massively to the wage scarring effect.

5.8 Appendix of Chapter 5

Appendix F: Detailed description of the matching procedure

As the research design of this article focusses on the identification of unemployment scarring effects on future wages, two groups of workers are needed in order to identify such effects. First, workers are required who suffer unemployment incidence (treated group) and, second, a control group of workers who do not suffer unemployment in the same period but can suffer unemployment in e.g. later periods in their employment biography. The latter is particularly important, as a control group of workers without any unemployment incidence is a selective group and would lead to an overestimation of the unemployment effect (Krolikowski 2018). However, some workers tend to be more often unemployed, such as younger workers or workers with low labor market experience. Thus, a selectivity into unemployment based on imbalances in observables might arise. In order to reduce these imbalances, I use the Coarsened Exact Matching (CEM) according to Iacus et al. (2011).

The CEM method provides different features and allows for either an exact match in observables similar to orthodox matching approaches or a coarsened exact match based on CEM's automatic algorithm (Iacus et al. 2011). I use exact matching on the educational attainment, the occupation and industry, as well as labor market experience categories because differences in these variables might lead to substantial differences in wages. Further, I apply coarsened exact matching to the variables: firm size and age category. For the matching procedure, I chose for the treated group the last observation before unemployment incidence. For the control group, I chose a randomized observation for each worker (similar to Blien et al. 2021).

Below in the table, I illustrate the difference for the matched variables before and after using CEM by providing the mean values. The table indicates that the matching procedure decreases imbalances in observables. Particularly differences in the distribution between industry sectors are more balanced after the matching procedure. The same applies to occupations (not shown in the table).

In order to use this matching outcome for the estimation of unemployment scarring, I include the weights created by CEM into the regression. Although the results do not change much, the matching indicates somewhat stronger effects in the initial periods for re-employed workers.

However, it does not change the conclusion or the patterns. The same applies for different settings of CEM, as it does not change the results in a noteworthy manner.

Matching results

Variable	Non-Unemployed		Unemployed	
	w/o match	matched	w/o match	matched
Age categories				
25-34 years	0.278	0.317	0.307	0.317
35-44 years	0.307	0.376	0.379	0.377
45-54 years	0.300	0.270	0.274	0.269
55-60 years	0.115	0.038	0.040	0.038
Firm size categories				
< 10 employees	0.105	0.175	0.174	0.175
10-19 empl.	0.084	0.116	0.118	0.116
20-49 empl.	0.133	0.178	0.176	0.178
50-99 empl.	0.112	0.129	0.129	0.129
100-199 empl.	0.116	0.125	0.126	0.125
200-499 empl.	0.147	0.124	0.121	0.124
500-999 empl.	0.095	0.060	0.062	0.060
1000-4999 empl.	0.136	0.073	0.074	0.073
>4999 empl.	0.072	0.020	0.021	0.020
Education				
No vocational training	0.116	0.102	0.118	0.102
Vocational training	0.762	0.810	0.777	0.809
University (applied science)	0.122	0.088	0.105	0.088
Labor market experience in years				
< 2 years	0.022	0.000	0.000	0.000
2-5 years	0.122	0.058	0.063	0.058
>5-10 years	0.295	0.350	0.344	0.350
>10-15 years	0.242	0.250	0.249	0.250
>15-20 years	0.154	0.171	0.173	0.171
>20 years	0.165	0.170	0.171	0.170
Industries (1-digit)				
Agricult., forestry, fish.	0.048	0.025	0.028	0.026
Food and beverage	0.026	0.027	0.031	0.027
Consumer goods	0.039	0.047	0.054	0.047
Production goods	0.161	0.156	0.154	0.156
Capital/utility goods	0.185	0.138	0.137	0.139
Construction	0.105	0.169	0.166	0.169
Hotels/Restaurants	0.150	0.216	0.211	0.215
Transport and Logistic	0.187	0.171	0.167	0.171
Education/Teaching	0.098	0.050	0.052	0.050

Source: SIAB 7517, own calculation. Note that the first category of labor market experience (<2 years) is shows values of 0 years. This results due to the restriction as to which unemployed workers need at least 3 years of firm tenure within the same firm implying at least 3 years overall experience in order to be eligible for the analysis. This is considered by the matching procedure as I conduct an exact matching on this variable. The results are robust for omitting this category.

Appendix G: Covariates used for the estimation

Variables	Description
Age	Categorical variable representing the workers age in years. Five categories: 25-34 (ref), 35-44, 45-54, 55-60.
Firm Tenure	Categorical variable with 6 categories of firm tenure in years: <= 2, > 2 to 5, > 5 to 10, > 10 to 15, > 15 to 20, > 20
Labor Market Experience	Categorical variable indicating the workers actual labor market experience in years. Variable is created on the observed employment duration in the data. Six categories: <= 2 (ref), > 2 to 5, > 5 to 10, > 10 to 15, > 15 to 20, > 20
Industry	Categorical variable encompassing nine categories of 1-digit industry based on Eberle et al. (2011).
Occupation	Categorical variable with thirteen occupation categories based on Schimpl-Neimanns (2003).
Labor Market Region	Categorical variable with 108 labor market regions (West Germany) according to Kosfeld and Werner (2012).
Last UE Duration	Categorical variable with nine categories of unemployment duration in months: <= 3 (ref), > 3 to 6, > 6 to 12, > 12 to 18, > 18 to 24, > 24 to 36, > 36 to 48, > 48 to 60, > 60 For comparison purposes to previous literature, I use this variable in months and months squared
UE History	Categorical variable representing six categories of individual unemployment history in months: <= 6, > 6 to 12, > 12 to 18, > 18 to 24, > 24 to 48, > 48. The unemployment history contains the sum of all individual unemployment episodes minus the last unemployment duration and indicates workers previous tendency to unemployment benefit receipts (Gregory and Jukes 2001; Cooper 2013).
Firm Size	Categorical variable with nine categories of firm sizes: <= 9, > 9 to 19, 20 to 49, 50 to 99, 100 to 199, 200 to 499, 500 to 999, 1000 to 4999, > 4999
CHK Firm-Effect	As I use a 2 percent sample of the IEB data, the identification of firm fixed effects may be biased due to an insufficient number of workers per firm. In order to control for unobserved firm heterogeneity, I use the information on German firms provided by Card et al. (2013). These firm-specific effects capture all unobserved firm characteristics such as management style, wage setting policies or similar. Unfortunately, this information is provided for the years 1985 to 2017, which decreases the analysis period.

Appendix H: Identification of mass layoff events and displaced workers.

Since the IEB does not provide any information on separation reasons, one often applied strategy is to use mass layoff events in order to identify displaced workers. For the identification of mass layoffs, I largely follow Davis and von Wachter (2011) as is often done in studies focusing on job losses (Blien et al. 2021; Burdett et al. 2020).

For the identification of mass layoffs or plant closures of a firm in year y, I use the following criteria:

(i) the firm must have at least 20 workers in year y-2

(ii) the number of workers must have decreased by at least 30% from y-1 to y

(iii) the number of workers in y-2 is not higher than 130% of workers than in y-3

If the above conditions are satisfied, I mark the firm with a dummy "ml" and merge this information to each worker working in such firms. Further, I mark workers as affected by mass layoffs, if they left the firm between y and y+1 and were unemployed for at least 31 days during this period. The latter condition follows Burdett et al. (2020) and is necessary to identify workers really affected by mass layoffs and displacements, as the share of workers in firms may decrease due to reorganization or outsourcing, which may lead to identification issues. With regard to the worker itself, I impose the same restriction as for the baseline estimation, according to which workers must have been employed for at least three years in the firm and have no unemployment episodes within these three years, which ensures a stable employment relation.

With regard to the above named conditions, I slightly deviate to Davis and von Wachter (2011), as I require 20 instead of 50 workers in (i). This deviation relates to Huttunen et al. (2018) or Jarosch et al. (2021), who use 20 and 25 workers respectively which increases the number of workers affected, which ease the identification of effect. Moreover, this reduction in workers reduces selectivity issues as on the one hand workers in large firms have different wage dynamics and suffer larger wage penalties if displaced (Fackler et al. 2021). On the other hand, larger mass layoff events may have regional effects as these events lead to displacement of workers with similar job experience and employment background, which contribute to the main effect of job loss and unemployment.

In order to compare the results of unemployment scarring caused by mass layoff events to the previous estimates, I re-estimate the models shown in Table 18 with the additional condition

that workers must have been affected by such events. Further, I change one condition with regard to the minimum number of annually observations from 8 to 4. This ensures enough cases for the analysis as the amount of cases is considerably lower using mass layoff events. The results are provided in the table below.

Unemployment scarring caused by mass layoff events – men working full-time (coefficients)

	(1)	(2)	(3)
Last UE Duration			
<3 months	(-)	(-)	(-)
3-6 months	-0.018*** (0.005)	-0.017*** (0.005)	-0.010* (0.005)
>6-12 months	-0.041*** (0.006)	-0.039*** (0.006)	-0.028*** (0.006)
>12-18 months	-0.044*** (0.008)	-0.041*** (0.008)	-0.030*** (0.008)
>18-24 months	-0.093*** (0.014)	-0.090*** (0.014)	-0.064*** (0.012)
>24-36 months	-0.119*** (0.016)	-0.117*** (0.016)	-0.080*** (0.015)
Came from UE	-0.057*** (0.006)		
Time since last UE			
< 1 year		-0.070*** (0.007)	-0.038*** (0.006)
1-2 years		-0.044*** (0.007)	-0.019*** (0.007)
2-3 years		-0.052*** (0.007)	-0.026*** (0.007)
3-4 years		-0.038*** (0.007)	-0.021*** (0.006)
4-5 years		-0.032*** (0.007)	-0.017** (0.007)
5-6 years		-0.036*** (0.007)	-0.020*** (0.006)
6-7 years		-0.029*** (0.007)	-0.014** (0.006)
7-8 years		-0.019*** (0.007)	-0.005 (0.006)
8-9 years		-0.019*** (0.007)	-0.008 (0.006)
9-10 years		-0.020*** (0.007)	-0.010* (0.006)
Time FE	Yes	Yes	Yes
Industry	Yes	Yes	Yes
Region	Yes	Yes	Yes
Occupation	Yes	Yes	Yes
Age	Yes	Yes	Yes
Experience	Yes	Yes	Yes
Firm Tenure	Yes	Yes	Yes
Firm Size	No	No	Yes
CHK Firm Effects	No	No	Yes
N Observations	2.174.262	2.174.262	1.887.576
R2 Adjusted	0.199	0.200	0.276
N Workers	110.808	110.808	110.170

Source: SIAB 7517, own calculation. Standard errors are clustered at the level of person ID, * 10%, ** 5%, *** 1%.

6 See you soon. Fixed-term contracts, unemployment and recalls in Germany: A linked employer-employee analysis[22]

Abstract

Almost 20 percent of all male employees in Germany who become unemployed return to their previous employers. Such temporary layoffs and the subsequent recalls are often used by firms to shift their labor costs to society and the unemployment benefit system, which has led to various legislation aimed at prohibiting or reducing this undesired instrument in Germany. This paper analyzes the interplay between fixed-term contracts, which can be used to undermine legal regulations, and temporary layoffs for men. For this purpose, I use comprehensive administrative data at individual level, complemented by various firm characteristics. My results show that unemployed workers who had previously worked on fixed-term contracts are more often recalled by their previous firms than workers who had permanent contracts. Moreover, older and low-skilled employees as well as migrants are particularly affected by the interplay between fixed-term contracts and temporary layoffs. This is also confirmed for women in an additional robustness analysis.

Keywords: Unemployment, Wage, Recall, fixed-term contracts, unobserved heterogeneity

JEL: J64, J65, J4

[22] This chapter is a slightly changed version of the following publication: Jost, O. See you soon: fixed-term contracts, unemployment and recalls in Germany—a linked employer–employee analysis. Empirica 49, 601–626 (2022). https://doi.org/10.1007/s10663-022-09540-1

6.1 Introduction and Literature

Unemployed workers re-entering employment can either start working for a new firm or return to their previous firm. The literature provides various theoretical models addressing the latter case, known as recalls. Feldstein (1976) and Baily (1977) build on the implicit contract theory to motivate recalls: firms temporarily lay off workers to compensate for a decrease in aggregate demand, and recall them at a later point in time. This approach is linked to an implicit agreement according to which laid-off workers will be recalled as soon as the firm's situation improves. Thus, temporary layoffs and recalls can be used as an instrument to shift labor costs onto the economy or the unemployment insurance system (UI), as shown by Albertini et al. (2020). This issue can be associated as a conflict of objectives between workers and employers. While employers are interested to use temporary layoffs in order to externalize and reduce labor costs in periods of decreases in aggregate demand, workers are interested to remain employed. Although lawmakers do not directly prohibit this process of layoff and recall afterwards, there are usually different measures and laws, which are part of the labor market policy and are intended to reduce such cases. These measures are particularly driven by arguments related to the externalization of labor costs on UI or the entire economy (Albertini et al. 2020; Fujita and Moscarini 2017; Liebig and Hense 2006).

However, although labor market policy aims to reduce the number of recalls, empirical studies analyzing this topic show high numbers of recalls and thus a major relevance of this topic for labor market dynamics of unemployed. Figures of 30 percent or more are found by almost all international studies, such as for the U.S. (Katz and Meyer 1990), Spain (Alba-Ramírez et al. 2007; Arranz and García-Serrano 2014), Austria (Böheim 2006; Nekoei and Weber 2015, 2020) or Sweden (Jansson 2002; Nivorozhkin 2008). For Germany, the corresponding figures are somewhat lower, ranging from 17 to 22 percent (Mavromaras and Rudolph 1995, 1997, 1998; Liebig and Hense 2006; Edler et al. 2019). Despite these high figures, the topic of temporary layoffs or recalls by previous employers is still often neglected when explaining unemployment dynamics, even though it is a popular instrument used by firms to reduce costs (Liebig and Hense 2006).

For Germany, a number of studies are available on this topic. Apart from an older descriptive review for Germany by Mavromaras and Rudolph (1995), there is evidence that rather smaller firms use temporary layoffs as shown by Mavromaras and Rudolph (1998). This is explained by the absence of work councils in smaller firms, which rather reject this instrument

(Mavromaras and Rudolph 1998). Further studies for Germany consider the gender wage discrimination linked to temporary layoffs (Mavromaras and Rudolph 1997), recalls associated with economic cycles (Liebig and Hense 2006) or recalls and differences in earnings (Edler et al. 2019). These studies show that certain occupations and industries are particularly affected by temporary layoffs such as construction, but also hotels and restaurants and other industries affected by seasonal fluctuations. Further, recalled workers show wage penalties compared to workers not affected by temporary layoffs, but higher wages compared to new workers changing their firm, which is also found for the US Kodrzycki (2007).

International literature reveals further interesting results according to which laid off workers, who expect to be rehired exert less search effort (White 1983; Mortensen 1990; Fujita and Moscarini 2017). However, their search effort increases the longer the unemployment duration lasts to avoid negative effects on their productivity. Another important and neglected aspect related to temporary layoffs, which is taken up by international literature is the use of fixed-term contracts as shown by Alba-Ramírez et al. (2007) and Arranz and García-Serrano (2014) for Spain. Firms use fixed-term contracts, which enables them amongst others, to reduce cost-efficient work force by not extending these contracts as, for example, no dismissal payments have to be paid nor social criteria has to be considered before a layoff. At the same time, firms still have the option of re-employing laid off workers later if for instance aggregate demand for goods rises. In this way, fixed-term contracts can be used to conduct recalls and to undermine employment protection laws, which usually prohibit temporary layoffs.

Analyzing recalls in Spain, Alba-Ramírez et al. (2007) obtain results indicating that the probability of a recall is higher for unemployed workers who had previously had a fixed-term contract. Arranz and García-Serrano (2014) also provide evidence that firms use fixed-term contracts to mitigate seasonal fluctuations in demand and recall laid off workers later. Further, they demonstrate that the instrument of fixed-term contracts is an essential part of Spanish firms' business strategies.

For Germany, no comparable study is available although the application of fixed-term contracts became a conventional tool in the last two decades (Bossler et al. 2020). Further, to the best of my knowledge no current study for Germany is available analyzing temporary layoffs using a competing risk framework, which enables the possibility to compare rehiring's to regular unemployment exits into new firms. This paper takes this up and builds particularly on previous work of Mavromaras and Rudolph (1995), Liebig and Hense (2006), Alba-Ramírez et al. (2007) and Arranz and García-Serrano (2014). In particular, I analyze the importance of

recalls for the German labor market and the relevance of fixed-term contracts in this context. The interplay between fixed-term contracts and recalls is particularly relevant in the German context, as the German labor market is considered less flexible due to strong employment protection laws. These laws make temporary layoffs and recalls more difficult to use.

For this paper, I use a large administrative individual data set, linked to establishment data for the years 2012 to 2017. Due to the administrative character of the data and information on individuals on a daily basis, the data is highly accurate and reliable. I can thus precisely identify transitions from unemployment to employment and control for various characteristics, such as wage, industry sector, occupation, education, or region.

I provide at least three important contributions. First, I analyze the relationship between fixed-term contracts and recalls for Germany, which was not yet examined for Germany. Second, I consider seasonal and business-cycle recalls with regard to fixed-term contracts, which was not yet addressed by previous literature, either. Third, the extensive and accurate data, which is not available in most comparable studies, enable me to provide a more detailed picture of unemployment dynamics related to temporary layoffs. Further, I use a competing risk framework, which is mostly used in international literature and makes my results directly comparable to other papers.

Using a competing risk framework based on survival time analysis with unobserved heterogeneity, my results indicate an interplay between temporary employment contracts, unemployment and recalls for Germany. Unemployed workers, who were previously employed in fixed-term contracts are more often rehired by their previous firms. Additional analyses show that particularly workers, who are in fixed-term contracts are recalled more often in fixed-term contracts again. This applies in particular for women and migrants. Further, comparing business cycle and seasonal recalls, my results provide evidence that firms use recalls to cope with seasonal fluctuations.

This chapter is organized as follows. The next section provides information on legal regulations and the identification strategy. It is followed by a description on the data, the summary statistics and on the main variables. The subsequent section presents the estimation and sensitivity analyses as well as a conclusion.

6.2 Theoretical considerations on Recalls

Although the amount of literature providing theoretical considerations on recalls is rather restricted, there are some important contributions, which are worth of being mentioned and

discussed in the present case. Beginning with Feldstein (1976) and Baily (1977), the authors discuss recalls as a very special situation with an implicit agreement between firms and employees. According to these considerations, firms that are affected by worsening economic situation and a decrease in demand for their goods intend to reduce the number of workers in order to save costs for labor during such situation. This strategy of reducing labor during periods of decreased demand is however not always possible due to different legal regulations aimed to protect workers of becoming immediately unemployed due to e.g. seasonal fluctuations. However, firms that are restricted in their flexibility to reduce labor and hence costs are on the risk of going bankrupt as they are confronted with high costs in situations with decreased revenue. Feldstein (1976) and Baily (1977) argue therefore that workers are aware of this situation leading to an implicit contract: in times of decreased demand and economic downturn, workers are willing to accept lay-offs. However, employers on the other hand, will employ their laid-off workers, once demand for goods rises and the economic situation improves, leading to an implicit agreement between firm and worker.

Newer theoretical considerations such as by Albertini et al. (2020) or Fujita and Moscarini (2017) build on a search-theoretical framework to discuss recalls and recall-related issues. Fujita and Moscarini (2017) include potential recalls and hence temporary layoffs in a search framework by arguing that recalls are not only common in the U.S. labor market but also obvious with regard to worker-firm match heterogeneity. Accordingly, both, workers and firms know each other after a period of employment, which reduces the potential search effort for both after layoffs making recalls more likely. The authors further analyze recalls and their effects for individual labor market experiences providing evidence that recalled workers have larger job tenure, shorter unemployment durations as well as lower likelihood for job changes.

Albertini et al. (2020) build on the work by Fujita and Moscarini (2017) and emphasize the importance of the so-called experience rating in the U.S. unemployment insurance (UI) system. The experience rating was implemented in the U.S. to internalize UI costs leading to a variable component of the individual UI firm tax rate. Accordingly, the individual UI tax rate for firm *f* increases if the UI benefits rises by workers laid-off by firm *f*. The authors analyze in their theoretical model the experience rating and its effect as well as a counterfactual scenario of UI without experience rating. They conclude that experience rating has a stabilizing effect on the UI emphasizing the importance of the experience rating system for entire economic situation.

Although there are a few newer theoretical discussions and contributions on the topic, the phenomenon of recalls can also be considered within an older framework, which was yet not

considered in this regard. The efficiency wage theory, mainly considered for the link between wages and productivity, might also explain findings related to recalls. According to this theory, higher wages improve labor productivity (Schlicht 2016). However, this in turn implies that firms must be able to evaluate workers productivity, which assumes a certain period of employment, where the worker is able to provide an insight of her or his ability. With regard to recalls, this would imply that recalled workers must have been passed the initial "test" period as firms would not recall low-ability workers. Further, it can be expected that due to the known productivity of recalled workers, the wage would be very similar to the previous wage in the last employment period before being recalled. According to these theoretical considerations, two assumptions can be made ex-ante. (i) Workers with larger firm tenure are proven employees and hence will tend to be chosen for recalls over workers with lower firm tenure (cet. par.), and, (ii) wages of recalled workers will tend to be similar to their previous wages before being laid-off. These assumptions will be considered in the empirical chapter.

6.3 Legal regulations

In order to discuss temporary layoffs and recalls on the German labor market, an insight into legal regulations of employment, dismissal and fixed-term employment is necessary. The Dismissal Protection Act permits only a few specific reasons for dismissing workers who have permanent and open-ended employment contracts. On the one hand, these are reasons related to personal misconduct, e.g., theft (Jahn 2009). On the other hand, they include dismissal for operational or economic reasons (*betriebliche Kündigung*) (Stephan 2006; Struck et al. 2007). However, dismissals for operational reasons are subject to various regulations and laws. Firms must prove a decline in business that is expected to persist in the future (Jahn 2009). Furthermore, firms conducting dismissals for operational reasons must take into account different social criteria among workers, which includes, e.g., the number of children or a disability status (Jahn 2009). These social criteria norms and thus the associated ranking of workers is uncertain in legal terms as the legislation does not weight these criteria, which leads to considerable insecurity in a judicial settlement (Jahn 2005, 2009). In order to avoid such settlements, firms tend to make severance payments when dismissing workers with permanent contracts, which makes layoffs costly.

However, there are ways to avoid such costs. Firms might use agency workers, hiring them from an agency for a certain period and releasing them when they are no longer required (Leiharbeit). Further, firms might use fixed-term contracts. This type of contract is often used as an extended trial period, which functions as a filter and prevents firms from employing less

productive workers. In addition, fixed term contracts give firms the possibility of not renewing these contracts if aggregate demand declines. Since lawmakers are also aware of these options and of possible exploitation at the workers' expense, there are a number of laws to protect this worker group. In particular, the use of successive fixed-term contracts is only allowed for a total duration of up to two, or in exceptional cases of up to four years of employment. Note that this restriction does not include fixed-term contracts in research and education, which may be longer. However, it is possible that this restriction itself can lead to temporary layoffs and recalls. Employees can take on a four-month period of unemployment after the maximum fixed-term period in order to interrupt the factual context (*sachlicher Zusammenhang*) of the fixed-term contract and begin again a new fixed-term contract in the previous firm. Moreover, if the duration is less than 4 months, the work is assumed to be related to the context before and a new fixed-term employment is not allowed. Thus, the law which is supposed to protect vulnerable groups, may lead to temporary layoffs itself.

However, these circumstances are taken into consideration by lawmakers, leading to some privileges for this vulnerable group of workers employed on fixed-term contracts with regard to their eligibility period for unemployment benefits. Workers affected by seasonal unemployment or working on fixed-term contracts usually require only 6 instead of 12 months of employment subject to social security contributions in the last 30 months in order to be eligible for unemployment benefit. For those who do not fulfill these criteria or whose unemployment benefit entitlement is exhausted there is the possibility to apply for unemployment assistance (UA), which is financed by taxes and provides a minimum income.

The identification of temporary layoffs builds on the information on legal regulations mentioned above. I use the information on unemployment benefit receipt to identify firm-side and hence involuntary temporary layoffs since the data does not include reasons for separation. This approach of using spells of unemployment benefit receipt instead of any periods of non-employment periods has different implications that are worth discussing. Using unemployment spells instead of periods of non-employment to identify recalls has the advantage of taking temporary layoffs into consideration, which are potentially disadvantageous for the unemployment benefit system and society. This results as these workers do receive unemployment benefits and are in fact unemployed and not self-employed in the meanwhile. Note that this approach also leads to an underestimation of recall rates in Germany as temporary layoffs indicated by non-employment periods are not considered. In addition to the latter

argument, this approach is in line with the consideration of temporary layoffs as a strategy used by firms to increase flexibility and to shift labor costs to the UI system (Albertini et al. 2020).

However, the previous arguments as well as the focus of this article relies on the crucial assumption that unemployment represented by unemployment benefits is in general involuntary and not driven by individual choice. This assumption is based on several reasonable arguments, which are briefly outlined in the following. First, in Germany unemployment benefit corresponds to 60 percent of the last wage (67 percent if children are living in the same household) and implies a massive deterioration of the income situation. In addition, this deterioration hits vulnerable groups most severely, as they usually earn lower wages and are therefore particularly dependent on their income. In this respect, I assume that workers who are affected by frequent seasonal work and therefore are aware of the consequence of temporary layoff are unemployed involuntary as well, as this is also associated with a loss of income. Benefits paid from the UA system are even lower and represent a living minimum, which strengthens the argument of periods of involuntary unemployment on the part of the employee and temporary layoffs on the part of the firm.

Second, the approach of identification through unemployment benefits reduces the likelihood of voluntary unemployment, as unemployment by voluntary reasons is a violation of insurance conditions of the German UI. Voluntary unemployment, e.g. due to dismissal by the worker and not by the firm, is punished with a period of up to 12-weeks without unemployment benefits (*Sperrzeit*). Such cases, in which unemployment benefit recipient in the first 30 days after the end of an employment spell is missing, are not considered in my analysis as these workers might be affected by punishment due to voluntary contract termination.[23] Note that this threshold of 30 days is in line to Nekoei and Weber (2020), who chose 40 days. The same applies to cases with a non-employment spell between two employment spells, because the reason for this period is not clear.

Third, analyzing unemployed workers in Germany in a panel setting, Chadi (2010) provides evidence indicating that only a minority of unemployed individuals can be regarded as voluntarily unemployed. This finding is strengthen by DellaVigna et al. (2020), who do not find any evidence of unemployed workers timing their job start to coincide with the end of unemployment benefit entitlement. I thus assume that the crucial assumption of involuntary

[23] The results are also robust and very similar for 45 and 60 days non-employment and non-benefit periods between the end of job and the beginning of unemployment payments.

unemployment is justified by the previous arguments and that there is no distortion in unemployment duration, as workers do not try to delay the start of their employment.

6.4 Data

For this paper, I use two linked administrative data sets: the Sample of Integrated Labor Market Biographies (SIAB) and the Establishment History Panel (BHP). The SIAB is a 2 percent random sample drawn from the Integrated Employment Biographies (IEB) provided by the Institute for Employment Research (IAB). This data covers individual wages, nationality, age, education, gender, unique establishment identifier, daily employment and unemployment benefit spells among others. The information is available for the employment biographies of employees covered by social security in Germany for the years 1975 to 2017 (SIAB 7517). As the data is derived from administrative records, it is highly valid in terms of employment and unemployment benefit spells, which is necessary for identifying temporary layoffs and recalls.

However, the SIAB does not contain any information on the self-employed or civil servants. Although employees covered by social security account for over 80 percent of the German workforce, the data may show shortcomings with regard to periods of non-employment, which are relevant for this analysis. Accordingly, these periods of non-employment may cover periods of self-employment or military service, which can be misinterpreted as temporary layoffs and rehires, which emphasizes the need for the identification strategy described above focusing on unemployment benefits.

In order to take additional information on firms into consideration, I merge data from the second administrative data set (BHP) via the unique establishment identifier. This data contains information on the median wage in the establishment, establishment size, industry sector, share of high-skilled workers, regional location or share of workers with fixed-term contracts in the establishment. Especially the extensive information on firms makes it possible to identify firms and firm variables that are related to temporary layoffs and recalls, which permits novel insights into the topic. It should be taken into account, however, that the BHP provides establishment-specific information as of June 30 of each year, meaning that variation within the year cannot be considered. Nevertheless, changes in establishment variables usually tend to be small, especially in larger establishments, so that changes during the year are negligible.

6.4.1 Data preparation and Sample Construction

In order to analyze the data provided by the IAB, various preparation steps are required that affect the results. I describe the most important steps of my data preparation and sample construction below. In preparing the data, I try to follow the literature mentioned in the introduction as far as possible. Alternative preparations for sensitivity analyses are described separately.

For my analysis, I use the period 2012 to 2017. This is because information on whether a fixed-term contract is used or not is only available in the data from 2012 onwards. However, in order to prepare the individual workers' employment biographies, which is necessary for information such as labor market experience or firm tenure, I use information from the years 1978 to 2017, because the data recorded before 1978 are incomplete. Since the data includes every employment spell reported in the period mentioned for the individuals of interest, I make use of actual observed work experience. In the case of overlapping employment spells, I retain the longest spell, and in the case of equal length, I retain the spell with the highest wage. Focusing first on the longest spells enables me to better identify transitions from employment to unemployment and is thus necessary for the research question.

Concerning potential missing values in the data, especially in the education variable, I apply an imputation following Fitzenberger et al. (2005). In addition, I use the wage imputation based on Card et al. (2013) to impute wages above the social security contribution assessment ceiling and conduct an inflation adjustment for wages.

As is often the case in the literature, I consider women in a separate analysis as their employment biographies often change because of parenting. This means that voluntary reasons for temporary layoffs may affect women more than men. Furthermore, women are differently distributed across jobs compared to men, which makes it necessary to analyze them separately, as some occupations have particularly high recall rates. With regard to age restrictions, I examine individuals between the age of 25 and 60.

Like Mavromaras and Rudolph (1998) as well as Mavromaras and Orme (2004), I restrict the employment spells to regular employment subject to social security contributions, which leads to a noticeable reduction in the number of recalls. This approach is consistent with the topic of interest as marginal part-time employment (which is not subject to social security contributions) is not very specific in terms of tasks. Therefore, it does not require much firm-internal knowledge, which becomes more relevant for regular employment. Thus, in regular

employment, not only employers but also employees have an interest in recalls as both can benefit from each other coming together again after the period of unemployment.

Another important aspect of my sample construction is the consideration of employed workers in regular employment receiving wage top-up benefits at the same time (*Aufstocker*). Such cases occur if workers earn wages below a certain threshold which are therefore topped up with benefits from UA. This happens, for instance, in families where only one parent is in employment and earns a wage that is not sufficient for the family. In these cases, there are employment spells that are parallel to the spells of benefit receipt. I exclude such cases from my analysis, as such workers are not solely dependent on their employment relationship and this may affect the duration of unemployment benefit receipt.

With regard to the data preparation for the survival time analysis, I merge employment spells with the same establishment identifier, creating coherent employment spells that are exact to the day for employees. The same applies for spells of unemployment benefits, which I merge for the observed individuals, creating coherent unemployment spells consisting of unemployment assistance and unemployment benefit spells. When merging these spells, I allow up to 30 days out of employment and data in between. Interruptions lasting more than 30 days lead to a new episode, because in this case, for example, self-employment or internships are possible. Furthermore, I copy any relevant information from the observed employment spells into subsequent and previous unemployment spells, which yields information on variables, as e.g., wages before and after unemployment.

As a result of the data preparation, the only unemployment spells that remain for the survival time analysis are those which either lead to employment in a new firm or a previous firm or are censored. I censor unemployment spells lasting until 31.12.2017, the last day of observation, spells with no employment after unemployment as well as spells with a duration exceeding 36 months.[24]

Moreover, I drop unemployment spells without any regular employment prior. Further, I consider only unemployment spells with a minimum duration of 14 days. Therefore, I identify temporary layoffs if the unique firm identifier matches before and after unemployment, corresponding to an ex-post identification. This approach is in line with the mentioned

[24] According to this restriction, which excludes some outliers, the longest unemployment duration until recall is actually 995 days. Other chosen censoring durations in the literature are 12, 19, 24 and 36 months.

literature, because usually no ex-ante information on recalls is available. However, this lack of ex-ante information may result in possible biases, as is discussed by Nekoei and Weber (2015). According to these authors, workers who expect to be rehired by their former employer might exhibit lower job-search intensity. However, this argument is limited. First, the authors show that firms by no means rehire all the workers who expect to be recalled, which implies that this expectation is subject to considerable uncertainty (Nekoei and Weber 2015, 2020). Second, many variables that are important for the quantitative analysis are not affected by the argument, such as firm-related characteristics like industry sector or job-specific information, which are relevant for my analysis.

6.4.2 Summary statistics

After applying the above-mentioned preparation steps, I obtain 64.847 observations with a total unemployment duration for the analysis of about 26,991 years for the period 2012 to 2017. Table 26 provides information on essential variables used for the analysis. This information is shown for the entire sample (including censored spells) in column 1, for recalls (column 2) as well as for employees who find a job in a new firm (New Firm) (column 3).

Table 26 shows that a considerable part of all unemployment spells, about 18 percent, end in employment in the previous firm (recall) and about 56 percent in a new firm. The rest stays either unemployed in the considered period or does not fulfill the requirements for recall or new-firm transition. This regards particularly workers, who take up employment in mini-jobs or who are more than 30 days out of data after the unemployment spell and hence are considered in column 1.

The absolute majority of the rehired workers have completed vocational training and are not low-skilled, which is in line with Alba-Ramírez et al. (2007). Moreover, 30 percent of all recalls occur in East Germany, although only about 18 percent of all German employees are employed in East Germany in 2018. Thus, there are notable regional differences of recall rates between East and West. Further, larger deviations in the age and firm size structure of recalled workers can be observed. Many workers over 44 years return to their previous firm, while younger workers tend to search for a new firm. The same applies to small firms with up to 10 workers, which use more frequent temporary layoffs and recalls as found by Mavromaras and Rudolph (1998). In addition, Table 26 shows that recalled workers are the only workers who do not suffer wage losses after unemployment, which is also discussed by Nekoei and Weber (2020). This finding is explained especially by the firm-specific human capital of recalled workers,

which justifies higher wages than those paid to new workers and is in line to the theoretical considerations implied by the efficiency wage theory. Further, firms have no additional training costs for recalled workers, making these workers a valuable resource to cover labor demand. Lastly, recalled workers have by far the lowest unemployment duration, as was also found by Nekoei and Weber (2020) or Fujita and Moscarini (2017). This is associated with the lowest negative wage effect in the literature and thus contributes to higher wages for recalled workers (Carrington and Fallick 2017).

Table 26: Summary statistics of the sample

Variable	Entire Sample	Recall	New Firm
	Mean (s.d.)	Mean (s.d.)	Mean (s.d.)
Share %	100	18.10	55.69
Educ %			
No Vocational Training	9.77	8.82	9.22
Vocational Training	77.48	86.68	77.40
University Degree	12.75	4.49	13.39
East Germany %	23.35	30.54	22.48
Migrant %	16.25	14.91	15.24
Age Category %			
25-34	35.71	26.22	39.35
35-44	25.94	24.66	26.65
45-54	26.43	31.89	25.20
55-60	11.91	17.23	8.80
Type of contract %			
Previous fixed-term	30.34	25.89	31.69
Post fixed-term	24.69	23.91	36.57
Previous Agency work	21.51	15.99	24.52
Previous Firm size %			
< 10	20.73	28.84	18.19
10-19	13.11	16.54	12.59
20-49	19.33	20.95	19.47
50-99	15.64	13.28	16.70
100-199	13.23	9.63	14.33
200-499	10.46	6.55	11.24
500-999	3.60	1.85	3.76
1000-4999	3.24	2.05	3.15
> 4999	0.66	0.31	0.58
Previous wage €/day	82.22 (60.30)	74.78 (35.07)	81.07 (59.54)
Post wage €/day	57.39 (53.40)	75.85 (35.28)	78.40 (51.13)
Unempl. duration days	152.03 (169.11)	87.89 (76.18)	138.99 (150.55)
Previous tenure firm /day	576.89 (1050.43)	421.38 (607.75)	550.02 (983.29)
Previous emply. in /day	1049.00 (1875.40)	549.34 (923.76)	1092.76 (1846.22)
Source unempl. benef %			
Unemployment Assist.	21.96	15.24	21.90
Unemployment Insur.	78.04	84.76	78.10
Observations	64.847	11.740	36.113

Source: SIAB 7517, own calculation.

Focusing on the first column, which also contains censored spells and spells that does not fulfil the requirements on the identification of recalls or transitions into new firm, shows that the post unemployment wage is considerably lower than in column 2 or 3. This particularly results due to the fact that this column contains observations, where workers e.g. take up employment in mini-jobs and hence have very low wages after being employed again. This is also supported by the fact that the share of workers without vocational qualification in column 1 is larger than in column 2 and 3.

6.5 Estimation and results

The empirical estimation must take into account several possible exits from unemployment, as unemployed workers may (i) return to their previous employer or (ii) switch to a new employer. These exits are defined as competing risks in the terminology of survival analysis, since only one of them can happen first. As the exit from unemployment into a previous or a new firm represent different processes, I refer to previous literature (Katz and Meyer 1990; Jansson 2002; Böheim 2006; Alba-Ramírez et al. 2007; Nivorozhkin 2008; Arranz and García-Serrano 2014) and use a competing risk framework. By assuming that two risks are independent, this econometric framework provides coefficients for both types of risks and thus takes different transition processes explicitly into account. Although for this paper, I focus on re-employment in previous firms, I also provide results for transitions into new firms and a combination of both exits (single risk) for comparison reason. Further, I refer to the previously mentioned literature and use a grouped time proportional hazard model, and consider unobserved heterogeneity.

Using a discrete estimation framework implies that time t can only take integer values and is measured in months in the present analysis. Further, the event or exit can only occur in the last month of the unemployment spell in $t=T$. Since both exit risks, indicated as j, recalls ($j=1$) and new firms ($j=2$) are considered as independent, the individual exit for each risk can be regarded as a binary outcome in each month, where the event in $t=T$ *and* $j=J$ is indicated by 1 and 0 otherwise. In order to estimate such outcome in a discrete estimation framework, different link functions can be used. The most popular link functions in this context are logit and probit but also rather less known link functions like the log-log or complementary log-log (cloglog) link functions can be employed for such estimations (Allison 2001; Jenkins 2004). In contrast to logit and probit models, the cloglog is a slightly asymmetrical model (around 0), which is particularly suitable for events with small and large probabilities (Allison 2001) and hence is

used for the present analysis of recalls. However, using different link functions does usually not affect the results in a crucial manner.

In order to derive the cloglog link function and the estimation procedure, I draw on Allison (2001), Long and Freese (2001) and particularly on van Horn (2015). First, to relate individual characteristics X to a dichotomized outcome y, a thresholding value z is needed:

$$y = \begin{cases} 1 \; if \; z > 0 \\ 0 \; if \; z = 0 \end{cases} \tag{1}$$

hereby, z is a latent variable and obtained from individuals characteristics and coefficients $X'ß$ shown below:

$$z = X'ß + \varepsilon \tag{2}$$

for the cloglog link function, z is assumed to follow a Poisson distribution (van Horn 2015) and thus is a count variable defined only for positive values. Note that the Poisson distribution implies $\mathbb{E}(\mathrm{z}|X) = \lambda$ and hence:

$$z \sim Poisson(\lambda) \tag{3}$$

where the expected value as well as the variance of z is λ (equidispersion). Recall that for a Poisson process the following identity applies $\mathbb{E}(\mathrm{z}|X) = \lambda = e^{X'ß}$ (Long and Freese 2001), where the conditional mean is modeled by the exponential function. Here, the exponential function transforms the input into positive values, which is a necessary assumption for a count variable. For the case of an event, where $z > 0$ given individual heterogeneity X, the following identity arises:

$$p = \Pr(z > 0|X) \tag{4}$$

Including the above shown identities, this equation can be transformed into the complementary log-log link function. Where the complementary situation to the above case (4) is z equal to 0 and shown in (5):

$$p = 1 - Poisson(0|\lambda) \tag{5}$$

considering the Poisson probability mass function, which is given by $\frac{\lambda^z}{z!}e^{-\lambda}$ for $z = 0$, it follows

$$= 1 - \exp(-\lambda) \tag{6}$$

$$= 1 - \exp(-\exp(X'ß)) \tag{7}$$

The latter double exponential equation can be estimated (see Jenkins 2004), which provides the parameters of interest for the present analysis. Note that the inner exponent term of the above equation is equal to a standard exponential model in survival time analysis, where the coefficient $ß$ are obtained from maximum likelihood estimations. The latter equation (7) can be written in a more applied form referring to the present analysis and related literature:

$$\theta_{jzt}(X_{jt}, m_{jz}) = 1 - \exp[-\exp(m_{jz} + ß_{j0} + X_{jt}ß_j)] \quad (8)$$

Where the cause-specific hazard $\theta_{jzt}(X_{jt}, m_{jz})$ to fail of risk *j* in period *t* given that no failure from any cause has yet occurred is represented by observed X_{jt} and unobserved heterogeneity m_{jz}. As already mentioned, *j=1* corresponds to reemployment in the previous firm and *j=2* to the employment in a new firm. Moreover, *t* represents the time interval and takes only positive values, measured in months and ends in *t=T* by risk *j=J*. The spell is censored if the worker is observed in *t* but not in *t+1*, when the unemployment spell lasts to the end of the observation period or when the requirements for recall or new firm are not fulfilled (e.g. mini-job). In such case of censoring, the fail of risk *j* remains 0 and the spell contributes to the likelihood function and probability of remaining unemployed for the spell duration (Alba-Ramírez et al. 2007). Unobserved heterogeneity m_{jz} enters the equation through two mass points, where the probability of individuals belonging to type *z* is p_z, which depends on the risk *j*. Note that unobserved heterogeneity is hence constant across observations for the same individual, which is important for unemployed workers with different spells and exits in the data. I use two mass points to model unobserved heterogeneity, as more mass points did not improve the information criteria. I use Akaike (AIC) and the Bayesian information criterion (BIC). Two mass points are also enough to model unobserved heterogeneity according to similar studies (Böheim 2006; Arranz and García-Serrano 2014). The approach of using discrete unobserved heterogeneity in form of mass points instead of a parametric distribution of unobserved heterogeneity offers the advantage of not assuming a certain distribution. Alba-Ramírez et al. (2007) and Böheim (2006) discuss this issue in more detail. However, I also estimated continuous time models with Weibull distributed baseline hazards and considered unobserved heterogeneity by several assumptions of frailty, which did not change the results noteworthy. Further, with regard to the specification of baseline hazards, I chose a piecewise constant specification. This approach is not restricted to a certain parametric specification and thus is particularly flexible. Of particular interest in the equation are the estimated coefficients $ß_j$. These coefficients are provided in the usual proportional hazard manner, where positive coefficients indicate an increase in the hazard rate, while negative coefficients represent a decrease in the hazards.

The results of the estimations are presented in

Table 27 and Table 28. Beside the results for the competing risks, I present estimation results for the single risk model used as a reference. In order to keep the discussion of the results concise and straightforward, I restrict it to the results for recalls and the main variables in the context of the topic. In general, the results show large disparities between different types of unemployment transitions, which indicate different transitions out of unemployment. However, the duration variables reveal quite similar unemployment duration effects on the hazard of the single risks, which is also found by Böheim (2006) for Austria.

With regard to education, the results show highest recall probabilities for workers without valid vocational training. This finding contradicts the theoretical model developed by Rodríguez-Planas (2014), according to which workers with the highest productivity levels should be recalled more often, as the firm is interested in these high productivity levels. Thus, my results indicate a rather involuntary recall process for low educated workers, as high-educated workers can leave unemployment by finding a job in a new firm (column 2 in Table 29). This conclusion is supported by particularly high coefficients for marginalized and vulnerable groups on the labor market such as older employees (55-60) and migrants. These groups tend to have lower labor market opportunities and are more likely to end up in precarious situations after unemployment, which increases the probability of being recalled involuntary. Relevant results are further shown for firm tenure and firm size. According to these findings, the probability of a recall is highest for workers with high firm tenure and in smaller firms. The finding regarding firm tenure may point to implicit contract theory and in particular to the wage efficiency considerations mentioned in the theoretical considerations of this chapter. Due to higher firm tenure and thus a special relationship of trust between firm and worker, laid off workers know expect to get rehired, when the situation improves. At the same time, workers with high firm tenure might have particularly valuable firm specific human capital, which increases the possibility of being recalled as well. With regard to firm size, the coefficients confirm largely the results of Mavromaras and Rudolph (1998) for Germany: small firms tend to use recalls more often than larger firms do. The authors explain these findings by the common absence of works councils in smaller firms, as also discussed and shown by Liebig and Hense (2006). However, it is noteworthy that the biggest firms in turn have larger recall hazards as well. This may be related to mass layoffs, where high numbers of workers are laid off and rehired when the economic situation recovers. Nevertheless, these results are at odds to the provided results by Arranz and García-Serrano (2014), who find clearly increasing recall hazards for larger firms in Spain.

Table 27: Estimation Results I/II

Variable	Recall	New Firm	Single Risk
Education			
No Vocational Training	(-)	(-)	(-)
Vocational Training	-0.188*** (0.056)	0.029 (0.027)	-0.019 (0.024)
University Degree	-0.327*** (0.094)	0.168*** (0.035)	0.094*** (0.032)
Task level			
Auxiliary activity	(-)	(-)	(-)
Trained clerk	0.007 (0.039)	0.032 (0.020)	0.035** (0.017)
Specialist/Expert	-0.023 (0.088)	0.015 (0.033)	0.020 (0.030)
Previous empl. in years	-0.035*** (0.005)	0.037*** (0.001)	0.025*** (0.001)
Age category			
25-34	(-)	(-)	(-)
35-44	0.098** (0.047)	-0.109*** (0.020)	-0.079*** (0.019)
45-54	0.090* (0.053)	-0.265*** (0.025)	-0.208*** (0.022)
55-60	0.477*** (0.058)	-0.293*** (0.031)	-0.115*** (0.027)
Firm tenure in years			
1-2	(-)	(-)	(-)
2-5	0.739*** (0.041)	-0.159*** (0.019)	0.009 (0.017)
5-10	0.866*** (0.048)	-0.367*** (0.028)	-0.076*** (0.024)
10-15	0.925*** (0.065)	-0.555*** (0.047)	-0.151*** (0.037)
15-20	0.900*** (0.082)	-0.710*** (0.070)	-0.215*** (0.052)
> 20	1.034*** (0.090)	-0.839*** (0.080)	-0.225*** (0.059)
Wage difference	0.198*** (0.047)	0.134*** (0.019)	0.155*** (0.017)
Contract type			
Previous fixed-term	0.117*** (0.042)	-0.084*** (0.017)	-0.052*** (0.016)
Post fixed-term	-0.435*** (0.041)	0.059*** (0.015)	-0.026* (0.014)
Migrant	0.177*** (0.050)	0.097*** (0.022)	0.116*** (0.021)
Firm size			
< 10	(-)	(-)	(-)
10-19	0.010 (0.046)	-0.004 (0.025)	0.005 (0.022)
20-49	-0.106** (0.045)	-0.055** (0.023)	-0.058*** (0.021)
50-99	-0.182*** (0.053)	-0.066*** (0.025)	-0.084*** (0.023)
100-199	-0.164*** (0.059)	-0.042 (0.026)	-0.064*** (0.024)
200-499	-0.081 (0.067)	-0.044 (0.028)	-0.054** (0.026)
500-999	-0.235** (0.116)	0.001 (0.040)	-0.035 (0.038)
1000-4999	0.212** (0.102)	-0.015 (0.043)	0.013 (0.040)
> 5000	0.658*** (0.210)	0.057 (0.087)	0.093 (0.081)
Unobserved heterogeneity			
Probability of Type 1	0.804	0.806	0.836
Probability of Type 2	0.196	0.194	0.164
Log-likelihood	-16.969.104	-56.647.086	-63.233.688

Table 28: Estimation Results II/II

Variable	Recall	New Firm	Single Risk
Duration in months			
< 1	(-)	(-)	(-)
2	-0.767*** (0.041)	-0.992*** (0.022)	-1.011*** (0.019)
3	-1.265*** (0.044)	-1.483*** (0.024)	-1.508*** (0.021)
4	-1.769*** (0.055)	-1.719*** (0.027)	-1.818*** (0.024)
5	-2.096*** (0.071)	-1.895*** (0.030)	-2.025*** (0.028)
6	-2.434*** (0.090)	-1.980*** (0.032)	-2.141*** (0.030)
6 – 12	-3.050*** (0.070)	-2.347*** (0.023)	-2.533*** (0.022)
12 – 18	-3.996*** (0.158)	-2.717*** (0.039)	-2.960*** (0.038)
18 – 24	-4.404*** (0.254)	-3.043*** (0.062)	-3.294*** (0.060)
24 – 36	-4.593*** (0.254)	-3.294*** (0.061)	-3.529*** (0.059)
Industries			
Agricult., forestry, fish.	(-)	(-)	(-)
Food and beverage	-0.071 (0.155)	0.335*** (0.071)	0.204*** (0.063)
Consumer goods	-0.530*** (0.201)	0.319*** (0.072)	0.155** (0.065)
Production goods	-0.071 (0.091)	0.222*** (0.055)	0.131*** (0.046)
Capital/utility goods	-0.615*** (0.130)	0.319*** (0.056)	0.164*** (0.049)
Construction	0.234*** (0.080)	-0.095* (0.053)	0.022 (0.044)
Hotels/Restaurants	-0.156* (0.085)	0.189*** (0.051)	0.077* (0.043)
Transport and Logistic	-0.084 (0.081)	0.133*** (0.050)	0.046 (0.042)
Education/Teaching	0.290** (0.114)	0.242*** (0.061)	0.191*** (0.053)
Occupations			
Agriculture	(-)	(-)	(-)
Simple Manual	-0.023 (0.086)	0.316*** (0.063)	0.135*** (0.050)
Trained Manual	-0.086 (0.088)	0.328*** (0.064)	0.123** (0.050)
Technician	-0.589*** (0.161)	0.624*** (0.073)	0.322*** (0.062)
Engineer	-0.631*** (0.196)	0.638*** (0.079)	0.333*** (0.068)
Simple Service	-0.103 (0.087)	0.430*** (0.062)	0.211*** (0.049)
Skilled Service	-0.249 (0.158)	-0.025 (0.085)	-0.231*** (0.073)
Semi professional	-0.377** (0.179)	0.577*** (0.083)	0.319*** (0.071)
Professionals	-0.848*** (0.235)	0.759*** (0.089)	0.425*** (0.079)
Simple commercial	-0.571*** (0.137)	0.531*** (0.070)	0.249*** (0.057)
Skilled commercial	-0.793*** (0.128)	0.622*** (0.066)	0.329*** (0.054)
Manager	-1.022*** (0.218)	0.605*** (0.076)	0.315*** (0.065)

Notes: The models include dummies for entry quarters of unemployment to control for seasonal effects, a categorical variable for labor market experience, source of last unemployment benefits (UI/UA). Also included are regional FE based on NUTS-1 regions. Occupational classifications are based on Blossfeld-Occupations according to Schimpl-Neimanns (2003), industry classifications created according to Eberle et al. (2011). Wage difference is defined as the difference between log daily wage in post minus previous employment, (-) represents reference category, * 10%, ** 5%, *** 1%, cluster robust s. e. for person id in ().

Turning to the main variables of interest, the type of contract, the coefficient for fixed-term contract in previous employment provides strong and distinct evidence for a higher probability of being recalled.[25] Accordingly, employers often rehire unemployed workers, who previously worked in temporary contracts for them. This indicates that firms use fixed-term contracts to be able to carry out temporary layoffs and recall those workers without being restricted by the dismissal protection act as discussed in the first section of this chapter. Such results are also provided for Spain by Alba-Ramirez et al. (2007) as well as by Arranz and García-Serrano (2014). The coefficient for the post fixed-term contract and the temporary employment contract after unemployment, suggests a strong negative relation with regard for being recalled. Thus, recalled workers tend to be rehired into permanent contracts, which is consistent with legal regulations mentioned in in the beginning of this chapter prohibiting chain fixed-temporary contracts. Note that the average unemployment duration for recalled workers is about 90 days (Table 26). This is not enough to interrupt the factual context and justify a new temporary contract, given that the worker was employed for two years. Additional analyses for unemployment periods of more than 4 months, which interrupt the factual context, show a negative coefficient for post fixed-term contracts as well (results not shown). Thus, there is no evidence that firms systematically lay off workers for more than 4 months in order to employ them in fixed-term contracts again. Firms rather use the possibility of not extending fixed-term contracts if they have the possibility and need to due to economic downturns.

Regarding unobserved heterogeneity, the estimation shows that about 20 percent of all employees belong to type 2. Thus, about 20 percent of the considered workers in the sample is recalled faster than the other 80 percent due to unobserved heterogeneity.

In terms of occupations and industries, despite different definitions in the literature, my results largely coincide with findings of Böheim (2006) for Austria as well as of Edler et al. (2019) and Liebig and Hense (2006) for Germany. Occupations and industries in the construction and agricultural sector use more often temporary layoffs and recall their workers after unemployment. Remarkably, the employees in education and teaching have the highest coefficients of being recalled, which is not discussed in previous studies for Germany.

[25] Having a fixed-term contract in previous employment period increases the hazard of being recalled by roughly 12 percent (exponential of 0.115).

However, this new trend, particularly with respect to teachers, who are laid-off during summer vacation is in the meanwhile recognized by the Federal Employment Agency (FEA 2020).

6.6 Discussion and additional Analyses

The model I use for the main analysis generally provides robust results that are not noteworthy altered by recoding variables or including other information. This applies in particular to regional information such as population density, regional unemployment rate in post employment relation or different information on wages. Further, including information whether a worker was previously employed by a temporary work agency does not change the provided results. The same applies for adding further firm information, such as the share of low or high skilled workers in the firm or the share of workers employed in fixed-term contracts or hired by an agency, which does not provide new insights nor clear effects on recall hazards. Accordingly, firm size and industry indicators sufficiently capture firm effects.

In order to extent the analysis and discussion on one of the main findings, the interplay between temporary contracts and recalls, I conduct two additional estimations. I omit the indicator for post fixed term contract and estimate the model shown in

Table 27 and Table 28 in the first column (recalls) for unemployed workers, who (i) take up employment in fixed-term contract and (ii) in permanent contract, both in their previous firms (recall). The results are provided in Appendix I. The results indicate that workers, who are recalled into temporary employment, were considerably more often employed in fixed-term contracts before becoming unemployed. In contrast, workers, who were recalled in permanent jobs had more often permanent contracts before their unemployment episode. These findings enlarge the previous analysis with regard to the contract type, as recalled workers in temporary contracts tend to stuck in such contract types.

Further, to extend the analysis with regard to the relevance and validity of the results for different groups, I conduct a separate analysis for women. The results are provided in Appendix J and show an even stronger interplay off fixed-term contracts and recalls for women than for men. Although any differences in the distribution within occupations and industries are controlled for, unemployed women are more likely to be recalled by former employers after temporary employment. At the same time, the coefficient for post fixed-term employment for women shows that women are less likely than men to be recalled in permanent contracts. Thus, the results and the picture of the analysis remain for the main variables.

Seasonal and Business Cycle Recalls

The distinction between seasonal and business cycle recalls is a relevant and mainly overseen aspect due to insufficient data possibilities. The seasonal cycle is regarded as the most important driver of recalls: seasonal effects such as the weather which changes the labor demand of the firms. Second, the business cycle is influenced by longer-term trends and affects the labor demand as well. Since these two reasons result in different dynamics and processes of unemployment and recalls, a separate consideration of them is important.

For the definition of seasonal and business cycle recalls I relate to Mavromaras and Rudolph (1995). According to their definition, seasonal recalls are defined by two criteria: (i) the unemployment duration must not be larger than 4 months[26] and, further, the previous employment spell must be in between 6 to 12 months. This approach identifies cases that are subject to repeated seasonal fluctuations, such as the construction sector. In contrast, business cycle recalls are identified according to Mavromaras and Rudolph (1995) and Liebig and Hense (2006) and require (i) an unemployment duration of at least 4 months and (ii) a previous employment spell of at least 12 months. The results are provided in Appendix K and offer a variety of relevant insights. Regarding the previous employment contract, the estimates reveal that workers affected by seasonal recalls are more often previously employed in fixed-term contracts, which is in line to the baseline estimates. In contrast, for business cycle recalls, the results show that affected workers are rather employed in permanent contracts before becoming unemployed and recalled. These findings provide evidence that recalls, as analyzed in the baseline estimation are rather driven by seasonal fluctuations, while business cycle recalls indicate layoffs by operating reasons due to economic downturns, which affect more regular workers in permanent contracts. This finding is strengthened by the coefficients for post fixed-term contracts, which are very strongly negative for business cycle recalls suggesting that these workers are employed in permanent contracts to a large extent when the economic downturn ends. Further relevant information provided by these models are the findings with regard to age. While seasonal recalls are restricted to older workers (55-60 years) and auxiliary workers only, business cycle recalls are found to be significant for all age groups. This finding indicates that rather older workers, whose options on the labor market are rather restricted, tend to be more often subject of employment, which tend to be strongly related to seasonal fluctuations.

[26] Since I define a month with 30 days, but in fact, months with 31 days are in the data as well, I choose a maximum duration of 124 days in order not to lose these cases.

Furthermore, the results show a more frequent use of recalls due to seasonal fluctuations for small firms, which may reflect their lower capital endowments. In addition, the results confirm previous findings with regard to industries and occupations, particularly with respect to education and teaching, which has yet not been discussed in studies for Germany.

6.7 Conclusion

This paper provides a detailed and relevant contribution on the topic of temporary layoffs for Germany but also for the international context. Although the German labor market is internationally considered as inflexible and temporary layoffs are in terms of employment policy undesired and prevented by different statutory regulations, 18 percent of all unemployed male workers return to their previous firm. Temporary layoffs and recalls are hence a relevant issue and an important driver for German unemployment dynamics, which is often neglected by the previous literature.

Using an empirical approach, which corresponds to the international literature, I can confirm most previous findings provided by other authors with regard to industries, occupations as well as firm size. This issue particularly regards small firms and sectors linked to strong seasonal fluctuations, as agriculture, foods and beverage as well as construction. Regarding the considered sectors, my results provide new evidence showing that recalls are often used in the sector of education and teaching. This however is a new trend on the German labor market, as many teachers are laid off during vacations, which previously has not been considered by research yet but already mentioned by the Federal Employment Agency (FEA 2020) and the media.

With respect to the contribution of the present study to the international literature, I provide different relevant findings. Indeed Germany recall more often unemployed workers, who were previously employed in fixed-term contracts, which has not yet been considered for Germany. Accordingly, firms use i.e. fixed-term contracts to temporary layoff workers and recall them afterwards if necessary. Further analysis shows that workers recalled in temporary contracts were considerably more often previously employed in fixed-term contracts as well. This finding indicates that these workers are often subject of unsteady employment relations, which are used to layoff and rehire them afterwards.

Further contributions to the present analysis concern differences between seasonal and business cycle recalls. The analysis shows that the major part of recalls is driven by seasonal fluctuations and not by the business cycles, which has not yet been discussed in the considered

framework. The type of previous employment contract also reflects this finding, which is more often temporary in seasonal temporary layoffs and permanent in business cycle recalls.

Further relevant findings of the present analysis show that recalls apply in particular for workers with large firm tenure as well as migrants, women and older workers in particular. This on the one hand reveals a special relationship between worker and firm as indicated by theoretical considerations in the first section of this chapter, which is often necessary for the process of rehiring. On the other hand, these findings reveal that particularly marginalized groups are affected by temporary layoffs, which might indicate a lack of alternatives for these disadvantaged workers.

Regarding firms strategy, my results however provide no evidence for a systematically layoff above four months in order to rehire workers in fixed-term contracts again, whose maximum employment duration in fixed-term contracts is expired. This finding is also confirmed with regard to the baseline estimation that, post unemployment contracts for recalled workers are rather permanent contracts.

Political recommendations for action should aim to protect affected workers and marginalized groups by further legal regulations, which make temporary layoffs by using fixed-term contracts more difficult. Firms can alternatively borrow workers from agencies to compensate for temporary fluctuations, thus avoiding potential outsourcing at societies expense.

6.8 Appendix of Chapter 6

Appendix I: Recall estimations for workers in temporary and permanent contracts after unemployment I/II

Variable	Post temporary employment	Post permanent employment
Education		
No Vocational Training	(-)	(-)
Vocational Training	-0.136 (0.120)	-0.212*** (0.064)
University Degree	0.063 (0.165)	-0.553*** (0.117)
Task level		
Auxiliary activity	(-)	(-)
Trained clerk	0.129 (0.084)	-0.057 (0.044)
Specialist/Expert	0.148 (0.152)	-0.236** (0.112)
Previous empl. in years	-0.046*** (0.015)	-0.022*** (0.005)
Age category		
25-34	(-)	(-)
35-44	-0.002 (0.097)	0.100* (0.055)
45-54	-0.074 (0.112)	0.081 (0.061)
55-60	0.322** (0.127)	0.448*** (0.066)
Firm tenure in years		
1-2	(-)	(-)
2-5	0.627*** (0.084)	0.662*** (0.046)
5-10	0.711*** (0.118)	0.774*** (0.053)
10-15	0.750*** (0.193)	0.820*** (0.070)
15-20	0.318 (0.242)	0.827*** (0.089)
> 20	0.730** (0.355)	0.938*** (0.095)
Wage difference	0.222** (0.095)	0.212*** (0.056)
Contract type		
Previous fixed-term	2.229*** (0.120)	-1.064*** (0.077)
Migrant	0.115 (0.106)	0.209*** (0.058)
Firm size		
< 10	(-)	(-)
10-19	0.183 (0.123)	-0.014 (0.050)
20-49	-0.076 (0.115)	-0.110** (0.049)
50-99	-0.039 (0.123)	-0.183*** (0.060)
100-199	-0.080 (0.130)	-0.141** (0.067)
200-499	0.217* (0.132)	-0.160** (0.081)
500-999	0.017 (0.198)	-0.227 (0.149)
1000-4999	0.321* (0.164)	0.172 (0.143)
> 5000	0.812*** (0.311)	0.868*** (0.286)
Unobserved heterogeneity		
Probability of Type 1	0.774	0.813
Probability of Type 2	0.226	0.187
Log-likelihood	-3.752.720	-12.670.962

Recall estimations for workers in temporary and permanent contracts after unemployment II/II

Variable	Post temporary employment	Post permanent employment
Duration in months		
< 1	(-)	(-)
2	-0.735*** (0.096)	-0.802*** (0.046)
3	-1.164*** (0.101)	-1.325*** (0.050)
4	-1.770*** (0.125)	-1.785*** (0.062)
5	-1.873*** (0.140)	-2.155*** (0.083)
6	-2.250*** (0.171)	-2.442*** (0.106)
6 – 12	-2.942*** (0.142)	-3.012*** (0.082)
12 – 18	-4.059*** (0.365)	-3.847*** (0.175)
18 – 24	-3.989*** (0.420)	-4.393*** (0.320)
24 – 36	-4.348*** (0.509)	-4.462*** (0.293)
Industries		
Agricult., forestry, fish.	(-)	(-)
Food and beverage	-0.041 (0.236)	-0.427* (0.236)
Consumer goods	-0.003 (0.319)	-0.757*** (0.265)
Production goods	-0.328 (0.203)	-0.027 (0.103)
Capital/utility goods	-1.186*** (0.300)	-0.409*** (0.145)
Construction	0.134 (0.175)	0.206** (0.091)
Hotels/Restaurants	-0.140 (0.163)	-0.237** (0.101)
Transport and Logistic	-0.273* (0.166)	-0.023 (0.094)
Education/Teaching	0.275 (0.182)	0.053 (0.168)
Occupations		
Agriculture	(-)	(-)
Simple Manual	0.051 (0.166)	0.036 (0.101)
Trained Manual	-0.051 (0.174)	-0.004 (0.103)
Technician	-0.361 (0.314)	-0.431** (0.189)
Engineer	-0.528 (0.358)	-0.411* (0.235)
Simple Service	-0.256 (0.161)	0.042 (0.104)
Skilled Service	-0.938*** (0.252)	0.085 (0.218)
Semi professional	-0.363 (0.266)	-0.264 (0.261)
Professionals	-0.746** (0.326)	-0.986** (0.422)
Simple commercial	-0.652** (0.262)	-0.310* (0.163)
Skilled commercial	-0.635*** (0.235)	-0.640*** (0.154)
Manager	-1.209** (0.543)	-0.730*** (0.245)

Notes: The models include dummies for entry quarters of unemployment to control for seasonal effects, a categorical variable for labor market experience, source of last unemployment benefits (UI/UA). They also include regional FE based on NUTS-1 regions. Occupational classifications are based on Blossfeld-Occupations according to Schimpl-Neimanns (2003), industry classifications created according to Eberle et al. (2011). Wage difference is defined as the difference between log daily wage in post minus previous employment, (-) represents reference category, * 10%, ** 5%, *** 1%, cluster robust s. e. for person id in ().

Appendix J: Estimation results for Women I/II

Variable	Recall	New Firm	Single Risk
Education			
No Vocational Training	(-)	(-)	(-)
Vocational Training	-0.147 (0.098)	0.123** (0.049)	0.066 (0.044)
University Degree	-0.285** (0.130)	0.140** (0.055)	0.069 (0.050)
Task level			
Auxiliary activity	(-)	(-)	(-)
Trained clerk	-0.061 (0.077)	0.158*** (0.040)	0.111*** (0.036)
Specialist/Expert	-0.275** (0.122)	0.170*** (0.050)	0.104** (0.046)
Previous empl. in years	-0.064*** (0.010)	0.034*** (0.002)	0.024*** (0.002)
Age category			
25-34	(-)	(-)	(-)
35-44	0.179** (0.088)	-0.209*** (0.034)	-0.162*** (0.032)
45-54	0.070 (0.094)	-0.363*** (0.039)	-0.310*** (0.036)
55-60	0.600*** (0.110)	-0.506*** (0.055)	-0.270*** (0.049)
Firm tenure in years			
1-2	(-)	(-)	(-)
2-5	0.674*** (0.074)	-0.145*** (0.030)	-0.023 (0.028)
5-10	0.855*** (0.095)	-0.281*** (0.046)	-0.003239
10-15	1.072*** (0.136)	-0.407*** (0.075)	-0.008052
15-20	0.707*** (0.217)	-0.521*** (0.115)	-0.314*** (0.102)
> 20	1.642*** (0.248)	-0.448*** (0.152)	-0.043 (0.130)
Wage difference	0.004 (0.083)	0.124*** (0.032)	0.115*** (0.030)
Contract type			
Previous fixed-term	0.273*** (0.067)	-0.153*** (0.027)	-0.083*** (0.025)
Post fixed-term	-0.349*** (0.064)	-0.067*** (0.024)	-0.113*** (0.023)
Migrant	0.225** (0.096)	0.027 (0.041)	0.068* (0.038)
Firm size			
< 10	(-)	(-)	(-)
10-19	-0.115 (0.103)	-0.035 (0.043)	-0.035 (0.040)
20-49	-0.068 (0.097)	0.023 (0.039)	0.013 (0.036)
50-99	-0.176 (0.110)	0.022 (0.042)	-0.021 (0.039)
100-199	-0.005 (0.109)	0.054 (0.043)	0.044 (0.040)
200-499	-0.143 (0.119)	0.005 (0.045)	-0.034 (0.042)
500-999	-0.188 (0.166)	-0.004 (0.059)	-0.033 (0.056)
1000-4999	0.164 (0.143)	-0.178*** (0.063)	-0.131** (0.058)
> 5000	0.955*** (0.260)	-0.148 (0.127)	0.003 (0.114)
Unobserved heterogeneity			
Probability of Type 1	0.717	0.843	0.864
Probability of Type 2	0.283	0.157	0.136
Log-likelihood	-4,970,385	-18,863,815	-20453.913

Estimation results for Women II/II

Variable	Recall	New Firm	Single Risk
Duration in months			
< 1	(-)	(-)	(-)
2	-0.724*** (0.082)	-0.984*** (0.035)	-1.027*** (0.032)
3	-1.270*** (0.091)	-1.500*** (0.039)	-1.554*** (0.036)
4	-1.655*** (0.104)	-1.809*** (0.044)	-1.888*** (0.041)
5	-1.911*** (0.119)	-1.997*** (0.049)	-2.085*** (0.046)
6	-2.312*** (0.157)	-2.156*** (0.054)	-2.286*** (0.052)
6 – 12	-2.756*** (0.115)	-2.449*** (0.037)	-2.599*** (0.035)
12 – 18	-3.069*** (0.196)	-2.914*** (0.074)	-3.088*** (0.069)
18 – 24	-3.889*** (0.362)	-3.195*** (0.114)	-3.448*** (0.108)
24 – 36	-4.483*** (0.455)	-3.348*** (0.120)	-3.619*** (0.116)
Industries			
Agricult., forestry, fish.	(-)	(-)	(-)
Food and beverage	0.021 (0.216)	0.033 (0.130)	0.038 (0.109)
Consumer goods	-0.305 (0.273)	0.211 (0.131)	0.071 (0.114)
Production goods	-0.274 (0.240)	0.333*** (0.120)	0.184* (0.104)
Capital/utility goods	-0.667** (0.268)	0.403*** (0.118)	0.224** (0.101)
Construction	0.451* (0.252)	0.142 (0.137)	0.104 (0.119)
Hotels/Restaurants	0.052 (0.172)	0.128 (0.108)	0.054 (0.090)
Transport and Logistic	-0.249 (0.180)	0.278*** (0.107)	0.137 (0.090)
Education/Teaching	-0.056 (0.185)	0.432*** (0.110)	0.297*** (0.092)
Occupations			
Agriculture	(-)	(-)	(-)
Simple Manual	0.145 (0.184)	0.343*** (0.124)	0.170* (0.099)
Trained Manual	0.116 (0.190)	0.367*** (0.131)	0.222** (0.106)
Technician	-0.286 (0.289)	0.568*** (0.136)	0.329*** (0.115)
Engineer	-0.248 (0.357)	0.530*** (0.149)	0.277** (0.128)
Simple Service	0.183 (0.167)	0.345*** (0.120)	0.208** (0.095)
Skilled Service	0.014 (0.196)	0.245* (0.126)	0.062 (0.102)
Semi professional	0.129 (0.202)	0.441*** (0.126)	0.258** (0.103)
Professionals	0.047 (0.267)	0.552*** (0.136)	0.332*** (0.114)
Simple commercial	-0.145 (0.184)	0.550*** (0.123)	0.295*** (0.098)
Skilled commercial	-0.543*** (0.181)	0.521*** (0.119)	0.264*** (0.095)
Manager	-0.757** (0.318)	0.569*** (0.131)	0.307*** (0.109)

Notes: The models include dummies for entry quarters of unemployment to control for seasonal effects, a categorical variable for labor market experience, source of last unemployment benefits (UI/UA). They also include regional FE based on NUTS-1 regions. Occupational classifications are based on Blossfeld-Occupations according to Schimpl-Neimanns (2003), industry classifications created according to Eberle et al. (2011). Wage difference is defined as the difference between log daily wage in post minus previous employment, (-) represents reference category, * 10%, ** 5%, *** 1%, cluster robust s. e. for person id in ().

Appendix K: Seasonal and Business Cycle Recalls I/II

Variable	Season	Business Cycle
Education		
No Vocational Training	(-)	(-)
Vocational Training	0.043 (0.090)	-0.172 (0.147)
University Degree	-0.069 (0.161)	-0.374 (0.233)
Task level		
Auxiliary activity	(-)	(-)
Trained clerk	-0.126** (0.055)	-0.001 (0.112)
Specialist/Expert	-0.106 (0.139)	-0.397 (0.256)
Previous empl. in years	0.475*** (0.170)	-0.059*** (0.013)
Age category		
25-34	(-)	(-)
35-44	-0.002 (0.072)	0.331*** (0.128)
45-54	-0.027 (0.078)	0.472*** (0.144)
55-60	0.330*** (0.085)	1.014*** (0.164)
Firm tenure in years		
1-2	(-)	(-)
2-5	0.486*** (0.061)	0.351*** (0.104)
5-10	0.442*** (0.068)	0.681*** (0.140)
10-15	0.276*** (0.089)	0.699*** (0.225)
15-20	0.346*** (0.107)	0.566 (0.344)
> 20	0.351*** (0.125)	0.778* (0.419)
Wage difference	0.039 (0.091)	0.457*** (0.120)
Contract type		
Previous fixed-term	0.155** (0.068)	-0.300** (0.124)
Post fixed-term	-0.295*** (0.068)	-0.773*** (0.113)
Migrant	0.127 (0.080)	0.318** (0.126)
Firm size		
< 10	(-)	(-)
10-19	-0.048 (0.065)	-0.002 (0.138)
20-49	-0.071 (0.061)	-0.199 (0.143)
50-99	-0.089 (0.074)	-0.111 (0.157)
100-199	-0.214** (0.089)	-0.377** (0.173)
200-499	-0.042 (0.101)	-0.112 (0.178)
500-999	-0.347 (0.213)	-0.220 (0.269)
1000-4999	0.052 (0.173)	0.436* (0.242)
> 5000	0.694 (0.556)	1.154*** (0.372)
Unobserved heterogeneity		
Probability of Type 1	0.770	0.804
Probability of Type 2	0.230	0.196
Log-likelihood	-6406.693	-2662.044

Seasonal and Business Cycle Recall II/II

Variable	Season	Business Cycle
Duration in months		
< 1	(-)	
2	-0.832*** (0.058)	
3	-1.323*** (0.060)	
4	-1.670*** (0.075)	(-)
5		-0.366** (0.149)
6		-0.856*** (0.165)
6 – 12		-1.592*** (0.148)
12 – 18		-2.980*** (0.249)
18 – 24		-3.840*** (0.443)
24 – 36		-4.154*** (0.477)
Industries		
Agricult., forestry, fish.	(-)	(-)
Food and beverage	0.376* (0.224)	-0.423 (0.443)
Consumer goods	0.242 (0.333)	-0.192 (0.463)
Production goods	0.051 (0.119)	-0.432 (0.314)
Capital/utility goods	-0.513** (0.247)	-1.029*** (0.350)
Construction	0.227** (0.102)	0.063 (0.280)
Hotels/Restaurants	-0.037 (0.112)	-0.275 (0.285)
Transport and Logistic	0.194* (0.108)	-0.063 (0.271)
Education/Teaching	0.489*** (0.168)	0.359 (0.338)
Occupations		
Agriculture	(-)	(-)
Simple Manual	0.160 (0.108)	0.295 (0.354)
Trained Manual	0.066 (0.112)	0.148 (0.361)
Technician	-0.391 (0.248)	-0.685 (0.538)
Engineer	-0.228072	-0.212 (0.537)
Simple Service	-0.091 (0.114)	0.078 (0.353)
Skilled Service	0.330 (0.215)	0.094 (0.528)
Semi professional	-0.430 (0.283)	-1.134 (0.698)
Professionals	-0.512688	-0.016 (0.553)
Simple commercial	-0.714*** (0.231)	-0.041 (0.430)
Skilled commercial	-0.752*** (0.229)	-0.348 (0.396)
Manager	-2.640*** (1.014)	-0.428 (0.530)

Notes: The models include dummies for entry quarters of unemployment to control for seasonal effects, a categorical variable for labor market experience, source of last unemployment benefits (UI/UA). They also include regional FE based on NUTS-1 regions. Occupational classifications are based on Blossfeld-Occupations according to Schimpl-Neimanns (2003), industry classifications created according to Eberle et al. (2011). Wage difference is defined as the difference between log daily wage in post minus previous employment, (-) represents reference category, * 10%, ** 5%, *** 1%, cluster robust s. e. for person id in ().

7 Summary and Conclusion

This thesis combines different aspects of the labor market around the most important variables unemployment and wages. It presents various new empirical insights for Germany and thus contributes to further understanding of labor market dynamics. Moreover, this thesis considers migrants in detail, who are a large and important group of workers in Germany.

The topic of this dissertation and its most important research outcomes are guided by multiple targets: first, the focus is to identify potential differences with regard to unemployment and wage structures between migrants and natives. Second, using different empirical approaches, I want to explain potential differences as far as possible in order to derive policy measures build on the provided insights. Moreover, there are various aspects related to the mentioned targets, such as the importance of regional influence, individual and long-term effects and transitions from unemployment, which are considered and emphasized in the four articles.

Chapter 3 is the first article of this thesis and considers the wage differential between skilled migrants and natives on the German labor market in the light of potential labor shortages due to demographic changes. Using the Integrated Employment Biographies, the study provides a novel insight into the wage structure and drivers of potential wage differentials between workers with vocational qualification. The results indicate that almost in all models, virtually the entire wage differential is explained by observable characteristics. Furthermore, the study takes up the latest literature on this topic and emphasize the role of the firm side on the wage differential between migrants and natives, which has not yet been considered in such detail for Germany.

Chapter 4 focuses on the relationship between regional and occupational unemployment structure and its effect on wages. For this study, the co-authors and I use a large sample of the Integrated Employment Biographies and find evidence for Germany that wages in a region are not only affected by regional unemployment levels as postulated by previous research but also by occupational unemployment levels. Furthermore, we find that these elasticities are different for the groups considered in the study. Accordingly, naturalized migrants provide the strongest wage growth with declining unemployment rates. In contrast, regular migrants are barely affected by the occupational-regional unemployment levels.

Chapter 5 builds on the previous topic by extending the effect of unemployment on the individual level. The article analyses the effect of unemployment incidence and unemployment duration on future wages, which is often considered as unemployment scarring. Controlling for various individual and firm related characteristics, the results indicate persistent negative effects on re-employment wages, which lasts up to 10 years. In addition, the results show that a large part of these negative effects are due to sorting into less productive firms after being re-employed. In order to exclude potential endogenous drivers of the negative wage effect, I conduct a robustness check using mass layoffs. The results do not deviate noteworthy in the provided pattern and thus strength the overall conclusion.

The last article of this thesis included in chapter 6 addresses the process of transitions out of unemployment. In particular, this article focuses on recalls and its interplay with previously held fixed term contracts. Using the Integrated Employment Biographies, I provide evidence that temporary employment contracts are indeed linked to recalls and thus firms use this kind of contracts in order to reduce labor if necessary. Further, the results indicate that firms use recalls in order to absorb changes in demand due to seasonal fluctuations. Moreover, certain industries use recalls particularly often, such as the construction sector or education sector. The same applies to migrants and women, who are substantially affected more often

In order to derive an overall conclusion, I have to focus on the common aspects of the presented articles in this dissertation. In general, the results show substantial differences between migrants and natives on the German labor market, which are to the disadvantage of migrants. This regards particularly the lower wages as well as the higher unemployment rates, which affects migrants. Accordingly, the articles of this dissertation show that this is linked to harmful long-term effects, as unemployment incidences affect individual labor market outcomes in the future, which is linked to further disadvantages and increases problems associated to poverty and overall opportunities. Further, the results indicate that migrants cannot benefit to the same extent as natives of regional und occupational improvements in terms of declining unemployment rates. In addition, the results indicate that these disadvantages in labor market outcomes are also linked to disadvantages to labor market opportunities as discussed in chapter 6. Accordingly, migrants also find themselves more often in more precarious situation on the labor market, as the likelihood is higher to be employed in unstable relations.

However, the first article mentioned in chapter 3 shows that these differences result mainly due to differences in observable characteristics. Particularly disadvantages in labor market and experience and firm tenure lead to disadvantages in labor market outcomes and are responsible for lower labor market outcomes. However, two of the four articles indicate that over time such differences decrease and thus lead to a substantial improvement of the situation for migrants. This is represented by different results for naturalized migrants, who usually show no noteworthy disadvantages with regard to labor market outcomes and provide more often similar observable characteristics to natives.

Based on the results and conclusions provided by each article, I derive several policy measures, which (i) build on the previous provided results and (ii) aim to equalize such differentials in terms of labor market outcomes and opportunities. These measures are particularly discussed against the background of fair and equal treatment of all workers.

First and most important, potential and existing barriers, which prevent and hardens the entry on the labor market for unemployed, should be further reduced. This is particularly important to give workers the opportunity to gain labor market experience and firm tenure, which is essential for labor market integration and equalization of disparities. Furthermore, particularly with regard to migrants, the recognition of abroad acquired human capital (chapter 2.3.1) should be considered as an important measure. This improves the labor market opportunities and prevents potential disadvantages related to crowding or overqualification (chapter 3). In addition, any measures related to an increase in the transition rate from unemployment to employment reduce long-term scarring effects. This is particularly important for the overall reduction in inequalities as such poverty or similar. However, prior to implementing any measures, potential exploitations to the disadvantage of workers or society should be considered, as discussed in chapter 6 with regard to the interplay between recalls and temporary contracts.

Nevertheless, this thesis faces different limits with regard to the considered topics and thus provides a starting point for further research. This applies particularly to limits related to data possibilities. Here, for example a combination between qualitative survey and administrative data could lead to further insights into different processes such as the issue of flatter experience curves for migrants or agency employment.

8 Bibliography

Abowd, John; Kramarz, Francis; Margolis, David (1999): High Wage Workers and High Wage Firms. Econometrica, vol. 67(2), pp. 251-333.

Acemoglu, Daron; Autor, David (2011): Skills, Tasks and Technologies: Implications for Employment and Earnings. Handbook of Labor Economics, in: O. Ashenfelter & D. Card (ed.), Handbook of Labor Economics, edition 1, vol. 4, chapter 12, pp. 1043-1171.

Aigner, Dennis J; Cain, Glen G. (1977): Statistical Theories of Discrimination in Labor Markets. Industrial and Labor Relations Review, vol. 30(2), pp. 175-187.

Alba-Ramírez, Alfonso; Arranz, José M.; Munoz-Bullón, Fernando (2007): Exits from unemployment: Recall or new job. Labour Economics, vol. 14(5), pp. 788-810.

Albertini, Julien; Fairise, Xavier; Terriau, Anthony (2020): Unemployment insurance, Recalls and Experience Rating. Working Paper, URL: https://halshs.archives-ouvertes.fr/halshs-02559317 (accessed January 18, 2021)

Aldashev, Alisher; Gernandt, Johannes; Thomsen Stephan L. (2012): The immigrant-native wage gap in Germany. Jahrbuecher fuer Nationaloekonomie und Statistik, Vol. 232 (5), pp. 490-517.

Allison, Paul (1999): Logistic Regression Using the SAS System: Theory and Application.

Arranz, José M.; García-Serrano, Carlos (2014): The interplay of the unemployment compensation system, fixed-term contracts and rehirings – The case of Spain. International Journal of Manpower, vol. 35(8), pp. 1236-1259.

Arrow, Kenneth J. (1973): The Theory of Discrimination, in: Orley Ashenfelter and Albert Rees, eds., Discrimination in Labor Markets. Princeton, pp. 3–33.

Arulampalam, Wiji (2001): Is Unemployment Really Scarring? Effects of Unemployment Experiences on Wages. Economic Journal, Royal Economic Society, vol. 111(475), pp. 585-606, November.

Atkinson, John; Giles, Lesley; Meager, Nigel (1996): Employers, recruitment and the unemployed. Institute for Employment Studies, report 325.

Autor, David H. (2015): Why Are There Still So Many Jobs? The History and Future of Workplace Automation. Journal of Economic Perspectives, American Economic Association, vol. 29(3), pp. 3-30.

Autor, David H.; Levy, Frank; Murnane Richard J. (2003): The Skill Content of Recent Technological Change: An Empirical Exploration. The Quarterly Journal of Economics, vol. 118(4), pp. 1279-1333.

Aydemir, Abdurrahman; Skuterud, Mikal (2008): The Immigrant Wage Differential within and across Establishments. ILR Review, Vol. 61 (3), pp.334-352.

Bade, Klaus; Oltmer, Jochen (2004): Normalfall Migration: Deutschland im 20. und frühen 21. Jahrhundert (Bundeszentrale für politische Bildung, Zeitbilder, Bd. 15). Bonn

Baert S, Cockx B, Gheyle N, Vandamme C (20115): Is There Less Discrimination in Occupations Where Recruitment Is Difficult? ILR Review 68(3), pp. 467-500.

Baily, Martin Neil (1977): On the Theory of Layoffs and Unemployment. Econometrica, vol. 45(5), pp.1043-1063.

Baltagi, Badi; Blien, Uwe; Wolf, Katja (2009): New evidence on the dynamic wage curve for Western Germany: 1980-2004. Labour Economics, vol. 16(1), pp. 47-51.

Baltagi, Badi; Blien, Uwe; Wolf, Katja (2012): A dynamic spatial panel data approach to the German wage curve. Economic Modelling, vol. 29(1), pp. 12-21.

Barrett, Alan; McGuinness, Sèamus; O'Brien, Martin (2012): The Immigrant Earnings Disadvantage across the Earnings and Skills Distributions: The Case of Immigrants from the EU's New Member States. British Journal of Industrial Relations, Vol. 50 (3), pp.457-481.

Basilio, Leilanie; Bauer, Thomas K; Kramer, Anica (2017): Transferability of Human Capital and Immigrant Assimilation: An Analysis for Germany. Labour, 31(3), pp. 245-264.

Becker, Gary S. (1964): Human capital. A theoretical and empirical analysis with special reference to education. New York, Columbia University Press.

Becker, Gary S. (1971): The Economics of Discrimination. University of Chicago Press, edition 2.

Bellmann, Lutz; Blien, Uwe (2001): Wage curve analyses of establishment data from Western Germany. Industrial and labor relations review, vol. 54(4), pp. 851-863.

Belzil, Christian (1995): Unemployment Duration Stigma and Re-Employment Earnings. The Canadian Journal of Economics, vol. 28(3), pp. 568-585.

Bachmann, Ronald; Cim, Merve; Green, Colin (2019): Long-Run Patterns of Labour Market Polarization: Evidence from German Micro Data. British Journal of Industrial Relations, vol. 57(2), pp. 350-376.

Bergmann, Barbara R. (1971): The Effect on White Incomes of Discrimination in Employment. Journal of Political Economy, vol. 79(2), pp. 294-313.

Bergmann, Barbara R. (1974): Occupational Segregation, Wages and Profits When Employers Discriminate by Race or Sex. Eastern Economic Journal, vol. 1(2), pp. 103-110.

Blackwell, M.; Iacus, S.M.; King, G.; Porro, G. (2009): cem: Coarsened exact matching in Stata. The Stata Journal, 9 (4), pp. 524-546.

Blanchflower, David; Oswald, Andrew (1994): The Wage Curve. In: MIT Press, Cambridge, MA.

Blanchflower, David; Oswald, Andrew (1995): An Introduction to the Wage Curve. In: Journal of Economic Perspectives 9(3), p. 153–167.

Blanchflower, David; Oswald, Andrew (2005): The Wage Curve Reloaded. NBER Working Papers 11338, National Bureau of Economic Research, Inc.

Blien, Uwe; Dauth, Wolfgang; Roth, Duncan (2021): Occupational routine intensity and the costs of job loss * evidence from mass layoffs. Labour economics, vol. 68, Art. 101953.

Blien, Uwe; Dauth, Wolfgang; Schank, Thorsten; Schnabel, Claus (2013): The institutional context of an 'empirical law': The wage curve under different regimes of collective bargaining. BJIR, vol, 51(1), pp. 59-79.

Blien, Uwe; Messmann, Susanne; Trappmann, Mark (2012): Do reservation wages react to regional unemployment? IAB-Discussion Paper, 22/2012.

Blinder, Alan S. (1973): Wage Discrimination: Reduced Form and Structural Estimates. The Journal of Human Resources, vol. 8(4), pp. 436-455.

Böheim, René (2006): “I’ll be Back” – Austrian Recalls. Empirica, vol. 33(1), pp. 1-18.

Boockmann, Bernhard; Steffes, Susanne (2010): Workers, Firms or Institutions: What Determines Job Duration for Male Employees in Germany? Industrial and Labor Relations Review, vol. 64(1), pp. 109-127.

Borjas, George (1987): Self-selection and the earnings of immigrants. The American Economic Review, Vol. 77, pp. 531–553.

Borjas, George J. (1985): Assimilation, Changes in Cohort Quality, and the Earnings of Immigrants. Journal of Labor Economics, vol. 3(4), pp. 463-489.

Bossler, Mario (2014): Sorting within and across establishments. The immigrant-native wage differential in Germany. IAB-Discussion Paper 10/2014. Nürnberg.

Bossler, Mario; Gürtzgen, Nicole; Kubis, Alexander; Küfner, Benjamin; Popp, Martin (2020): Befristungen bei Neueinstellungen 2020. Aktuelle Daten und Indikatoren. URL: http://doku.iab.de/arbeitsmarktdaten/Befristungen_bei_Neueinstellungen.pdf (accessed October 18, 2021)

Brenzel, Hanna; Laible, Marie-Christine (2016): Does personality matter? The impact of the big five on the migrant and gender wage gaps. IAB-Discussion Paper, 26/2016.

Brücker, Herbert (2013): Auswirkung der Einwanderung auf Arbeitsmarkt und Sozialstaat: Neue Erkentnisse und Schlussfolgerungen für die Einwanderungspolitik. In: Bertelsmann Stiftung (Hrsg). Vielfältiges Deutschland. Gütersloh.

Brücker, Herbert (2015a): Mehr Chancen als Risiken durch Zuwanderung. Aktuelle Berichte, 1/2015. URL: http://doku.iab.de/aktuell/2015/aktueller_bericht_1501.pdf (accessed October 18, 2021).

Brücker, Herbert (2015b): A Quantitative and Structural Analysis of Diversion of Migration Flows. In: K. Hank & M. Kreyenfeld (Eds.), Social Demography. Forschung an der Schnittstelle von Soziologie und Demografie (Kölner Zeitschrift für Soziologie und Sozialpsychologie. Sonderheft, 55), pp. 165-191.

Brücker, Herbert; Glitz, Albrecht; Lerche, Adrian; Romiti, Agnese (2021): The integration of immigrants in Germany: Formal recognition of foreign occupational qualifications has positive labor market effects. IAB-Kurzbericht, 02/2021.

Brücker, Herbert; Hauptmann, Andreas; Jahn, Elke; Upward, Richard (2014): Migration and imperfect labor markets: Theory and cross-country evidence from Denmark, Germany and the UK. European Economic Review, vol. 66(C), pp. 205-225.

Brücker, Herbert; Jahn, Elke (2011): Migration and Wage-setting: Reassessing the Labor Market Effects of Migration. Scandinavian Journal of Economics, vol. 113, pp. 286-317.

Brunow, Stephan and Peter Nijkamp (2018): The Impact of a Culturally Diverse Workforce on Firms' Revenues and Productivity: An Empirical Investigation on Germany. International Regional Science Review, Vol. 41(1), pp. 62-85.

Brunow, Stephan; Jost, Oskar (2019): Wages of migrant and native employees in Germany: new light on an old issue. (IAB-Discussion Paper, 10/2019), Nürnberg, 48p.

Burdett, Ken; Carrillo-Tudela, Carlos; Coles, Melvyn (2020): The Cost of Job Loss. Review of Economic Studies, vol.87(4), pp. 1757-1798.

Card, David; Cardoso, Ana Rute; Heining, Jörg; Kline, Patrick (2018): Firms and labor market inequality * evidence and some theory. Journal of Labor Economics, vol. 36(1), pp. 13-70.

Card, David; Heining, Jörg; Kline, Patrick (2013): Workplace heterogeneity and the rise of West German wage inequality. In: The Quarterly Journal of Economics, Vol. 128 (3), pp. 967-1015.

Carrillo-Tudela, Carlos; Launov, Andrey; Robin, Jean-Marc (2021): The fall in german unemployment: A flow analysis. European Economic Review, vol. 132(C).

Carrington, William J; Fallick, Bruce (2017): Why Do Earnings Fall with Job Displacement? Industrial Relations: A Journal of Economy and Society, vol. 56(4), pp. 688-722.

Chadi, Adrian (2010): How to Distinguish Voluntary from Involuntary Unemployment: On the Relationship between the Willingness to Work and Unemployment-Induced Unhappiness. Kyklos, vol. 63(3), pp. 317-329.

Chernozhukov, Victor; Fernández-Val, Iván; Melly, Blaise (2013): Inference on Counterfactual Distributions. Econometrica, Vol.81 (6), pp. 2205-2268.

Chiswick, Barry R. (1978): The Effect of Americanization on the Earnings of Foreign-born Men. Journal of Political Economy, Vol. 86(5), pp.897-921.

Chiswick, Barry R; Miller, Paul W. (2002): Immigrant earnings: Language skills, linguistic concentrations and the business cycle. Journal of Population Economics, Vol. 15(1), pp.31-57.

Chiswick, Barry R; Miller, Paul W. (2003): The complementarity of language and other human capital: immigrant earnings in Canada. Economics of Education Review, Vol. 22(5), pp.469-480.

Chiswick, Barry R; Miller, Paul W. (2009): The international transferability of immigrants' human capital. Economics of Education Review, 28, 162-169.

Cooper, Daniel (2013): The effect of unemployment duration on future earnings and other outcomes. Working Papers 13-8, Federal Reserve Bank of Boston.

Couch, Kenneth; Dana, Placzek (2010): Earnings Losses of Displaced Workers Revisited. American Economic Review, 100(1), pp. 572-589.

Crown, Daniel; Faggian, Alessandra (2019): Naturalization and the productivity of foreign-born doctorates. Journal of Geographical Systems, vol. 21(4), pp. 533-556.

Dalenberg, Douglas; Partridge, Mark (2000): An Empirical Analysis of State Labor Markets: Has Worker Insecurities Shifted Wages in the 1990s? The Quarterly Review of Economics and Finance, vol. 40(3): pp. 303-323.

D'Amuri, Francesko; Ottaviano, Gianmarco; Peri, Giovanni (2010): The Labor Market Impact of Immigration in Western Germany in the 1990s. European Economic Review, vol. 54(4), pp. 550-570.

Dauth, Wolfgang; Eppelsheimer, Johann (2020): Preparing the sample of integrated labour market biographies (SIAB) for scientific analysis. Journal for labour market research, vol. 54(1), pp. 1-10.

David Card & John E. DiNardo (2002): Skill-Biased Technological Change and Rising Wage Inequality: Some Problems and Puzzles. Journal of Labor Economics, vol. 20(4), pp. 733-783.

Davis, Steven; von Wachter, Till (2011): Recessions and the Cost of Job Loss. Brookings Papers on Economic Activity. Pp.1-55.

de Groot, Olaf; Sager, Lutz (2010): Migranten in Deutschland: soziale Unterschiede hemmen Integration. DIW Wochenbericht, vol. 77(49), pp. 2-9.

DellaVigna, Stefano; Heining, Jörg; Schmieder, Johannes F.; Trenkle, Simon (2020): Evidence on job search models from a survey of unemployed workers in Germany. IAB-Discussion Paper, 13/2020.

Destatis – Statistisches Bundesamt (Federal Statistical Office) (2021): Bevölkerung in Privathaushalten nach Migrationshintergrund. URL: https://www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Bevoelkerung/Migration-Integration/Tabellen/migrationshintergrund-geschlecht-insgesamt.html (accessed October 18, 2021)

Destatis – Statistisches Bundesamt (Federal Statistical Office) (2019): Wanderungen zwischen Deutschland und dem Ausland 1991 bis 2019. URL https://www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Bevoelkerung/Wanderungen/Tabellen/wanderungen-alle.html#fussnote-1-115678 (accessed October 18, 2021)

Dostie, Benoit; Li, Jiang; Card, David; Parent, Daniel (2020): Employer Policies and the Immigrant-Native Earnings Gap, IZA Discussion Papers 13245, Institute of Labor Economics (IZA).

Dustmann, Christian; Glitz, Albrecht (2011): Migration and education. In Eric A. Hanushek, Stephen Machin, and Ludger Wößmann (Eds.). Handbook of the Economics of Education, vol. 4, pp.327–439. Amsterdam, Elsevier.

Eberle, Johanna; Jacobebbinghaus, Peter; Ludsteck, Johannes; Witter, Julia (2011): Generation of time-consistent industry codes in the face of classification changes * Simple heuristic based on the Establishment History Panel (BHP). FDZ-Methodenreport, 05/2011.

Edler, Susanne; Jacobebbinghaus, Peter; Liebig Stefan (2019): Recall – A way to mitigate adverse effects of unemployment on earnings across occupations? Research in Social Stratification and Mobility, vol. 60, pp. 39-51.

Fackler, Daniel; Müller, Steffen; Stegmaier, Jens (2021): Explaining Wage Losses after Job Displacement: Employer Size and Lost Firm Wage Premiums. (Forthcoming) Journal of the European Economic Association.

FEA – Federal Employment Agency (Bundesagentur für Arbeit) (2020): Arbeitslosigkeit von Lehrkräften während der Sommerferien. Berichte: Arbeitsmarkt kompakt. URL: https://statistik.arbeitsagentur.de/DE/Statischer-Content/Statistiken/Themen-im-Fokus/Berufe/Generische-Publikationen/Lehrer.pdf?__blob=publicationFilea (accessed October 18, 2021)

Feldstein, Martin (1976): Temporary Layoffs in the Theory of Unemployment. The Journal of Political Economy, vol. 84(5), pp. 937-958.

Fernandez-Kelly, Patricia (2012): The Unequal Structure of the German Education System: Structural Reasons for Educational Failures of Turkish Youth in Germany. Spaces & flows: an international journal of urban and extraurban studies, vol. 2(2), pp. 93–112.

Fitzenberger, Bernd; Osikominu, Aderonke; Völter, Robert (2005): Imputation rules to improve the education variable in the IAB employment subsample. IAB-FDZ-Methodenreport, Nürnberg.

Fitzenberger, Bernd; Wilke, Ralf (2010): New insights into unemployment duration and post unemployment earnings in Germany. Oxford Bulletin of Economics and Statistics, vol. 72(6), pp. 794-826.

Flaaen, Aaron; Shapiro, Matthew; Sorkin, Isaac (2019): Reconsidering the Consequences of Worker Displacements: Firm versus Worker Perspective. American Economic Journal: Macroeconomics, vol. 11(2), pp. 193-227.

Fortin, Nicole; Lemieux, Thomas; Firpo, Sergio (2011): Decomposition Methods in Economics. Handbook of Labour Economics, Vol. 4a.

Fox, Jeremy (2009): Firm-Size Wage Gaps, Job Responsibility, and Hierarchical Matching. Journal of Labor Economics, vol. 27(1), pp. 83-126.

Friedberg, Rachel M. (2000): You Can't Take It with You? Immigrant Assimilation and the Portability of Human Capital. Journal of Labor Economics, vol. 18,(2), pp. 221-251.

Fuchs, Johann; Kubis, Alexander; Schneider, Lutz (2015): Zuwanderungsbedarf aus Drittstaaten in Deutschland bis 2050. Szenarien für ein konstantes Erwerbspersonenpotenzial - unter Berücksichtigung der zukünftigen inländischen Erwerbsbeteiligung und der EU-Binnenmobilität. Gütersloh: Bertelsmann, 91 p.

Fuchs, Johann; Kubis, Alexander; Schneider, Lutz (2019): Immigration and digitisation* How much migration from third countries will the German labour market require in the future? Gütersloh, 113 p.

Fuchs, Michaela; Jost, Oskar; Kaufmann, Klara; Ludewig, Oliver; Weyh, Antje (2018): Baustelle Arbeitsmarkt - die Beschäftigungsdynamik in Ost und West hat sich angeglichen. In: IAB-Forum, 09.11.2018

Fuchs, Johann; Söhnlein, Doris; Weber, Brigitte; Weber, Enzo (2016): Ein integriertes Modell zur Schätzung von Arbeitskräfteangebot und Bevölkerung. IAB-Forschungsbericht 10/2016.

Fuchs, Johann; Weber, Brigitte (2020): Höhere Erwerbsquoten stoppen nicht den Rückgang des Erwerbspersonenpotenzials. Sozialer Fortschritt, vol. 69 (2020), pp. 45–71.

Fuchs, Michaela; Rossen, Anja; Weyh, Antje; Wydra-Somaggio, Gabriele (2021): Where do women earn more than men? Explaining regional differences in the gender pay gap. Journal of regional science, online first, pp. 1-23.

Fujita, Shigeru; Moscarini, Giuseppe (2017): Recall and Unemployment. American Economic Review, vol. 107(12), pp. 3875-3916.

Ganzer, Andreas; Schmidtlein, Lisa; Stegmaier, Jens; Wolter, Stefanie (2020): Betriebs-Historik-Panel 1975-2018. FDZ-Datenreport, 01/2020.

GCEE German Council of Economic Experts (2017): Annual Report 2017/18 – Towards a Forward-Looking Economic Policy. OECD, URL: https://www.sachverstaendigenrat-wirtschaft.de/en/publications/annual-reports/previous-annual-reports/annual-report-201718.html (accessed October 18, 2021)

Geis-Thöne, Wido (2019): Sprachkenntnisse entscheidend für die Arbeitsmarktintegration, IW-Trends, The German Economic Institute (IW), vol. 46(3), pp. 73-89.

Gerard, Francois; Lagos, Lorenzo; Severnini, Edson R; Card, David (2018): Assortative Matching or Exclusionary Hiring? The Impact of Firm Policies on Racial Wage Differences in Brazil. IZA Discussion Papers 11923.

Glitz, Albrecht (2014): Ethnic segregation in Germany. Labour Economics, vol. 29(C), pp. 28-40.

Gotter, Christa; Ketzmerick, Thomas; Reis, Sabrina (2018): Zuwanderung nach Deutschland und die Stellung von Ausländern auf dem Arbeitsmarkt. In: Petrick, M., Wiener, B. (Hrsg.): Landwirtschaftliches Personalmanagement im Kontext internationaler Zuwanderung nach Deutschland. Pp. 87-135.

Graf, Johannes; Heß, Barbara (2020): Ausländische nicht-akademische Fachkräfte auf dem deutschen Arbeitsmarkt. Eine Bestandsaufnahme vor dem Inkrafttreten des Fachkräfteeinwanderungsgesetzes. Forschungsbericht 35. Bundesamt für Migration und Flüchtlinge. Nürnberg.

Granato, Nadia; Frank, Kalter (2018): Migration und ethnische Ungleichheit auf dem Arbeitsmarkt. In: Abraham M., Hinz T. (eds) Arbeitsmarktsoziologie. Springer VS, Wiesbaden.

Green, Simon (2013): Germany: a changing country of immigration. German politics, Vol. 22(3), pp.333-351.

Gregory, Mary & Jukes, Robert (2001): Unemployment and Subsequent Earnings: Estimating Scarring among British Men 1984-94. Economic Journal, Royal Economic Society, vol. 111(475), pp. 607-625.

Guvenen, Fatih; Karahan, Fatih; Ozkan, Serdar; Song, Jae (2017): Heterogeneous Scarring Effects of Full-Year Nonemployment. American Economic Review, vol. 107(5), pp. 369-373.

Haller, Peter; Heuermann, Daniel (2020): Opportunities and competition in thick labor markets: Evidence from plant closures. Journal of Regional Science, vol. 60(2), pp. 273-295, March.

Harris, John; Todaro, Michael (1970): Migration, Unemployment and Development: A Two-Sector Analysis. American Economic Review, vol. 60(1), pp. 126-142.

Heckman, James J; Lochner, Lance J; Todd, Petra (2006): Earnings Functions, Rates of Return and Treatment Effects: The Mincer Equation and Beyond. Handbook of the Economics of Education, edition 1, volume 1, chapter 7, pp. 307-458. Elsevier.

Himmler, Oliver; Jäckle, Robert (2017): Literacy and the Migrant-Native Wage Gap. Review of Income and Wealth, vol. 64 (3), pp.592-625.

Hinz, Thomas; Abraham, Martin (2018): Theorien des Arbeitsmarktes. Arbeitsmarktsoziologie: Probleme, Theorien, empirische Befunde. Springer VS, pp. 9-76.

Hirsch, Boris; Jahn, Elke J. (2015): Is there Monopsonistic Discrimination against Immigrants? ILR Review, Vol. 68 (3), pp.501-528.

Hofer, Helmut; Titelbach, Gerlinde; Winter-Ebmer, Rudolf; Ahammer, Alexander (2017): Wage Discrimination Against Immigrants in Austria? Labour, Vol. 31 (2), pp.105-126.

Hunger, Uwe; Kranich, Sascha (2018): Advantages and Disadvantages of a Point-based Immigration Regulation for the Labor Market. Zeitschrift für Vergleichende Politikwissenschaft, vol. 1, pp. 229-243.

Hunkler, Christian (2013): Fehlende Ressourcen oder Diskriminierung? Ethnische Ungleichheit beim Zugang zu Ausbildungsplätzen im dualen System. Dissertation, University Mannheim.

Huttunen, Kristiina; Møen, Jarle; Salvanes, Kjell (2018): Job Loss and Regional Mobility. Journal of Labor Economics, vol. 36(2), pp. 479-509.

Iacus, Stefano M; King, Gary; Porro, Giuseppe (2011): Multivariate matching methods that are monotonic imbalance bounding. Journal of the American Statistical Association, vol. 106(493), pp. 345–361.

Illing, Hannah; Koch, Theresa (2021): Who Suffers the Greatest Loss? Costs of Job Displacement for Migrants and Natives. IAB-Discussion Paper, 08/2021.

International Organization for Migrants (IOM): World Migration Report 2020. URL: https://publications.iom.int/system/files/pdf/wmr_2020.pdf (accessed October 18, 2021)

Jahn, Elke (2005): Wie wirkt der Kündigungsschutz? Zeitschrift für Arbeitsmarktforschung, Vol. 38, pp. 284-304.

Jahn, Elke (2009): Do firms obey the law when they fire workers? Social criteria and severance payments in Germany. International Journal of Manpower, vol. 30(7), pp. 672-691.

Jahn, Elke; Neugart, Michael (2020): Do neighbors help finding a job? Social networks and labor market outcomes after plant closures, Labour economics, Vol. 65(C), pp. 1-15.

Jansson, Fredrik (2002): Rehires and Unemployment Duration in the Swedish Labour Market – New Evidence of Temporary Layofs. LABOUR, vol. 16(2), pp. 311-345.

Jarosch, Gregor (2021): Searching for Job Security and the Consequences of Job Loss. NBER Working Papers 28481.

Jarosch, Gregor; Oberfield, Ezra; Rossi-Hansberg, Esteban (2021): Learning From Coworkers. Econometrica, vol. 89(2), pp. 647-676.

Jenkins, Steve P (2004): Survival analysis. Lecture notes. URL: http://www.iser.essex.ac.uk/teaching/degree/stephenj/ec968

Jinkins, David; Morin, Annaig (2018): Job-to-Job Transitions, Sorting, and Wage Growth. Labour Economics, vol. 55(C), pp. 300-327.

Jones, F.L; Kelley, Jonathan (1984): Decomposing Differences between Groups. A Cautionary Note on Measuring Discrimination. Sociological Methods & Research, Vol. 12 (3), pp. 323-343.

Jost, Oskar; Bogai, Dieter (2016): Ausländer am Arbeitsmarkt in Berlin-Brandenburg. IAB-Regional. Berichte und Analysen aus dem Regionalen Forschungsnetz, 1/2016. Nürnberg.

Katz, Lawrence F.; Meyer, Bruce D. (1990): Unemployment Insurance, Recall Expectations, and Unemployment Outcomes. The Quarterly Journal of Economics, vol. 105(4), pp. 973-1002.

Klinger, Sabine; Fuchs, Johann (2019): Country report: Germany. In: H. Räisänen & T. Maunu (Eds.), Effects of population changes in the labour market: an analysis of six European countries, Helsinki, pp. 54-66.

Knight, John; Li, Shi (2006): Unemployment duration and earnings of re-employmed workers in urban China. China Economic Review, vol. 17(2), pp. 103-119.

Kodrzycki, Yolanda (2007): Using unexpected recalls to examine the long-term earnings effects of job displacement. Working Papers 07-2, Federal Reserve Bank of Boston, revised 2007.

Kogan, Irena (2004): Labour Market Careers of Immigrants in Germany and the United Kingdom. Journal of international migration and integration, vol 5(4), pp. 417-447.

Kogan, Irena (2011): New immigrants – old disadvantage patterns? Labour market integration of recent immigrants into Germany. International Migration, vol. 49(1), pp. 91-117

Kosfeld, Reinhold; Werner, Alexander (2012): Deutsche Arbeitsmarktregionen –Neuabgrenzung nach den Kreisgebietsreformen 2007–2011. Spatial Research and Planning, vol.70(1), pp. 49-64.

Kristen, Cornelia; Granato, Nadia (2007): The educational attainment of the second generation in Germany. Ethnicities, vol. 7(3), pp. 343-366.

Krolikowski, Pawel (2018): Choosing a Control Group for a Displaced Workers. Industrial and Labor Relations Review, vol. 75(5), pp. 1232-1254.

Kunaschk, Max (2020): Trotz Mindestlohn zeigt sich die Beschäftigung im Friseurgewerbe bislang stabil. In: IAB-Forum, 11.03.2020.

Lehmer, Florian; Ludsteck, Johannes (2011): The Immigrant Wage Gap in Germany: Are East Europeans Worse Off? International Migration Review, Vol.45 (4), pp.872-906.

Lehmer, Florian; Ludsteck, Johannes (2015): Wage Assimilation of Foreigners: Which Factors Close the Gap? Evidence from Germany. Review of Income and Wealth, Vol.61 (4), pp.677-701.

Lehmer, Florian; Ludsteck, Johannes (2015): Wage assimilation of foreigners. Which factors close the gap? Evidence from Germany. Review of Income and Wealth, Vol. 61(4), pp. 677-701.

Lemieux, Thomas (2006): The “Mincer Equation” Thirty Years after Schooling, Experience, and Earnings. Jacob Mincer: A Pioneer Of Modern Labor Economics, pp. 127-145. Springer Science. New York.

Licht, Georg; Steiner, Viktor (1994): Assimilation, labour market experience and earnings profiles of temporary and permanent immigrant workers in Germany. International Review of Applied Economics, vol. 8(2), pp. 130–156.

Liebig, Stefan; Hense, Andrea (2007): Die zeitweise Verlagerung von Arbeitskräften in die Arbeitslosigkeit: eine „neue“ personapolitische Flexibilierungsstrategie? Journal for Labour Market Research, vol. 40(4), pp. 399-417.

Long, Scott; Freese, Jeremy (2001): Regression models for categorical dependent variables using Stata. 2nd Edition. Stata Press.

Longhi, Simonetta; Nijkamp, Peter; Poot, Jacques (2006): Spatial Heterogeneity And The Wage Curve Revisited. Journal of Regional Science vol. 46(4), pp. 707-731.

Lopes, Marta (2018): Unemployment Duration and Re-employment Wages. Working Paper, September 2018. https://drive.google.com/file/d/0BykwKtuhLt32VV9zN21YT0l6M28/view (accessed October 18, 2021)

Ludsteck, Johannes (2014): The impact of segregation and sorting on the gender wage gap - evidence from German linked longitudinal employer-employee data. ILR Review, Vol. 67 (2), pp. 362-394.

Manfred Antoni, Alexandra Schmucker, Stefan Seth, Philipp vom Berge (2019): Sample of Integrated Labour Market Biographies (SIAB) 1975 - 2017. FDZ data report, 02/2019.

Mavromaras, Kostas; Rudolph, Helmut (1995): Recalls – Wiederbeschäftigung im alten Betrieb. Mitteilungen aus der Arbeitsmarkt- und Berufsforschung. Institute for Employment Research, vol. 28(2), pp. 171-194.

Mavromaras, Kostas; Rudolph, Helmut (1997): Wage Discrimination in the Reemployment Process. Journal of Human Resources, vol. 32(4), pp. 812-860.

Mavromaras, Kostas; Rudolph, Helmut (1998): Temporary Separations and Firm Size in the German Labour Market. Oxford Bulletin of Economics and Statistics, vol. 60(2), pp. 215-225.

Mergener, Alexandra (2018): Zuwanderung in Zeiten von Fachkräfteengpässen auf dem deutschen Arbeitsmarkt: Einflussfaktoren auf die Beschäftigungs- und Rekrutierungschancen ausländischer Fachkräfte aus betrieblicher Perspektive. Berichte zur Beruflichen Bildung, Verlag Barbara Budrich. Leverkusen.

Miguélez, Ernest; Moreno, Rosina (2014): What Attracts Knowledge Workers? The Role of Space And Social Networks. Journal of Regional Science, vol. 54(1), pp. 33-60.

Mortensen, Dale T. (1990): A Structural Model of Unemployment Insurance Benefit Effects on the Incidence and Duration of Unemployment. Advances in the Theory and Measurement of Unemployment. Palgrave Macmillan, London.

Müller, Dana; Wolter, Stefanie (2020): German labour market data – Data provision and access for the international scientific community. German Economic Review, Vol. 21, (3), pp. 313-333.

Nanos, Panagiotis; Schluter, Christian (2014): The composition of wage differentials between migrants and natives. European Economic Review, Vol. 65, pp. 23-44.

Nekoei, Arash; Weber, Andrea (2015): Recall Expectations and Duration Dependence. American Economic Review: Papers & Proceedings, vol. 105(5), pp. 142-146.

Nekoei, Arash & Weber, Andrea (2020): Seven Facts about Temporary Layoffs. CEPR Discussion Papers 14845, C.E.P.R. Discussion Papers.

Nivorozhkin, Anton (2008): Layoffs, recalls and unemployment duration * evidence from Sweden. International Review of Applied Economics, vol. 22(6), pp. 725-744.

OECD (2019): International Migration Outlook 2019. URL: https://www.oecd-ilibrary.org/sites/c3e35eec-en/index.html?itemId=/content/publication/c3e35eec-en&mimeType=text/html (accessed October 18, 2021)

Ortego-Marti, Victor (2017): Loss of Skill during Unemployment and TFP Differences across Countries. European Economic Review, vol. 100(C) pp. 215-235.

Oaxaca, Ronald (1973): Male-Female Wage Differentials in Urban Labor Markets. International Economic Review, vol. 14(3), pp. 693-709.

Partridge, Mark; Rickman, Dan (1997a): The Dispersion of U.S. State Unemployment Rates: The Role of Market and Nonmarket Factors. Regional Studies, Vol. 31(6), pp. 593-606.

Partridge, Mark; Rickman, Dan (1997b): Has the Wage Curve Nullified the Harris-Todaro Model. Economics Letters, Vol. 54(3), pp. 277-282.

Peter Nijkamp & Jacques Poot (2005): The Last Word on the Wage Curve? Journal of Economic Surveys, Vol. 19(3), pp. 421-450.

Phelps, Edmund S. (1972): The Statistical Theory of Racism and Sexism. The American Economic Review, vol. 62(4), pp. 659-661.

Potrafke, Niklas (2012): Unemployment, human capital depreciation and pension benefits: an empirical evaluation of German data. Journal of Pension Economics and Finance, vol. 11(2), pp. 223-241.

Rahimi, Ebrahim; Nazari, Seyed Saeed Hashemi (2021): A detailed explanation and graphical representation of the Blinder-Oaxaca decomposition method with its application in health inequalities. Emerging Themes in Epidemiology, vol. 18(12).

Rodríguez-Planas, Núria (2014): Playing Hard to Get: Theory and Evidence on Layoffs, Recalls, and Unemployment. Research in Labor Economics, vol. 38, pp. 211-258.

Rokicki, Bartlomiej; Blien, Uwe; Hewings, Geoffrey J. D; Phan thi Hong, Van (2020): Is there a Wage Curve with Regional Real Wages? IAB-Discussion Paper, 17/2020

Schimpl-Neimanns, Bernhard (2003): Mikrodaten-Tools: Umsetzung der Berufsklassifikation von Blossfeld auf die Mikrozensen 1973-1998. ZUMA-Methodenbericht 2003/10, URL: https://www.gesis.org/fileadmin/upload/forschung/publikationen/gesis_reihen/gesis_methodenberichte/2003/03_10_Schimpl.pdf (accessed October 18, 2021)

Schlicht, Ekkehart (2016): Efficiency wages: Variants and implications. IZA World of Labor 2016. Doi: 10.15185/izawol.275

Schmidt, Christoph (1997): Immigrant Performance in Germany: Labor Earnings of Ethnic German Migrants and Foreign Guest-Workers. The Quarterly Review of Economics and Finance, vol. 37, pp. 379–397.

Schmidt, Christoph; Zimmermann, Klaus (1992): Migration Pressure in Germany: Past and Future, pp. 201-230. K.F. Zimmermann (ed), Migration and Development, Springer, Berlin.

Schmieder, Johannes; von Wachter, Till; Bender, Stefan (2016): The Effect of Unemployment Benefits and Nonemployment Durations on Wages. American Economic Review, vol. 106(3), pp. 739-777.

Seibert, Holger; Wapler, Rüdiger (2020): Immigration to Germany: Many high-skilled, but also many unskilled. IAB-Kurzbericht 08/2020, 12 p.

Serrano, Felipe; Eguía, Begoña; Ferreiro, Jesús (2011): Public pensions' sustainability and population ageing: Is immigration the solution? International Labour Review, vol. 150(1-2), pp. 63-79.

Spence, Michael (1973): Job Market Signaling. The Quarterly Journal of Economics, vol. 87(3), pp. 355-374.

Statistik der Bundesagentur für Arbeit (2020): Arbeitslose und Arbeitsuchenende nach Staatsangehörigkeiten (Monatszahlen). Deutschland und Länder. URL: https://statistik.arbeitsagentur.de/SiteGlobals/Forms/Suche/Einzelheftsuche_Formular.html?nn=25122&topic_f=nat-ins (accessed October 18, 2021)

Stephan, Gesine (2006): Fair geht vor. Was die Leute von Entlassungen und Lohnkürzungen halten. IAB Kurzbericht No. 1.

Struck, Olaf; Grotheer, Michael; Schröder, Tim; Köhler, Christoph (2007): Instabile Ergebnisse zu einer alten Kontroverse. Kölner Zeitschrift für Soziologie und Sozialpsychologie, vol. 59, pp. 271-293.

Tanis, Kerstin (2020): Regional distribution and location choices of immigrants in Germany. Regional Studies, vol. 54(4), pp. 483-494.

Todaro, Michael (1969): A Model for Labor Migration and Urban Unemployment in Less Developed Countries. American Economic Review, vol. 59(1), pp. 138-148.

United Nations (UN) (2019): Number of migrants now growing faster than world population, new UN figures show. URL: https://news.un.org/en/story/2019/09/1046562 (accessed October 18, 2021).

van den Berg, Gerard (1992): A Structural Dynamic Analysis of Job Turnover and the Costs Associated with Moving to Another Job. The Economic Journal, vol. 102(414), pp. 1116-1133.

van Horn, Kevin (2015): Which Link Function – Logit, Probit or Cloglog? URL: http://bayesium.com/wp-content/uploads/2015/08/logit-probit-cloglog.pdf (accessed October 18, 2021).

Weichselbaumer, D. (2017), Discrimination Against Migrant Job Applicants in Austria: An Experimental Study. German Economic Review 18, pp. 237-265.

White, Barbara Ann (1983): Optimal Strategies for Workers on Temporary Layoff. Economic Inquiry, vol. 21, pp. 520-544.

Wolf, Elke (2014): The German part-time wage gap: bad news for men? Discussion paper, SOEPpaper No. 663.

Yun, Myeong-Su (2005): A Simple Solution to the Identification Problem in Detailed Wage Decomposition, Economic Inquiry (2005), 43(4), pp. 766-772, with Erratum, Economic Inquiry, 44 (1), p. 198.

Zibrowius, Michael (2012): Convergence or divergence? Immigrant wage assimilation patterns in Germany. SOEP papers, DIW Berlin, 479-2012.

Zimmermann, Ralf; Kaimer, Steffen; Oberschachtsiek, Dirk (2007): Dokumentation des "Scientific Use Files der Integrierten Erwerbsbiographien" (IEBS-SUF V1) Version 1.0. FDZ-Datenreport, 01/2007.

Erklärung

Hiermit erkläre ich, dass ich die Bestandteile der kumulativen Dissertation selbständig verfasst und keine anderen als die angegebenen Hilfsmittel genutzt habe und alle verwendeten Quellen und Hilfsmittel sowie wörtlich oder sinngemäß entnommenen Stellen aus anderen Werken als solche kenntlich gemacht worden sind. Ich versichere außerdem, dass ich die beigefügte Dissertation nur in diesem und keinem anderen Promotionsverfahren eingereicht habe und, dass diesem Promotionsverfahren keine endgültig gescheiterten Promotionsverfahren vorausgegangen sind. Da die vorliegende kumulative Dissertation aus mehreren Kapiteln besteht, sind einzelne Kapitel als alleinstehende Artikel bereits in einer ähnlichen Form veröffentlicht:

Kapitel 3:
Brunow S.; Jost O. (2022): Wages of Skilled Migrant and Native Employees in Germany: New Light on an Old Issue. International Migration Review, Vol. 56(2), pp. 410-432. DOI:10.1177/01979183211040505. URL: https://journals.sagepub.com/doi/full/10.1177/01979183211040505

Kapitel 5:
Jost, O. (2022), "Unemployment and its scarring effect on wages in Germany: evidence from linked employer-employee data", International Journal of Manpower, Vol. 43 No. 5, pp. 1126-1143. https://doi.org/10.1108/IJM-02-2021-0065

Kapitel 6:
Jost, O. See you soon: fixed-term contracts, unemployment and recalls in Germany—a linked employer–employee analysis. Empirica 49, 601–626 (2022). https://doi.org/10.1007/s10663-022-09540-1