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The Impact of Skill Mismatch on Earnings Losses after Job Displacement*

Ljubica Nedelkoska, Frank Neffke, and Simon Wiederhold[†]

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Abstract

The long-term earnings losses of displaced workers are substantial. We investigate the role of post-displacement occupational matching in explaining the cost of job displacement. We combine German administrative data on the work history of displaced workers with information on the task content of more than 260 occupations, providing a measure of skill mismatch between a worker's pre- and post-displacement occupation. We find that displaced occupational switchers suffer average wage losses of more than 8% over 15 years. However, displaced workers moving to occupations where they are initially underqualified quickly manage to return to their pre-displacement earnings path, and even gain from switching in the long run. Our preliminary results suggest that policy should encourage the requalification of displaced workers to occupations that are more skill demanding than their pre-displacement occupations.

JEL Code: J24, J31, J63, J65

Keywords: job displacement, human capital, skill mismatch, occupational change

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1 Introduction

A growing number of empirical studies evidence large and persistent earnings losses of displaced workers. The majority of these studies agree that displaced workers experience earnings losses relative to their non-displaced peers of about 15% per year lasting up to 15–20 years after displacement.¹ Recent literature also highlights additional non-monetary cost associated with involuntary job losses, suggesting that both life expectancy and fertility are negatively affected by displacements.² Job displacement even seems to entail inter-generational cost, as parental job loss appears to be related to adverse impacts on children including poorer schooling outcomes and worse labor market outcomes as adults (Oreopolous, Page and Stevens, 2008; Kalil and Wightman, 2011). This paper investigates occupational switching and skill mismatch after displacement as possible channels through which the sharp earnings losses of displaced workers materialize.

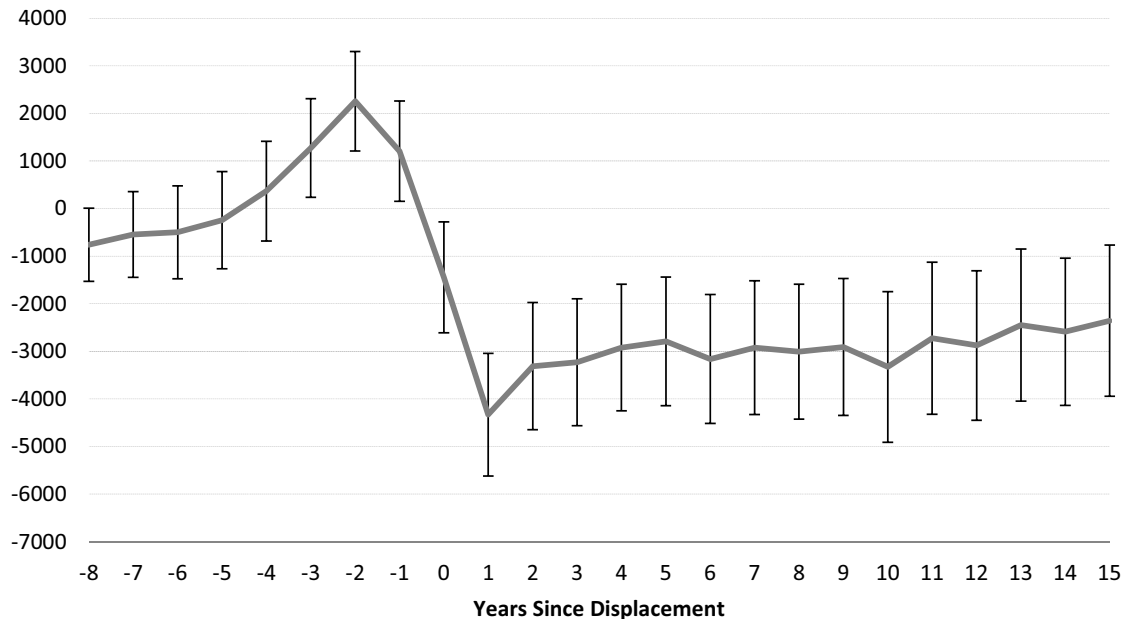
Figure 1 shows total annual wage losses of displaced workers relative to a control group consisting of all workers in Germany who have never been displaced, considering all displacement events due to plant closings in 1993. The figure demonstrates that displaced workers suffer large initial wage losses, which settle down to a long-term loss relative to pre-displacement wages of about 13%. These results are in line with those presented in Schmieder, von Wachter and Bender (2010), who investigate the earnings losses of high-

¹ Jacobson, LaLonde and Sullivan (1993) used data from administrative records in Pennsylvania to estimate the earnings losses of high-tenure workers displaced in the course of mass-layoff events or firm closures in the early 1980s. Couch and Placzek (2010) replicated the Jacobson, LaLonde and Sullivan (1993) research design for Connecticut in a more recent period (1993–2004). Presenting evidence for Germany, Schmieder, von Wachter and Bender (2010) generalized the finding of long-term earnings losses associated with job displacements to labor markets with tight social safety nets. Similar conclusions were reached by Eliason and Storrie (2006) and Seim (2012) with Swedish data. Country-level studies for Canada (Bonikowska and Morissette, 2012) and the UK (Hijzen, Upward and Wright, 2010) also indicated substantial cost of job displacement on the workers directly affected.

² Sullivan and von Wachter (2009) estimate reductions in life expectancy of 1–1.5 years resulting from high-tenured workers losing their jobs. Moreover, the authors find mortality increases by 50–100% in the year following displacement. These health problems and mortality increases from job loss amplify the long-term earnings losses. Using Austrian data, Del Bono, Weber and Winter-Ebmer (2012) report reductions in average fertility by 5–10% of women being laid-off by plant closures. Frey and Stutzer (2002) summarize evidence suggesting that that job loss and unemployment generally lead to reductions in happiness and life satisfaction.

tenure workers in Germany who lost their jobs in mass lay-offs in the 1982 recession.³

Figure 1: Effects of Displacement on Wages



Note: The figure plots the coefficients from a regression of annual wage income on years relative to displacement interacted with a dummy for whether the individual was displaced in 1993. The controls are year and worker fixed effects as well as age and age squared. The control group consists of workers who never experienced a displacement due to plant closure in their working career. Confidence intervals are defined at the 95% level and derived from standard errors clustered at the individual level. Data source: SIAB 1975–2008 (see Section 2).

Theoretically, there are at least four reasons why displaced workers experience such difficult transitions: (i) the skills specific to the old job may not be useful in the new one (Becker, 1962; Neal, 1995; Parent, 2000; Poletaev and Robinson, 2008; Kambourov and Manovskii, 2009; Gathmann and Schönberg, 2010); (ii) incentive contracts that raised earnings beyond market wages are lost with a job separation (Lazear, 1979); (iii) there is search cost associated with finding a new job (Topel and Ward, 1992); and (iv) workers who were laid-off may

³ Similar to Davis and Von Wachter (2011), we find that displacement cost vary with the overall business cycle conditions. As shown in Figure 1, the wage losses relative to pre-displacement earnings amount to 13% when a worker is laid off in 1993 (that is, a recession year). Figure A.1 displays that workers displaced from their jobs in 2000 (that is, a non-recession year) suffer wage losses of only 7%. However, despite the relatively favorable macroeconomic conditions prevailing in 2000, earnings of displaced workers do not appear to recover during the first 8 years after displacement.

be stigmatized on the labor market (Vishwanath, 1989; Biewen and Steffes, 2010).⁴ However, thus far, it is still a puzzle why most displaced workers never manage to return to their pre-displacement earnings paths.

Several empirical studies find support for the theory of specific human capital, which predicts that job switching causes wage penalties proportional to the loss of specific human capital (Podgursky and Swaim, 1987; Jacobson, LaLonde and Sullivan, 1993; Neal, 1995; Parent, 2000; Burda and Mertens, 2001; Kambourov and Manovskii, 2009; Gathmann and Schönberg, 2010). These studies use job displacements due to plant closures or mass layoffs to control for selection based on unobserved characteristics, for instance, the quality of the job match. The relative earnings losses of displaced workers have been found to be higher for industry switchers, occupational switchers, or those who switch their skill portfolios. Their findings suggest that to maximize long-term earnings workers should avoid switching to skill-unrelated jobs during their careers.

The recent additions to the skill-biased technological change literature (for instance, Goos and Manning, 2007; Autor, Katz and Kearney, 2008; Acemoglu and Autor, Forthcoming) give rise to the idea that displaced workers with occupational skills that are easily substituted by technology or prone to outsourcing may face a labor market that demands quite different skills than they provide. At the same time, exactly these groups of workers have the highest hazards of unemployment and occupational change (Nedelkoska, Forthcoming). Workers displaced as a result of technological change or production outsourcing are likely to have difficulties finding a good skill match, and thus may experience larger and more persistent earnings losses after displacement. In a structurally changing economy where job destruction mainly takes place in manufacturing and jobs are mainly created in services, many displaced workers may find it difficult to remain in skill-related occupations. Moreover, in the long run, the benefits of staying in skill-related jobs might be canceled out by the disadvantages of

⁴ Stevens (1997) shows that serially correlated displacement spells explain much of the persistence and magnitude in lowered earnings after job displacement in the U.S. Similarly, Ruhm (1991) finds that displaced workers experience higher unemployment rates for at least four years after the initial job loss event.

working in a downsizing sector. The decision to change the occupation after displacement, even when causing immediate wage penalties, can therefore be optimal if it serves as an adjustment mechanism entailing lower long-term displacement cost.⁵

Against the background of a structurally changing economy, this study investigates whether the initial wage losses of displaced workers may be mitigated, or even reversed in the long run, by occupational change. More specifically, we analyze whether there are certain types of occupational switches, for instance, changes to more skill-demanding occupations, that are particularly favorable for displaced workers.

To shed light on these questions, we use German administrative data with longitudinal information on workers and their employers covering more than 30 years of labor market history. Following Hethy and Schmieder (2010) and Schmieder, von Wachter and Bender (2010), we take plant closures as an indicator for exogenous job separations. We supplement these data with information about the occupation-specific tasks and skills from a representative worker survey. This allows us to describe skill transitions of displaced workers with far higher precision than in previous studies.

We address the potential endogeneity in occupational switching after displacement behavior in several ways. First, we focus on displaced workers with at least three years of occupational tenure. It is likely that these workers expected to remain in their occupation in the absence of a plant closure, so most of them would not have moved to another occupation voluntarily. Moreover, we control for pre-displacement earnings trends of occupational stayers and switchers (Jacobson, LaLonde and Sullivan, 1993; von Wachter, Song and Manchester, 2009; Davis and Von Wachter, 2011). If earnings fully reflect unobserved factors that determine the occupational switching decision after displacement, such as ability, creativity, or regional mobility, our estimates of earnings differences between occupational stayers and switchers will be valid. Moreover, the inclusion of worker fixed effects allows the selection into a new post-displacement occupation to depend on time-invariant characteristics.

⁵ See Phelan (2011) for an insightful discussion.

We find that displaced occupational switchers experience an average wage loss of about 8.4% relative to their pre-displacement wage, controlling for the wage growth that would have occurred in the absence of switching. However, these losses are not equally distributed among occupational switchers. Workers who move to occupations where they appear to be underqualified relative to their pre-displacement occupation manage to recover quickly from the initial wage losses after displacement. In fact, wages of underqualified switchers increase faster than the counterfactual, while the wage difference becomes significant from the twelfth post-displacement year onwards. Occupational switchers who do not appear as underqualified, however, face substantial wage penalties from changing the occupation after displacement. While overqualified switchers lose an average of 4.6% of pre-displacement earnings, workers who move to occupations that are very similar to their previous ones suffer wage losses of almost 15%. These results somewhat challenge the general finding that staying in skill-related occupations improves wages.

The remainder of the paper is organized as follows: In Section 2, we introduce the data and describe the sample restrictions. We then construct measures of skill transferability between occupations (Section 3) and show descriptive evidence on the role of occupation-specific skills in explaining the cost of job displacement (Section 4). The econometric framework is presented in Section 5. Section 6 contains the empirical results. Section 7 discusses the implications of our findings for policy and research.

2 Data and Sample

2.1 SIAB

The Sample of Integrated Labor Market Biographies (SIAB), provided by the Institute for Employment Research (IAB), allows us to track the employment and unemployment histories of displaced and non-displaced workers. These data are a 2% random sample of all German social security records, being available for the years 1975 to 2008 (Dorner et al.,

2010).⁶ Because employers are required by law to report the exact beginning and the end of any employment relationship that is subject to social security contributions, the SIAB is the largest and most reliable source of employment information in Germany. Moreover, misreporting of earnings is punishable by law, which ensures high reliability of the earnings information.

2.2 BIBB/IAB and BIBB/BAuA Surveys

The BIBB/IAB and BIBB/BAuA Surveys of the Working Population (BIBB/IAB and BIBB/BAuA Surveys) are conducted by the Federal Institute for Vocational Education and Training (BIBB), the IAB, and the Federal Institute for Occupational Safety and Health (BAuA). Its purpose, among others, is to track task, skill, and knowledge requirements of occupations in Germany. It is a repeated cross-section carried out in seven-year intervals, starting in 1979. The data cover individuals aged 16–65, who are employed in Germany at the time of the survey. The survey is a rich source of information about the types of tasks employees execute at their jobs and builds a detailed account of their general and specific education and training.⁷ For the purpose of this study, we only consider the most recent wave of the survey, 2005/06, which constitutes a sample of 20,000 individual observations.

To reduce measurement error, we drop all occupations that have less than 3 observations. This leaves us with 266 occupations. We merge the information about skill mismatch derived from the BIBB/BAuA Survey with the SIAB at the level of occupational pairs.

2.3 Sample

We define a job displacement as the event where a tenured worker is laid off in the course of a plant closure. We use the definition by Hethey and Schmieder (2010) to identify plant clo-

⁶ East Germany enters the sample in 1992.

⁷ The survey has extensively been used for labor-market research, for instance, by DiNardo and Pischke (1997), Spitz-Oener (2006), Dustmann, Ludsteck and Schönberg (2009), Black and Spitz-Oener (2010), and Gathmann and Schönberg (2010).

asures⁸. In addition to the year of closure, we also consider all job separations one year before the closure. This is in line with previous literature (for instance, Davis and Von Wachter, 2011; Schwerdt, 2011) and reflects the fact that many workers leave closing plants already some time before the official closure.

The sample contains workers displaced due to plant closure in the in the period 1975–2008 who fulfill the following conditions: (i) A worker’s pre-displacement establishment employed at least 10 workers two years prior to the closure, to avoid cases where individual workers significantly contribute to the bad fortune of the establishment. (ii) Workers between 18 and 60 years of age.⁹ (iii) Workers with at least three years of occupational tenure before displacement. (iv) Workers who were displaced only once in the period 1975-2008.¹⁰

Non-displaced workers are those who never experienced a displacement in their work history. An occupational switch occurs if a worker moves between any of the 266 3-digit occupations. Overqualified workers are those who switch to occupations where their skill redundancy is more than two months longer than their skill shortage. Underqualified workers, on the other hand, switch to occupations where their skill shortage is more than two months longer than their skill redundancy. Moves to highly-related occupations, that is, occupations where the difference between skill shortage and redundancy is at most two months, are defined as lateral switches.¹¹ Section 3 provides the definitions of skill shortage and skill redundancy.

The sample counts 16,400 displaced workers whose employment, unemployment, and non-participation history is followed for twenty years on average. Out of the sample of displaced workers, 12,828 stay in the same 3-digit occupation after displacement, and 3,502 switch to

⁸ That is, we restrict the sample of displaced workers to only include displacement events where more than 80% of all workers were laid off in a given year, requiring that not more than 20% of the leaving workers were re-employed together in the following year.

⁹ Because their labor-market histories are left-censored, we do not consider individuals who enter the sample in 1975 and are older than 21.

¹⁰ 85% of all displaced workers avoid additional displacements in their work history. Thus, serially correlated displacement spells seem not to play a major role in explaining the prolonged earnings losses of displaced workers in Germany.

¹¹ We also experimented with cutoffs of one or three months. The results were qualitatively similar to those reported below.

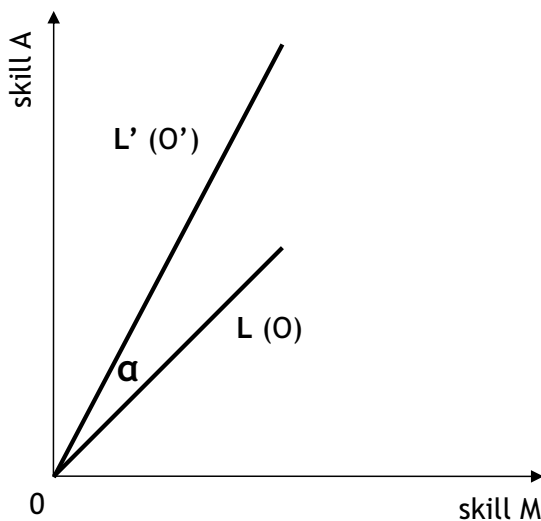
another occupation. Within the group of switchers, 1,257 individuals move to occupations where they are underqualified, and 980 individuals switch to occupations where they are overqualified. The remaining 1,265 switchers are lateral switchers.

3 Measures

3.1 Measurement of Skill Mismatch

We assume that each occupation has a specific skill profile. A skill profile expresses the level of mastery that is required to be able to fulfill the tasks associated with a job consisting of k general skills. Accordingly, an occupation's skill profile can be depicted as a k -dimensional skill vector. In Figure 2, we show an example of two different occupations O' and O , which use $k = 2$ different skills. As can be seen from the positions of the skill vectors, L' and L , both occupations require similar levels of skill M, but occupation O' demands about twice as much of skill A as occupation O . In other words, O does not only involve a different skill mix than O' , but also different skill levels. This difference in the skill levels between jobs introduces asymmetries in the transferability of human capital between occupations.

Figure 2: Skill Profiles of Occupations O' and O in a Two-Dimensional Skill Space



The occupation-specific information on both the levels and mix of required skills can be combined in a number of ways to construct measures of skill shortage and skill redundancy between occupations. One straightforward approach is illustrated in Figure 3. The figure illustrates the skill mismatch for the hypothetical case that a worker moves from O' to O . For each skill dimension, one can subtract the skill factor length associated with the current occupation, f_{ko} , from that of the previous one, denoted by $f_{ko'}$, to obtain the skill factor difference:

$$f_{k,o'o} = f_{ko} - f_{ko'}$$

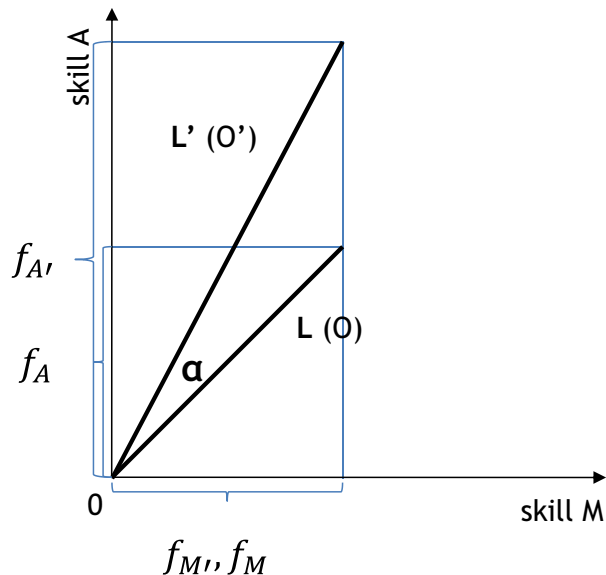
Skill redundancy is then defined as the length of the vector determined by the negative skill factor differences. Likewise, skill shortage is the length of the vector defined by the positive skill factor differences.

$$redund_{o'o} = \sqrt{\sum_{k=1}^n (f_{k,o'o})^2} \text{ if } f_{k,o'o} < 0$$

$$short_{o'o} = \sqrt{\sum_{k=1}^n (f_{k,o'o})^2} \text{ if } f_{k,o'o} > 0$$

We can use Figure 3 to illustrate an example. A job move from O' to O will on average incur a skill shortage of zero, because employees in O' are at least as qualified as those in O in both skills. At the same time, the skill redundancy of such move will equal $f_{A'} - f_A$. In contrast, a move from O to O' results in a skill shortage of $f_{A'} - f_A$, with zero redundancy.

Figure 3: Skill Shortage and Skill Redundancy



We operationalize the conceptual idea described above in a six dimensional skill space. To derive the skill dimensions from the data, we select 53 questions about job tasks, knowledge, and work conditions from the 2005/2006 wave of the BIBB/IAB and BIBB/BAuA Surveys. We average the answer scores across individuals within the same occupation to capture the occupation-specific skill structures. Variables that are given on a Likert scale are transformed into a binary scale, because we are only interested in whether a particular task is present or absent, irrespective of the intensity of use.¹² We conduct a principal component analysis on these variables, which results in six orthogonal factors with eigenvalues above one, which altogether capture 79% of the variance in the data. We associate these factors with cognitive, technical, interactive, commercial, production, and security-related skills.¹³ Table A.1 contains the factor loadings on the 53 questions. Following Poletaev

¹² Intensities of job tasks are self-reported in the BIBB/IAB and BIBB/BAuA data. Closer inspection of these data reveals that people seem to make erroneous judgments. This is due to the fact that most individuals are unaware of the true task distribution in the population; they mainly compare the tasks they fulfill with the tasks in jobs they know of.

¹³ Previous work that uses the task-based approach to capture the relevant dimensions of the task content of jobs typically identifies three to four groups of tasks. Autor, Levy and Murnane (2003) and Spitz-Oener

and Robinson (2008), these factors are rescaled to start at zero, such that they compose a six-dimensional coordinate system. This provides us with vectors whose elements contain the percentile positions of an occupation on each skill factor.

People are likely to take their own job as a frame of reference when reporting their job tasks. Thus, we interpret the task intensities relative to the intensity of other tasks in the job, and not relative to how intensely the task is used in other occupations. We therefore normalize the vectors to have unit length. As a last step, we add information on the complexity of an occupation’s task profile by multiplying the vectors with the average number of years of schooling employees in the occupation have.¹⁴ Thus, the units in which skill shortages and redundancies are measured reflect the number of years of schooling that are lacking or idle. Following this procedure, we find, for instance, that an occupational switch from metal moulder to an electrical engineer results in 7.8 years of skill shortage and about half a year of redundancy. Accordingly, a worker who switches in the opposite direction incurs half a year of skill shortage and 7.8 years of skill redundancy.

As a result, each occupation can be depicted as a vector in the six-dimensional coordinate system, and each vector is characterized by its position and length. The position depends on the presence or absence of the six general skills mentioned above, and the length of the vector corresponds to the average education in each occupation.

3.2 Types of Occupational Switch

People are seldom only overqualified or only underqualified when switching occupations. Most often, they are skilled in areas that are not needed for the job, and underskilled in areas relevant for the job. To capture this, our measures of skill mismatch between

(2006) distinguish between routine cognitive, routine manual, non-routine cognitive, and non-routine manual. Goos, Manning and Salomons (2009) and Gathmann and Schönberg (2010) differentiate between abstract, routine/manual, and service tasks.

¹⁴ The BIBB/IAB and BIBB/BAuA data contain information on the exact number of months an individual spent on tertiary and university education. To that, we add the number of years that correspond to the highest level of secondary education the individual acquired, excluding primary school; Hauptschule and Realschule are both counted as yielding 5 years of education and Abitur represents 9 years of education.

occupations depend on both, skill shortage and skill redundancy. If skill shortage in the post-displacement occupation exceeds skill redundancy by more than two months, we regard a worker as underqualified. If skill shortage is smaller than skill redundancy by more than two months, a worker is overqualified. If an occupational switch is such that the skill shortage-skill redundancy difference is at most two months, we define it as a lateral switch.

A further advantage of this approach to skill mismatch is that, unlike measures of over- and underqualification that are solely based on educational requirements (see Leuven and Oosterbeek, 2011, for an overview), it additionally takes into account the qualitative differences in skills. This means that our measures also capture skill mismatch between occupations that need the same years of formal education but require different sets of skills.

4 Descriptive Evidence

Average values of our main demographic and economic variables are shown separately for stayers and switchers and by type of switch in Table 1. The economic variables are evaluated two years prior to the displacement year. For occupational switchers, we additionally show the mean skill shortage, skill redundancy, and qualification between the pre- and post-displacement occupation. Stayers appear remarkably similar in their labor market characteristics to switchers, only having slightly higher daily wages and a somewhat higher labor market attachment as indicated by the days worked. The annual wages of stayers are modestly higher than those of switchers. There are also some differences in the personal characteristics. A larger share of stayers is female, stayers are less likely to be employed in the primary or secondary sector prior to displacement, and they possess a university degree more often. While skill mismatch is by definition zero for stayers, switchers on average incur 2.5 years of skill shortage and 2.6 years of skill redundancy when changing the occupation. Thus, the average occupational switcher is slightly overqualified.

When distinguishing between different types of occupational moves, some differences

to the stayers become apparent. Underqualified switchers are somewhat younger and less educated than stayers. They also have lower wages. Overqualified switchers are better educated and are more likely to be employed in East Germany than stayers, and earn almost the same wages. Moreover, a higher share of overqualified switchers is male. Compared to stayers and other types of switchers, lateral switchers are most often working in the primary or secondary sector. Moreover, lateral switchers earn least.

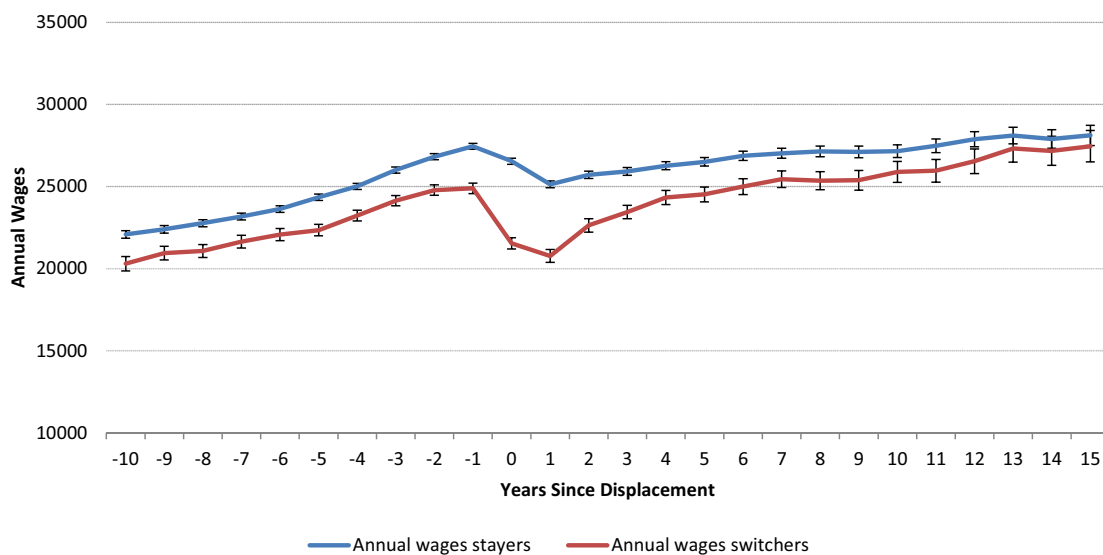
Table 1: Descriptive Statistics of Displaced Workers

	Stayers	Switchers	Overqualified	Switchers Underqualified	Lateral
Personal characteristics:					
% Male	58.07	64.76	68.53	63.55	61.26
% West	89.58	87.46	85.59	88.99	86.27
Age	36.44	35.1	35.47	34.44	35.38
% University graduates	10.21	9.40	13.09	6.26	8.22
% Primary or secondary sector	43.91	56.04	49.52	49.31	66.32
Labor market characteristics (Two years prior to displacement):					
Mean daily wages (€)	72.75	69.01	71.74	67.69	65.28
Annual wages (€)	26,344	24,975	25,936	24,387	23,651
Annual income (€)	26,496	25,105	26,152	24,582	23,807
Days worked	335	351	350	346	348
Days worked full-time	321	332	329	322	333
Total years of unemployment	0.35	0.36	0.38	0.39	0.37
Skill mismatch measures:					
Skill shortage		2.48	2.95	4.96	0.38
Skill redundancy		2.60	4.99	3.02	0.38
Qualification		-0.11	-2.05	1.94	0.00

Note: All monetary values are expressed in Euros in 2000 prices. Annual income is annual wages plus unemployment insurance payments. See Section 3 for the definitions of overqualified, underqualified, and lateral occupational switches.

Next, we now compare the annual wage dynamics and days worked for workers who stay in their pre-displacement occupation and those who switch occupations. Figure 4 shows that stayers earn significantly more than switchers before displacement, with the wage trends running in parallel. In the first years after displacement, stayers again earn significantly more than switchers. However, the wage trends of the two groups change after displacement as wages of switchers now increase faster than those of stayers.¹⁵

Figure 4: Annual Wages of Displaced Workers: Occupational Stayers vs. Switchers



Note: This figure shows labor earnings by year for workers who were laid off in plant closings. Wages are measured in Euros in 2000 prices. The x-axis displays years since displacement, so displacement takes place in year 0. The upper line shows wages for workers who remain working in their pre-displacement occupation in their next employment spell (stayers). The bottom line shows wages for workers who change their pre-displacement occupation when re-entering the labor market after displacement (switchers). Confidence intervals are defined at the 90% level.

Moreover, as evidenced in Figure 5, we observe that the difference in annual wages between stayers and switchers is mainly driven by the reduction in the days worked around the time of displacement. The difference in supplied days of work between stayers and switchers drastically increases shortly before and immediately after displacement, which translates into a large drop in the annual wages of occupational switchers.

¹⁵ A similar pattern emerges when we account for unemployment insurance benefits in addition to wages.

Figure 5: Days Worked of Displaced Workers: Occupational Stayers vs. Switchers



Note: The figure displays annual days worked for occupational stayers (top line) and occupational switchers (bottom line). See Figure 4 for details.

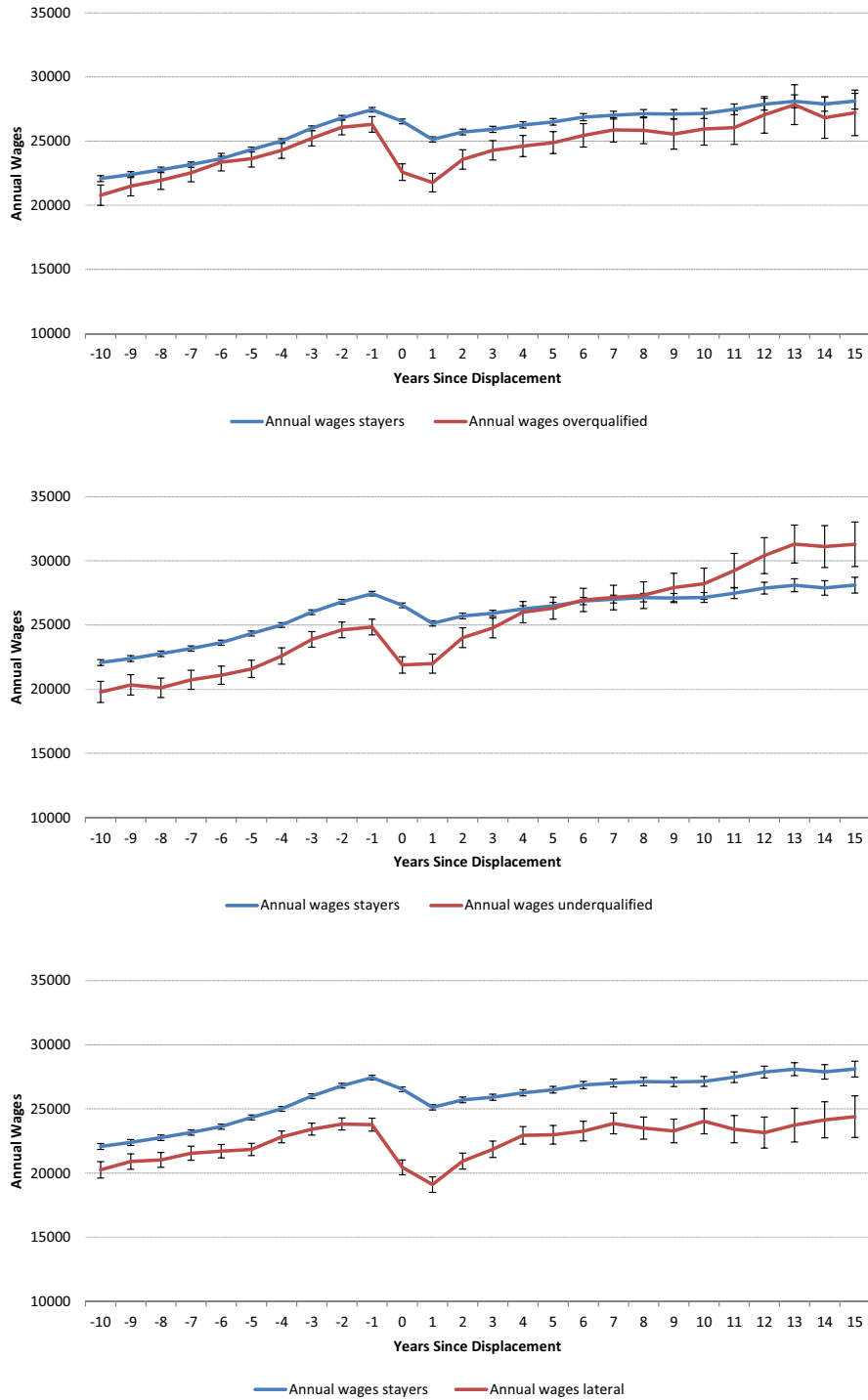
We now analyze the wage dynamics by type of occupational switch. Figure 6 depicts the annual wages of stayers and compares them to those of overqualified, underqualified, and lateral occupational switchers, respectively. As shown in the top panel, after experiencing significantly larger wage losses than stayers shortly before and immediately after displacement, overqualified workers start to catch up to the earnings of stayers. In fact, the earnings trends of overqualified switchers and stayers after displacement appear very similar to those before displacement.

The middle panel in Figure 6 indicates that underqualified switchers are primarily responsible for the convergence in wages between stayers and switchers after displacement (see Figure 4). Before displacement, underqualified switchers earn less than stayers, and similar wage trends for both groups suggest that this earnings gap would have remained stable in the absence of displacement. However, after displacement, underqualified switchers first quickly catch up to the wages of stayers, and even start earning more than them after a few years.

The lower panel in Figure 6 displays that lateral switchers perform worst in terms of earn-

ings, both before and after displacement. Moreover, the wage gap between lateral switchers and stayers tends to widen after displacement.

Figure 6: Annual Wages of Displaced Workers by Type of Occupational Switch

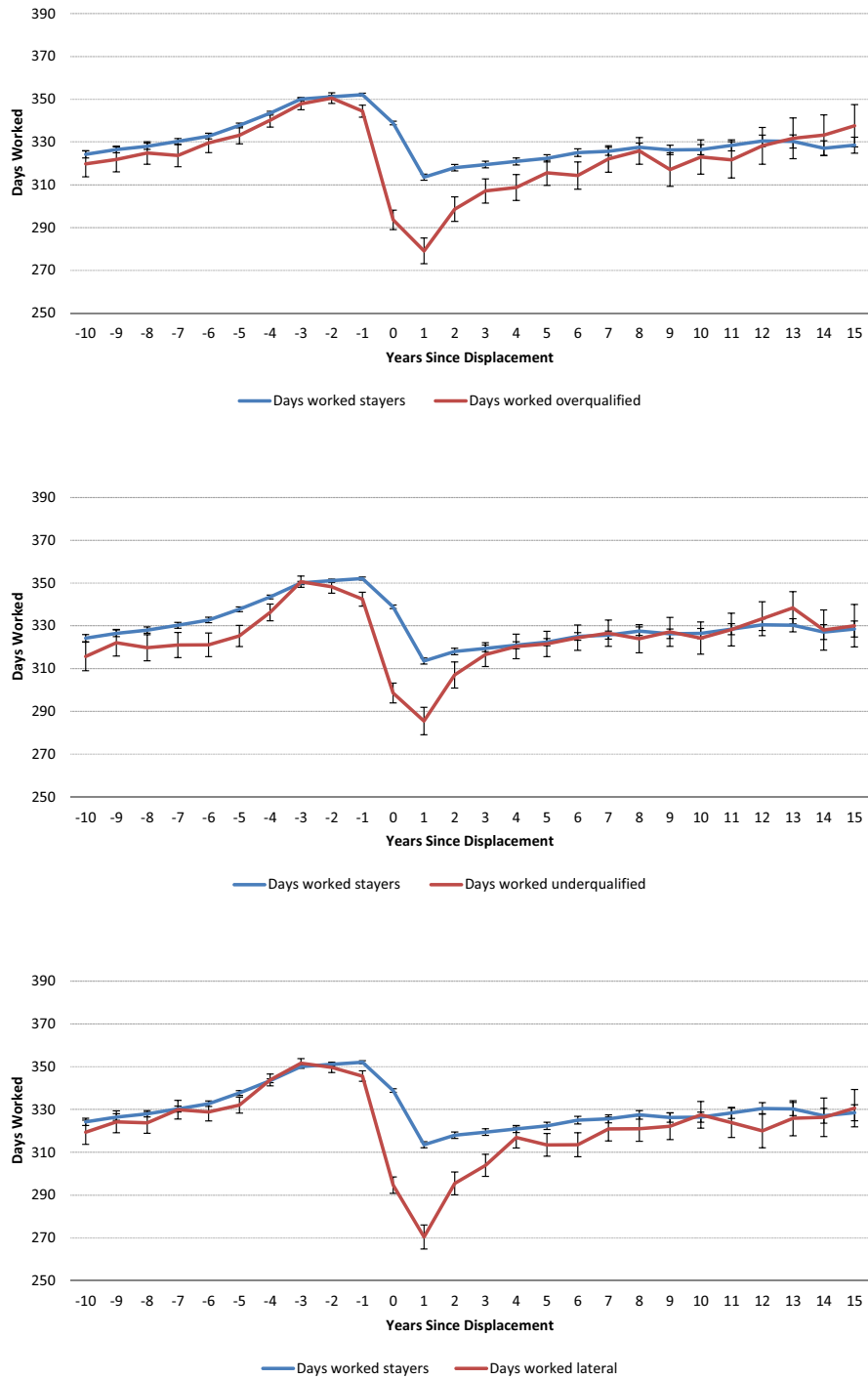


Note: This figure plots the annual labor earnings of workers who differ in the type of occupational switch after job displacement. In the top (middle, bottom) panel, occupational stayers are compared to overqualified (underqualified, lateral) occupational switchers. See Section 3 for the definitions of the types of switches. Figure 4 provides further information on the construction of annual wages.

Figure 7 indicates that the total wage differences between stayers and the various types of occupational switchers are not due to a reduction in days worked. Switchers quickly manage to close the gap in annual days worked that opened at the time of displacement.¹⁶ Thus, the post-displacement wage development of switchers *vis-à-vis* stayers is mainly driven by daily wages.

¹⁶ The steep reduction in days worked that we observe for switchers after the job loss is not surprising, because changing the occupation often requires re-qualification. See also Figure 8 below.

Figure 7: Days Worked of Displaced Workers by Type of Occupational Switch



Note: This figure compares the days worked by year of workers staying in their pre-displacement occupation after displacement with those of displaced workers who are overqualified (top panel), underqualified (middle panel), or lateral (bottom panel) occupational switchers.

We now shed some light on the structural dynamics of displaced workers. In Figure 8, we compare the highest educational degree at the point of displacement with the attained education at the first post-displacement job. We do this comparison for all displaced workers and separately by the type of switch. It is apparent that the average displaced worker upgrades her education before entering a new job. This pattern, however, is much more pronounced for switchers. While the share of displaced workers holding a secondary school degree as highest educational achievement decreases by 2.3% after displacement, approximately 4.7% of displaced switchers upgrade from a secondary school degree.

Figure 8 further indicates that many displaced workers get some type of vocational training after displacement, which is reflected in the opposite growth patterns of (i) secondary education *vis-à-vis* secondary education with vocational training; and (ii) upper secondary education *vis-à-vis* upper secondary education with vocational training. Underqualified switchers mainly upgrade from secondary and upper secondary education to upper secondary education with vocational training and university, respectively. In particular, a relatively high share of underqualified switchers acquires a degree from universities of applied sciences. On the other hand, overqualified switchers often reappear in the labor market after displacement having obtained secondary education with vocational training or a university degree.

Figure 8: Change in the Highest Educational Achievement Before and After Displacement

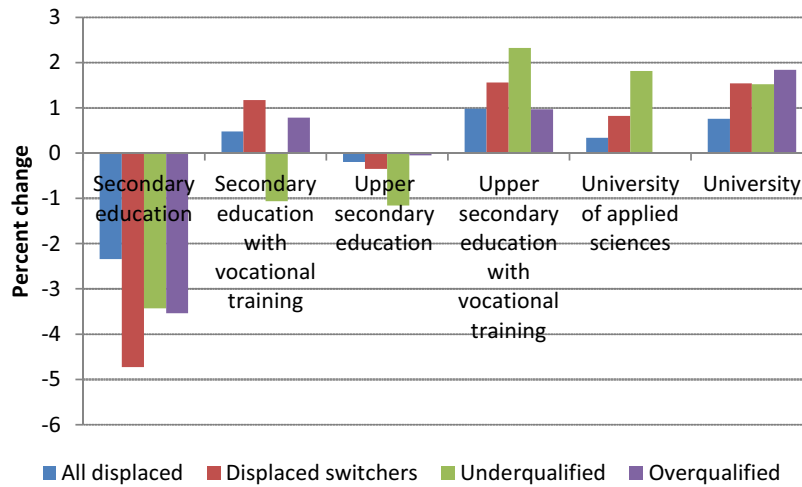
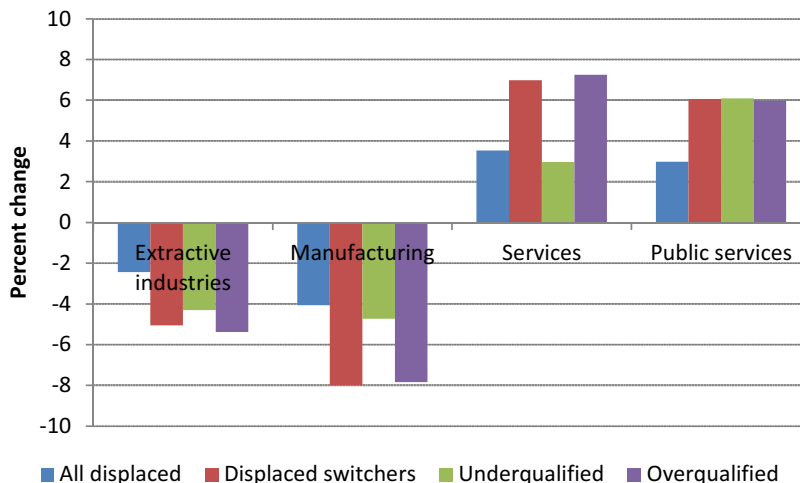


Figure 9 shows a major post-displacement employment shift from extractive industries, including construction, and manufacturing toward services and public services. Perhaps not surprisingly, this shift is more pronounced for occupational switchers than for stayers. Comparing over- and underqualified switchers, the figure suggests that overqualified switchers leave the primary sector—and, to an even larger extent, the secondary sector—more often than their underqualified counterparts. Moreover, while after displacement both over- and underqualified switchers equally increase employment shares in the public sector (which also includes healthcare and education), underqualified switchers are much less likely to move to the private services.

Figure 9: Change in Industries Before and After Displacement



5 Empirical Strategy

To estimate differential earnings effects of displaced occupational stayers vs. displaced occupational switchers, we employ the approach taken in the program-evaluation literature (for instance, Ashenfelter, 1978; Ashenfelter and Card, 1985) by defining a treatment group (displaced switchers) and a control group (displaced stayers).¹⁷ Our identification strategy is based on the assumption that, conditional on workers fixed effects, pre-displacement earnings trends, and further observable worker characteristics, workers in the control group are observationally equivalent to those in the treatment group. In particular, if both occupational stayers and switchers are on average remunerated according to their productivity, then the pre-displacement earnings trend should appropriately reflect their overall earnings potential. In this case, our difference-in-differences strategy accounts for occupational selection and yields a valid estimate of the differential effect of displacement between occupational stayers and switchers.¹⁸

¹⁷ We applied the same difference-in-differences methodology for the comparison of annual wages of displaced and non-displaced workers, as shown in Figures 1 and A.1. See also, among others, Jacobson, LaLonde and Sullivan (1993) and Schmieder, von Wachter and Bender (2010).

¹⁸ Pre-treatment wages have previously been used to control for selection. Ashenfelter and Card (1985) account for pre-training earnings to correct for the fact that participants in training programs experience a

We estimate the following regression based on a sample that includes only displaced workers:

$$y_{it} = \alpha_i + \gamma_t + X'_{it}\beta + \sum_{k \geq -8} D_{it}^k \delta_k + \varepsilon_{it}, \quad (1)$$

where y_{it} is annual wage of individual i at time t . The inclusion of worker fixed effects, denoted by α_i , controls for heterogeneity across workers and allows the selection into occupational switching to depend on time-invariant characteristics. γ_t are calendar time effects, which account for macroeconomic effects affecting all workers. The vector X_{it} consists of the observed, time-varying characteristics of the worker, such as age and age squared.¹⁹ ε_{it} is the error term.

D_{it}^k is an indicator of worker i at time t being displaced in year $t - k$ and having changed the occupation in the employment spell following displacement.²⁰ Depending on the specification, the dummy variables D_{it}^k identify all, overqualified, underqualified, or lateral occupational switchers. The formulation of the dummy variable implies that a displaced switcher in 1993 faced the same situation in 1996 as a displaced worker switching in 2000 did in 2003; thus, we estimate the average wage effect of switching occupations after displacement. The coefficients δ_k measure the time path of annual wages of occupational switchers before and after switching relative to the baseline²¹ and control group. Workers in the control group also fulfill the sample selection criteria described in Section 2, but stayed in their

decline in earnings prior to the training period. In the context of sorting induced by redistribution policies, Abramitzky (2009) argues that wages well capture individual characteristics that influence selection. McKenzie, Gibson and Stillman (2010) control for pre-migration wages to investigate earnings gains from migration. They find that the resulting difference-in-differences specification comes reasonably close to the results gained by experimental data.

¹⁹ The results shown below continue to hold when we control for pre-displacement industry fixed effects; that is, when we include dummy variables for extractive industries, manufacturing, services, and the public sector. The industry dummies account for the possibility that declining industries exhibit negative trends in earnings and at the same time force workers to leave the industry (and the occupation) due to vanishing employment opportunities there.

²⁰ Switchers can have an unemployment or non-participation spell in between the pre- and post-displacement employment spells. We only restrict switchers to be working in an occupation other than the pre-displacement occupation in their first job after displacement.

²¹ The baseline is annual wages in years nine and ten before displacement. These wages identify the worker fixed effects.

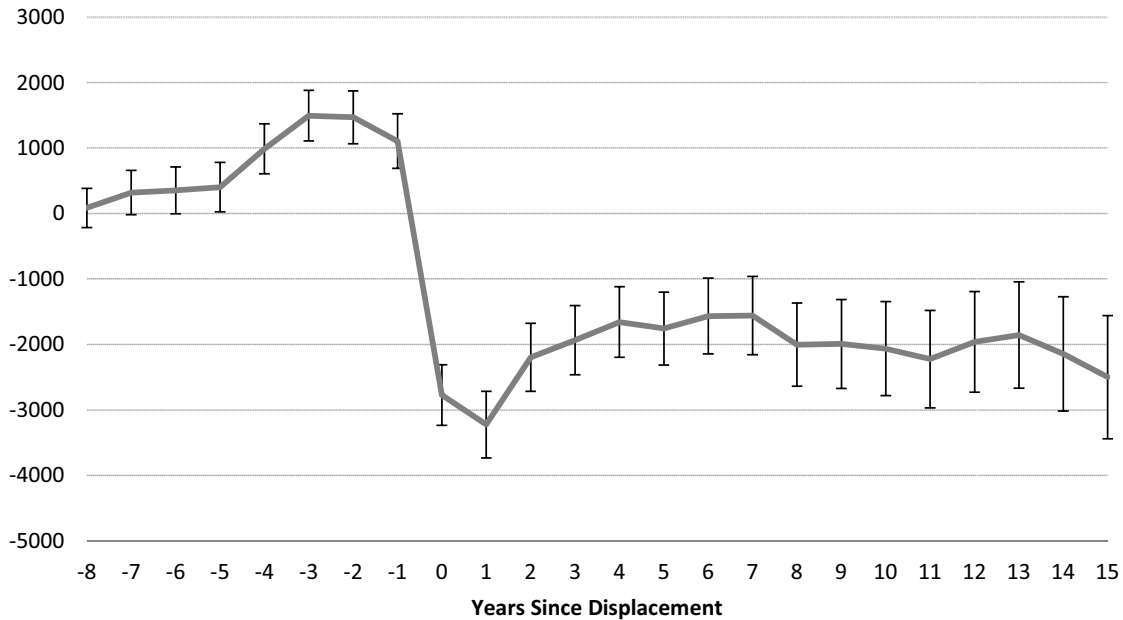
pre-displacement occupation after losing their job due to plant closure.

6 Results

The results of the regression analysis for the evolution of annual wages of displaced occupational switchers relative to displaced stayers are shown in Figure 10. It is straightforward to see that displaced workers who switch occupations suffer substantial wage losses. One year after displacement, the wages of switchers have dropped by 3,200 Euros, or 13% of pre-displacement wages. There is some recovery over time but even 15 years after displacement, the annual wages of switchers are almost 2,500 Euros below the counterfactual. On average, the wage losses amount to 8.4% of the pre-displacement wages. This is in line with the results of Kambourov and Manovskii (2009), who find that displaced workers in the U.S. who switch occupations experience 12% larger losses than those who stay in the same occupation. Our results complement these findings, because we can observe the wage dynamics over a long post-displacement time window.²²

²² The wages of occupational switchers exhibit a downward trend already about two years before displacement. Jacobson, LaLonde and Sullivan (1993), Schmieder, von Wachter and Bender (2010), and Davis and Von Wachter (2011) find a similar pattern when comparing annual wages of displaced and non-displaced workers.

Figure 10: Annual Wages of Displaced Switchers Relative to Stayers



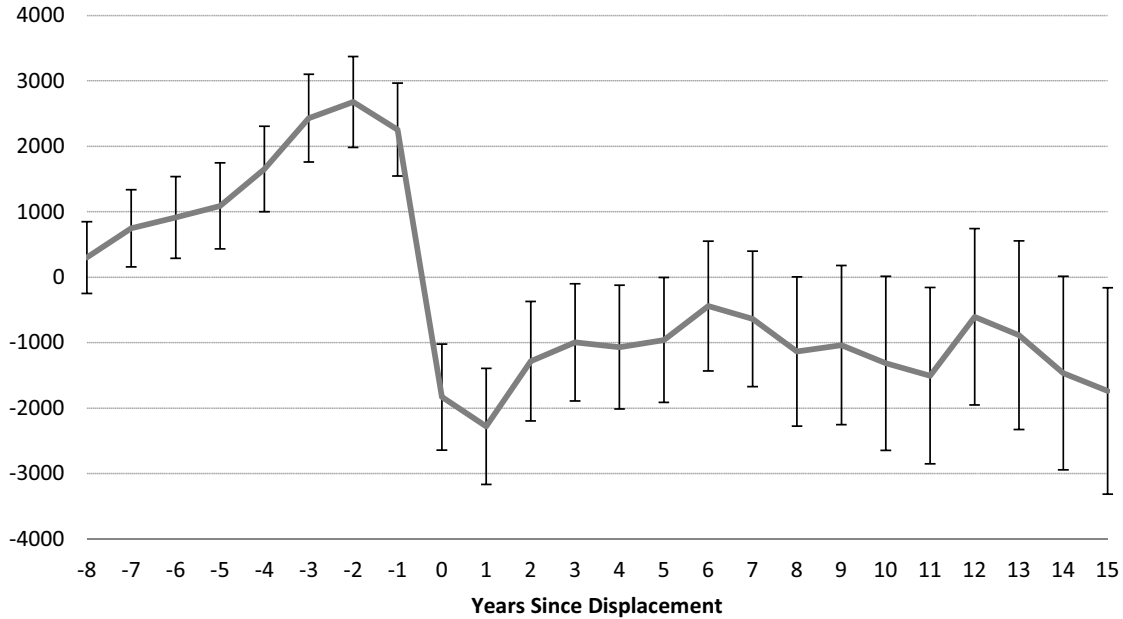
Notes: The figure plots coefficients from a regression of annual wages on years relative to displacement interacted with a dummy for whether the person switches occupation after displacement. Displaced stayers remain in their pre-displacement occupation after the job loss, while switchers change their occupation. Included controls are calendar time and individual fixed effects as well as age and age squared. The confidence intervals are defined at the 95% level, derived from standard errors clustered by individual.

The results thus far draw a rather pessimistic picture for workers who are forced to leave their occupation due to structural change or for other reasons. However, occupational moves are heterogeneous: some displaced workers move to occupations with very similar skill requirements (lateral moves), others move to occupations that require more skills than their previous occupation (underqualified moves), and yet others switch to occupations that demand fewer skills than the pre-displacement occupation (overqualified moves). We now provide evidence that the wage losses of occupational switchers depend on the type of switch.

Figure 11 presents annual wages of overqualified switchers relative to the baseline and control group consisting of occupational stayers. The figure clearly demonstrates that overqualified switchers incur substantial wage losses due to their switching behavior after losing the job. In the first year after displacement wages drop sharply by about 2,300 Euros, which

corresponds to a loss of 8.8% of annual pre-displacement wages. Just as in the case of all switchers, the wages only partially recover; 15 years after displacement, the estimated losses of overqualified switchers are almost 1,800 Euros. The average estimated wage losses associated with overqualification amount to 4.6%.

Figure 11: Annual Wages of Displaced Overqualified Switchers Relative to Stayers



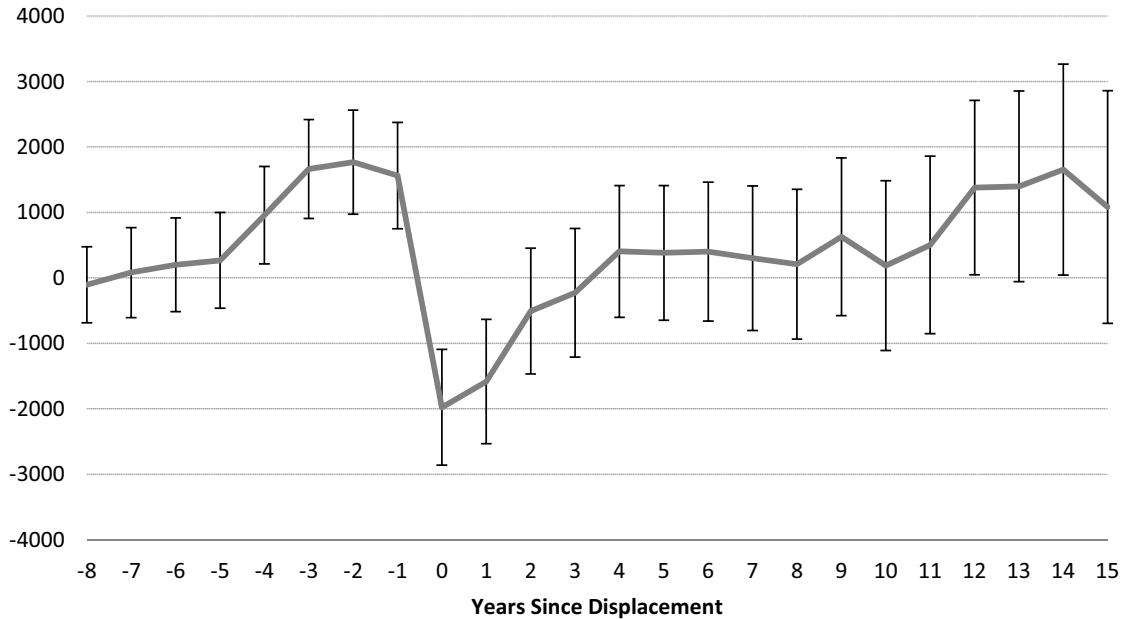
Notes: his figure plots coefficients from a regression analogous to that underlying Figure 10, but only considers overqualified switchers instead of all switchers. Overqualified switchers are those who switch to an occupation where skill redundancy exceeds skill shortage for more than two months.

Underqualified occupational switchers, however, manage to largely avoid the losses that an average occupational switcher suffers from. Although, as displayed in Figure 12, wages of underqualified switchers decrease by almost 1,600 Euros (or 6.5% of pre-displacement wages) in the first year after displacement, they recover very quickly. From the twelfth year after displacement onwards, underqualified switchers are even gaining relative to the counterfactual.²³ On average, workers enjoy a modest wage advantage of about 1% from

²³ Without controlling for age, wages of underqualified switchers start to exceed counterfactual wages in the fourth year after displacement. This result suggests that age differences between underqualified switchers and occupational stayers are responsible for much of the wage advantage enjoyed by underqualified switchers after displacement (see Figure 6).

moving to occupations where they are initially underqualified.

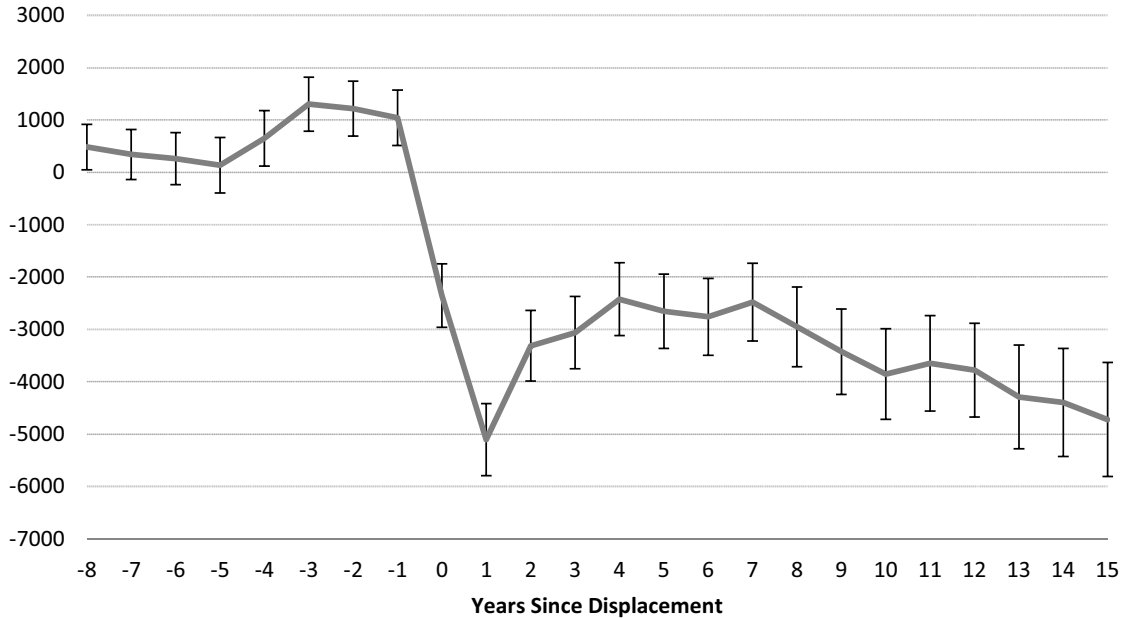
Figure 12: Annual Wages of Displaced Underqualified Switchers Relative to Stayers



Notes: In this figure, annual wages of occupational stayers are compared to those of the sub-sample of underqualified switchers. We define the latter as workers who, after displacement, move to an occupation with skill shortage longer than skill redundancy for more than two months.

The group that fares worst after job displacement are the lateral occupational switchers. Figure 13 shows the wage profile of lateral switchers relative to occupational stayers. Wage losses at displacement are very large initially, 5,100 Euros (corresponding to 22% of pre-displacement wages) in the first year after displacement. After a mild recovery until year 4, wages of lateral switchers start to diverge again. During our period of observation, average wage losses are about 14.6%.

Figure 13: Annual Wages of Displaced Lateral Switchers Relative to Stayers



Notes: The figure shows the annual wage development of lateral switchers relative to that of occupational stayers. Occupational switchers are defined as lateral when their first post-displacement occupation exhibits a skill shortage-skill redundancy difference of not more than two months.

We believe that our results yield a good first approximation of the causal effect of switching occupations after job displacement on wages. However, a potential concern with estimates obtained from the model in equation (1) is that they do not allow for differential trends among displaced switchers and workers in the control group. To gain further confidence that occupations stayers and switchers would evolve similar in the absence of job displacement, we plan to include worker-specific linear trends in a future version of the paper (see also Ashenfelter and Card, 1985; Jacobson, LaLonde and Sullivan, 1993; Stevens, 1997).

7 Conclusions

Human capital is occupation-specific (Poletaev and Robinson, 2008; Kambourov and Manovskii, 2009). This finding suggests that to maximize long-term earnings workers should avoid switching to skill-unrelated jobs during their careers. However, in a structurally changing

economy where job destruction mainly takes place in manufacturing and jobs are newly created in services, many workers who involuntarily lose their job may find it difficult to remain in a skill-related occupation after displacement. In this paper, we investigate under which conditions occupational change does indeed lead to long-term wage losses, and whether certain types of occupational switches can even promote the careers of displaced workers. More specifically, we propose that the degree of overlap between the worker's acquired human capital and the skill requirements of the targeted occupation is an important mechanism behind the large and persistent earnings effects of job displacements.

We empirically test this idea by exploiting German administrative data with longitudinal information on the employment and unemployment histories of individuals subject to social security in the period 1975–2008. We use these data to identify workers who were permanently separated from their previous employer in the course of a plant closure. To measure the skill requirements of occupations, we use a large representative survey on the tasks performed at the job. We derive a unique characterization of the more than 260 occupations covered by our data, along the following skill dimensions: cognitive, technical, interactive, commercial, production and security-related.

We find that the cost of job displacement is sensitive to both the direction and distance of occupational switches after displacement. Workers who move to occupations where they appear to be underqualified relative to their pre-displacement occupation manage to recover quickly from the displacement-induced wage losses. In fact, wages of underqualified switchers increase faster than the counterfactual. Overqualified occupational switchers, in contrast, are subject to long-lasting wage penalties, which amount to an average of 4.6% of the pre-displacement wages. Moreover, the annual wages of overqualified switchers do not show any sign of recovery even 15 years after job displacement. However, the most pronounced losses from job displacement are borne by lateral switchers, who incur an average wage disadvantage of almost 15%.

Our results suggest that requalification policies after displacement should be designed

such that people can acquire more skills, which should not necessarily be related to the previous occupation. Post-displacement occupational moves that leave a large part of the previously acquired skills idle lead to substantial earnings losses without an apparent tendency for recovery.

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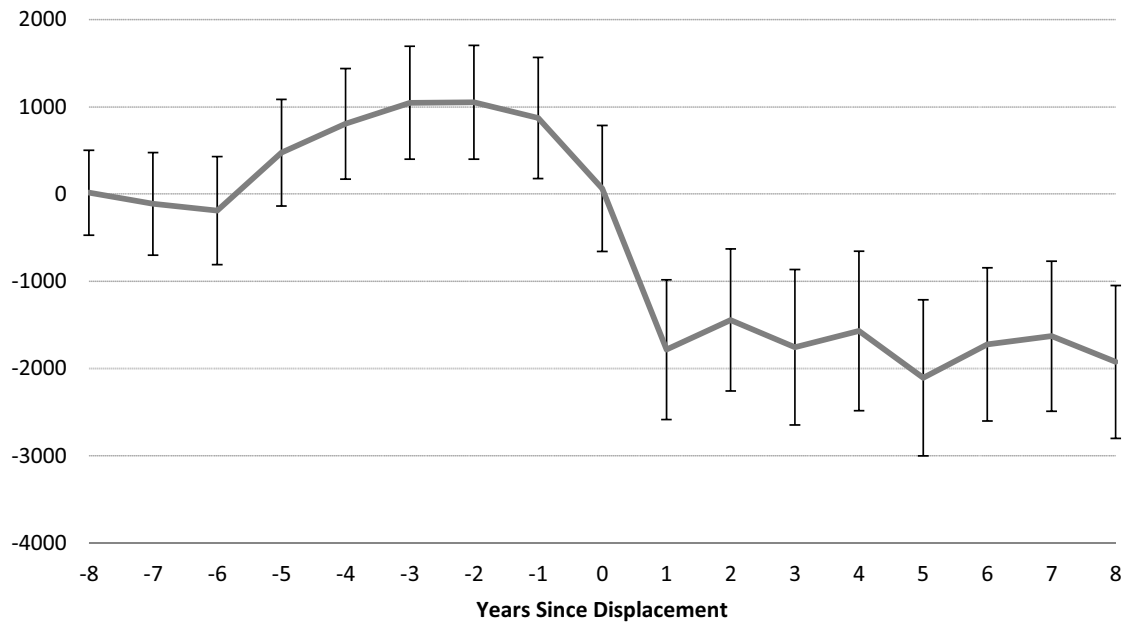
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A Appendix

Figure A.1: Effects of Displacement on Wages: Displacement Year 2000



Notes: The regression underlying this figure is similar to that performed to construct Figure 1. However, we here only consider displacements due to a plant closure in the year 2000.

Table A.1: Factor loadings

	Cognitive	Technical	Interactive	Commercial	Production	Security
Tasks:						
Production of goods	-0.5164	0.2698	-0.1196	-0.0377	0.3062	0.0738
Measuring, checking, quality control	-0.312	0.5935	-0.0438	0.0193	0.3643	0.0257
Monitoring, operating of machines	-0.5159	0.4212	0.0008	-0.3061	0.2779	0.2664
Repair, maintenance	-0.3021	0.6288	0.085	0.1346	-0.132	-0.1604
Purchase, procurement, sales	0.2601	-0.0385	0.2298	0.7052	0.2117	0.1044
Transport, storage, distribution	-0.3692	0.1024	0.2355	0.2905	0.0343	0.2356
Advertising, marketing, PR	0.4479	-0.2334	0.0462	0.3349	-0.0826	0.1637
Organize, plan, prepare work processes	0.4884	0.2954	0.1703	0.1547	0.0591	0.0175
Develop, plan, design	0.4526	0.3081	-0.337	-0.0247	0.1527	-0.2592
Educate, teach, raise	0.5314	0.1002	0.4148	-0.1933	0.0636	-0.1936
Collect information, research, document	0.8232	0.0484	-0.0573	-0.0978	0.0701	0.0395
Consult, inform	0.7969	-0.0065	0.2251	0.1943	-0.0163	0.087
Serve, accommodate, prepare food	0.0107	-0.2165	0.4189	0.0806	0.2114	0.087
Care, parent, cure	0.3187	-0.0401	0.6343	-0.2007	0.3203	-0.1493
Secure, protect, guard, monitor, regulate traffic	-0.0369	0.2645	0.3327	-0.2895	0.0555	0.2705

Work with computers	0.667	0.04	-0.4008	-0.149	0.1888	0.2675
Cleaning, collect trash, recycle	-0.4842	0.0819	0.3889	0.0933	0.3212	0.0509
Computer programming	0.3586	0.2781	-0.3745	-0.1349	0.0983	0.0042
Solving unforeseen problems	0.59	0.3805	0.1762	-0.226	-0.1398	0.0845
Simple presentation of difficult situations	0.9021	0.0888	0.1412	-0.068	-0.0927	-0.0545
Persuade, negotiate compromise	0.8096	0.09	0.2235	0.0046	-0.194	0.0457
Independently making difficult decisions	0.644	0.3114	0.1941	0.0315	-0.1192	0.0844
Finding and closing own knowledge gaps	0.5921	0.1041	-0.0033	-0.2116	-0.1178	0.1389
Speeches, presentations	0.7495	-0.0656	0.1987	-0.2251	-0.1915	-0.1029
Contact with customers and patients	0.6734	-0.2105	0.3597	0.3826	-0.0384	-0.0129
Performing many different tasks	0.4873	0.3056	0.2288	0.1621	0.0412	0.1491
Responsibility for the welling of other people	0.5507	-0.0168	0.6344	-0.097	0.1156	0.0516

Knowledge:

Natural sciences	0.4218	0.3805	0.0342	-0.0043	0.3545	-0.2249
Manual, technical	-0.3717	0.6251	0.0848	0.2968	-0.0607	-0.2711
Pedagogy	0.531	-0.0272	0.4433	-0.2232	0.0001	-0.2797
Law	0.5502	0.0014	0.1387	-0.1149	-0.1867	0.1607
Project management	0.6473	0.2478	-0.266	0.1097	0.0219	-0.0498

Medicine and healthcare	0.327	0.018	0.4789	-0.1245	0.4009	-0.1961
Layout, composition, visualization	0.3293	0.1031	-0.2628	0.1697	-0.013	0.0037
Mathematics, statistics	0.2784	0.5522	-0.2108	0.3086	0.0883	-0.1153
German, writing, spelling	0.7954	0.0057	-0.0979	0.0218	-0.1044	0.0609
PC applications	0.547	0.1487	-0.4747	0.1326	0.0789	0.0045
Technical	-0.0019	0.7723	-0.2245	0.1441	0.0918	-0.1558
Business administration	0.4854	-0.0177	0.0182	0.5393	0.0287	0.25
Foreign languages	0.5791	0.136	-0.2926	-0.074	0.0868	-0.0969

Working conditions:

Work under time and performance pressure	0.179	0.395	-0.047	-0.0594	-0.2345	0.334
Repetitive work	-0.6199	-0.1837	0.1193	0.0096	0.2257	0.204
New tasks which require effort to understand	0.5647	0.3596	-0.2441	-0.1245	-0.1251	-0.0647
Multitask	0.4315	0.2389	0.1176	-0.1176	0.1783	0.4324
Can small mistake cause large financial losses?	-0.0804	0.4561	-0.0596	-0.1734	-0.077	0.4343
Work very fast	-0.2593	0.0883	0.1387	0.1687	-0.0319	0.3045
Carry weight of over 20kg?	-0.5378	0.2945	0.3754	0.1363	-0.2161	-0.0594
Work with smoke, dust, gas, vapor?	-0.5952	0.3626	0.1583	-0.1294	0.0003	0.1042
Work in cold, hot, wet, humid, drought?	-0.4879	0.2769	0.3402	0.0289	-0.3049	0.0332

Work with oil, fat, dirt?	-0.5405	0.4707	0.1884	-0.0837	-0.1158	-0.0468
Work bended, crouching, on the knees, horizontally?	-0.3321	0.3973	0.3313	0.1302	-0.2941	-0.2542
Work with strong commotions, kicks, vacillations?	-0.3388	0.2835	0.2342	-0.0683	-0.3474	0.0731

Notes: The table provides the factor loadings yielded by a principal component analysis of the 53 task-related questions in the BIBB/IAB and BIBB/BAuA Surveys (2005/2006 wave). Individual-level data was aggregated at the occupational level before performing the factor analysis. In total, there are 266 occupations. The factor analysis resulted in six orthogonal factors, displayed in Columns 2–7.