

Appendix A: Proof

This appendix provides a brief proof of the following well-known OLS property: If $\hat{\beta}^{OLS}$ are the OLS coefficients on X from a regression of y on $[X \ Z]$, then the OLS coefficients on Z from regressing $(y - X\hat{\beta}^{OLS})$ on Z and regressing y on $[X \ Z]$ are numerically identical. This property used to simplify the estimation follows from the OLS normal equations:

$$\begin{pmatrix} X'X & X'Z \\ Z'X & Z'Z \end{pmatrix} \begin{pmatrix} \hat{\beta}^{OLS} \\ \hat{\delta}^{OLS} \end{pmatrix} = \begin{pmatrix} X'y \\ Z'y \end{pmatrix}$$

As $\hat{\beta}^{OLS}$ is assumed to be known, the second line is a system of equations which is uniquely solved by $\hat{\delta}^{OLS}$. Rearranging and solving for $\hat{\delta}^{OLS}$ yields

$$Z'X\hat{\beta}^{OLS} + Z'Z\hat{\delta}^{OLS} = Z'y \Leftrightarrow$$

$$Z'Z\hat{\delta}^{OLS} = Z'(y - X\hat{\beta}^{OLS}) \Leftrightarrow$$

$$\hat{\delta}^{OLS} = (Z'Z)^{-1}Z'(y - X\hat{\beta}^{OLS})$$

Regressing $(y - X\hat{\beta}^{OLS})$ on Z yields:

$$\hat{\delta} = (Z'Z)^{-1}Z'(y - X\hat{\beta}^{OLS}) = \hat{\delta}^{OLS}$$

which shows that the estimates from the auxiliary regression are numerically equal to $\hat{\delta}^{OLS}$, the estimates obtained from the full regression.

Appendix B: Summary of the computational steps in the algorithm

1. Identify connected groups. Abowd, Creedy, and Kramarz (2002) describe this algorithm. This step is not necessary when using the CGA.
2. Calculate individual, firm and spell means.
3. Estimate the slope coefficients:
 - For the TWFE-model, do the WK transformation for y and X using the Cholesky factorization of $[F - K'T^{-1}K]$, which can be calculated separately by group and stored for later use or by applying the CGA to every variable. Regress the transformed y on the transformed X to obtain the slopes.
 - For the match effects model, run OLS on the deviations of y and X from spell means
4. Obtain \tilde{y}_i, \tilde{y}_j and \tilde{y}_s by subtracting $\bar{X}\hat{\beta}^{OLS}$ (where the mean of X is taken over the appropriate index) from the individual, firm and spell means from step 2.
5. Calculate the firm fixed effects for each connected group separately using formula 5, which can be done by using the Cholesky factorization of $[F - K'T^{-1}K]$ (in case of the TWFE-model, it has already been calculated for step 3) or the CGA.
6. Use the firm effects to calculate the individual and match effects.
7. Calculate SEs of the slopes and required test statistics based on the residuals from step 3. For uncorrelated errors or one-way clustering, standard formulas apply. Most software packages provide estimates of the SEs that only need to be corrected for the degrees of freedom taken up by the fixed effects. For two-way clustered errors, one can use the formula to calculate $V(\hat{\beta})$ from one-way clustering matrices in Cameron, Gelbach and Miller (2011), which is computationally simple. In the two-way clustering case, it reduces to

$$V(\hat{\beta}) = (\tilde{X}'\tilde{X})^{-1}[\hat{B}^J + \hat{B}^I + \hat{B}^S](\tilde{X}'\tilde{X})^{-1} \quad (1)$$

\tilde{X} is the transformed data matrix that is obtained as a byproduct of the partial regression in step 3 and \hat{B}^J, \hat{B}^I and \hat{B}^S are the $\tilde{X}'\hat{\varepsilon}\hat{\varepsilon}'\tilde{X}$ -matrices obtained from clustering at the firm, individual and match level. Clustering on both units allows the residuals to be arbitrarily correlated within matches, so no additional clustering is necessary for the match effects model.

Appendix C: Simulation Setup

The simulations are based on randomly generated data with 5 time-varying covariates. The covariates in the simulation are drawn from the following joint normal distribution:

$$X \sim N \left[\begin{pmatrix} 5 \\ -6 \\ 0.5 \\ 3 \\ 2 \end{pmatrix}, \begin{pmatrix} 9 & 5 & 2 & 3 & 4 \\ 5 & 9 & 1 & 7 & 3 \\ 2 & 1 & 9 & 2 & 1 \\ 3 & 7 & 2 & 9 & 4 \\ 4 & 3 & 1 & 4 & 9 \end{pmatrix} \right]$$

The parameters are arbitrary and there is no serial correlation in the covariates. The individual and firm fixed effects are correlated with the mean of X of the respective individual or firm. Each individual is observed for 10 time periods and individuals move to a randomly chosen firm once with probability 0.16 or twice with probability 0.04. The dependent variable is then generated from the simple linear model

$$y_{it} = x_{it}\beta + \theta_i + \Psi_j + \varepsilon_{it}$$

with $\beta = (1,2,3,4,5)$. ε_{it} is a random normal error term, with the standard deviation fixed at 1/6th of the standard deviation of the resulting dependent variable. For each size of the problem, I run each algorithm on the same five randomly generated data sets and record the average time of computation. All simulations are carried out single-threaded on a server with 74 GB of main memory.

Code to replicate these simulations is available from my website and also provides further detail on the setup. The setup involves several arbitrary choices, such as the number and correlation of covariates, and several simplifications to make data generation feasible, such as random, but high mobility (to ensure connectedness). Computation time depends on features of the data such as the ratio of J to N and the connectedness, but I have no reason to believe that the setup here favors a particular algorithm. The program can easily be modified to examine different setups and I expect similar speed gains, since my implementation avoids some of the most computationally demanding steps of other programs.

Appendix D: Data Description

The German Institute for Employment Research (IAB) created the LIAB data I used by linking social security records to panel data on firms. The firm data stem from the IAB Betriebspanel (Fischer et al. 2008), a panel based on yearly interviews with managers of the firms. The panel dates back to 1993 (1996 for the former East Germany) and is a stratified random sample of establishments in Germany. There are 43,617 firms in total and between 4,265 and about 16,000 firms per year, with a large part of the variation explained by successive expansion of the panel. The IAB created a linked employer-employee dataset by matching this data to administrative records from the German social security system of the individuals working at the firms in the panel (Jacobebbinghaus 2008).

The data cover 1993 to 2008 and only include firms that employed at least one worker who also worked for another firm in the panel, i.e. only firms for which the firm effect is identified. They contain all workers who moved between firms in the panel. In addition to all movers (713,559 individuals), the IAB sampled up to 500 employees from each firm. Since the individual data stem from social security records, they include very accurate employment biographies. This information makes it possible to create biographic covariates such as exact work experience, tenure, year and age at which a person entered the labor market as well as information on job transitions and unemployment. Fischer et al. (2008) and Jacobebbinghaus (2008) contain a detailed discussion of the data and how it was created, so I only discuss the details and problems that matter for the application in this paper below. In particular, I discuss issues raised by the coverage of social security records, the sampling of individuals and the problem that earnings are topcoded at the social security limit.

While there are good reasons to believe that the records provide very accurate information on earnings and labor market histories, a downside is that they do not include work that is not subject to social security such as self-employment. Approximately 75-80% (Koch and Meinken 2004) of employment in Germany is subject to social security and the data is only representative of this population. In addition, social security

records for people from the former GDR do not exist prior to 1990. The data I use starts in 1990, so it does not affect the sampling of individuals, but their labor market histories will not be accurate if they were employed prior to 1990. Consequently, I exclude people from the former GDR who first entered the labor market before 1990.

In order to make the data representative of this population, I adjust the weights from the firm survey. The firm survey includes weights based on sample and population distributions that adjust for non-response and the non-random sampling. These weights are designed to make survey estimates representative of the universe of German firms, which does not extend to the sample of individuals. This is due to the fact that the individual data contains all workers that move between the firms in the sample (713,559) and up to 500 randomly selected employees of each firm who did not move or moved to firms that are not in the sample. If the firm had fewer than 500 employees subject to social security, all employees are selected. Using the number of individuals at each firm that the IAB used as the sampling frame, I adjust the weights from the firm survey to make the resulting sample representative of the population of employees subject to social security. However, I only use these weights in the regressions with the fixed effects as dependent variables and do not use weights in the main regressions, as they increase the computational complexity considerably. I condition on all variables that were used to create the weights, so the only consequence is inefficiency

A final problem with social security data is that earnings are topcoded at the social security limit for some individuals, because employers can report the social security limit instead of the actual income if the latter exceeds the former. This limit is different for the states that belonged to the former GDR and varies by year. The exact values can be obtained from the website of the IAB, in 2007, for example, it was € 63,000/year (East: € 54,600). This limit affects 6.9% of the sample (4.7% after weighting). In order to account for this problem, all analyses include a dummy if an observation is topcoded. As a robustness check, I repeat the entire analysis excluding individuals with any university education, which reduces the

problem of topcoding. In this restricted sample, only 3.9% of all observations are affected by topcoding (3% after weighting). Overall, the results are similar and the substantive conclusions above remain unchanged. Results from this sample are reported in appendix F.

Appendix E: Summary Statistics

Table A1: Summary Statistics for Main Regression

	Full Sample		Low Education Sample	
	Mean	SD	Mean	SD
Daily wage	4.12	0.77	4.08	0.77
Total number of employees	326.48	1309.04	308.89	1237.32
<i>Business volume, categorical</i>				
0 to 72,000	0.22%	4.69%	0.21%	4.58%
72,000 to 120,000	0.24%	4.89%	0.24%	4.89%
120,000 to 166,200	0.34%	5.82%	0.35%	5.91%
166,200 to 245,400	0.72%	8.45%	0.75%	8.63%
245,400 to 332,300	1.30%	11.33%	1.34%	11.50%
332,300 to 490,000	1.93%	13.76%	1.97%	13.90%
490,000 to 715,800	2.78%	16.44%	2.84%	16.61%
715,800 to 1,227,100	5.18%	22.16%	5.29%	22.38%
1,227,100 to 3,163,900	11.28%	31.63%	11.48%	31.88%
More than 3,163,900	57.85%	49.38%	57.67%	49.41%
Missing	18.16%	38.55%	17.87%	38.31%
<i>Business volume per employee, categorical</i>				
0 to 21,300	3.31%	17.89%	3.40%	18.12%
21,300 to 30,700	3.67%	18.80%	3.77%	19.05%
30,700 to 39,800	4.36%	20.42%	4.39%	20.49%
39,800 to 50,000	6.13%	23.99%	6.09%	23.91%
50,000 to 59,700	4.96%	21.71%	4.93%	21.65%
59,700 to 71,600	5.47%	22.74%	5.46%	22.72%
71,600 to 92,900	8.10%	27.28%	8.16%	27.38%
92,900 to 128,600	11.67%	32.11%	11.73%	32.18%
128,600 to 230,100	16.79%	37.38%	16.86%	37.44%
More than 230,100	17.36%	37.88%	17.34%	37.86%
Missing	18.16%	38.55%	17.87%	38.31%
Fraction of employees working part time	18.10%	21.24%	18.12%	21.38%
<i>Investment per employee, categorical</i>				
0 to 500	19.09%	39.30%	19.37%	39.52%
2,100 to 3,000	6.88%	25.31%	6.94%	25.41%
3,000 to 4,200	12.00%	32.50%	11.99%	32.48%
4,200 to 6,100	12.54%	33.12%	12.47%	33.04%
6,100 to 10,000	13.35%	34.01%	13.33%	33.99%
10,000 to 18,600	13.78%	34.47%	13.74%	34.43%
more than 18,600	15.53%	36.22%	15.45%	36.14%
Missing	6.82%	25.21%	6.71%	25.02%
Fraction of female employees	40.26%	28.05%	40.19%	28.33%
DHS employment growth index	0.02	0.17	0.02	0.17
More employees than previous year	60.89%	48.80%	60.79%	48.82%
<i>Wanted to hire people, but did not</i>				
Successfully hired or did not want to	86.77%	33.88%	86.62%	34.04%
Wanted to hire people, but did not	8.64%	28.10%	8.73%	28.23%
Missing	4.59%	20.93%	4.65%	21.06%
<i>Expected business volume relative to last year</i>				
Same	41.54%	49.28%	41.52%	49.28%
Increasing	31.70%	46.53%	31.50%	46.45%
Decreasing	19.86%	39.89%	20.13%	40.10%
Missing	6.90%	25.35%	6.85%	25.26%
Total number of new employees	12.32	47.25	11.52	43.25
Firm was hiring in current year	69.99%	45.83%	69.46%	46.06%
Total number of employees that left	14.07	61.99	13.26	58.22

	Full Sample		Low Education Sample	
	Mean	SD	Mean	SD
Employees have left in current year	75.14%	43.22%	74.83%	43.40%
Number of days in current establishment	3034.97	2688.82	3075.94	2708.80
Age at end of year	40.40	11.65	40.35	11.78
Part time job	20.82%	40.60%	21.30%	40.94%
Daily wage topcoded	4.69%	21.14%	3.01%	17.09%
<i>Year</i>				
1993	6.25%	24.21%	6.35%	24.39%
1994	6.25%	24.21%	6.36%	24.40%
1995	6.25%	24.21%	6.35%	24.39%
1996	6.25%	24.21%	6.36%	24.40%
1997	6.25%	24.21%	6.34%	24.37%
1998	6.25%	24.21%	6.27%	24.24%
1999	6.25%	24.21%	6.28%	24.26%
2000	6.25%	24.21%	6.26%	24.22%
2001	6.25%	24.21%	6.22%	24.15%
2002	6.25%	24.21%	6.23%	24.17%
2003	6.25%	24.21%	6.23%	24.17%
2004	6.25%	24.21%	6.16%	24.04%
2005	6.25%	24.21%	6.16%	24.04%
2006	6.25%	24.21%	6.14%	24.01%
2007	6.25%	24.21%	6.13%	23.99%
2008	6.25%	24.21%	6.14%	24.01%
Experience in years	14.11	8.41	14.24	8.44

Note: Weighted statistics calculated from the IAB LIAB MM 9308.

Table A2: Summary Statistics for Time Invariant Firm Characteristics

	Mean	SD		Mean	SD
<i>Industry</i>			<i>Legal Form</i>		
Agriculture and forestry	1.57%	12.43%	Individually-owned firm	34.30%	47.47%
Mining, quarrying and electricity	0.32%	5.65%	Partnership	7.63%	26.55%
Food products	2.29%	14.96%	Limited liability company	42.01%	49.36%
Clothing and textile	0.72%	8.45%	Company limited by shares	2.72%	16.27%
Paper and printing	1.08%	10.34%	Public corporation	6.28%	24.26%
Wood Products, furniture, jewelry, toys	1.53%	12.27%	Other legal form	5.28%	22.36%
Chemical industry	0.36%	5.99%	Missing/don't know	1.78%	13.22%
Rubber/plastic	0.57%	7.53%	<i>Main/Exclusive Ownership</i>		
Non-metallic mineral products	0.63%	7.91%	Eastern German property	10.99%	31.28%
Basic metals, steel, light metal recycling	/	/	Western German property	51.87%	49.97%
Machinery	2.23%	14.77%	Foreign property	2.33%	15.09%
Motor vehicles:			Public property	2.65%	16.06%
Production/sales/repair/fuel	5.01%	21.82%	No principal shareholder	2.86%	16.67%
Other transport equipment	/	/	Unknown	2.25%	14.83%
Electrical equipment	1.61%	12.59%	Missing	27.05%	44.42%
Precision and optical equipment	1.02%	10.05%	<i>Year founded (only after 1990)</i>		
Main construction trade	5.52%	22.84%	Founded before 1990	40.65%	49.12%
Building installation/completion	5.43%	22.66%	1990	2.63%	16.00%
Sales: retail and wholesale	16.60%	37.21%	1991	3.38%	18.07%
Transportation	5.79%	23.36%	1992	2.34%	15.12%
Communication	0.27%	5.19%	1993	2.50%	15.61%
Credit and financial intermediation	1.20%	10.89%	1994	2.84%	16.61%
Insurance	0.98%	9.85%	1995	2.89%	16.75%
Computer and related activities	1.42%	11.83%	1996	2.02%	14.07%
Research and development	0.41%	6.39%	1997	2.17%	14.57%
Legal consulting, advertising	4.60%	20.95%	1998	2.12%	14.41%
Real estate	1.78%	13.22%	1999	2.10%	14.34%
Renting, business activities	5.82%	23.41%	2000	1.84%	13.44%
Hotel and restaurant	6.27%	24.24%	2001	1.39%	11.71%
Education/teaching	2.26%	14.86%	2002	1.27%	11.20%
Human health, veterinary and social work	9.47%	29.28%	2003	1.40%	11.75%
Sanitation	0.53%	7.26%	2004	1.24%	11.07%
Recreation, culture, sports	1.51%	12.20%	2005	1.19%	10.84%
Other services	2.64%	16.03%	2006	1.01%	10.00%
Organizations, lobbying	2.31%	15.02%	2007	/	/
Public administration and social security	2.14%	14.47%	2008	/	/
<i>State</i>			Missing	24.43%	42.97%
Schleswig-Holstein	4.85%	21.48%	<i>Establishment/department is...</i>		
Hamburg	3.22%	17.65%	Independent company w/o other places of business	75.65%	42.92%
Lower Saxony	10.51%	30.67%	Business/office/branch	15.56%	36.25%
Bremen	1.44%	11.91%	Head office	5.35%	22.50%
North Rhine-Westphalia	17.77%	38.23%	Middle-level authority	1.59%	12.51%
Hesse	8.04%	27.19%	Missing	1.85%	13.48%
Rhineland-Palatinate	5.63%	23.05%	<i>Company pays for job training/courses</i>		
Baden-Wuerttemberg	13.24%	33.89%	No	39.80%	48.95%
Bavaria	15.16%	35.86%	Yes	51.61%	49.97%
Saarland	2.09%	14.30%	Missing	8.59%	28.02%
Berlin	3.91%	19.38%	<i>Has Worker's Council</i>		
Brandenburg	2.69%	16.18%	No	79.98%	40.01%
Mecklenburg-Western Pomerania	2.19%	14.64%	Yes	18.37%	38.72%

	Mean	SD		Mean	SD
Saxony	4.29%	20.26%	Missing	1.65%	12.74%
Saxony-Anhalt	2.50%	15.61%	<i>Collective wage agreement</i>		
Thuringia	2.46%	15.49%	Industry-wide wage agreement	43.05%	49.51%
<i>Owner working in Company</i>			Company agreement	4.56%	20.86%
No	/	/	No collective agreement	44.65%	49.71%
Yes	73.81%	43.97%	Missing	7.74%	26.72%
Missing	/	/			

Note: Weighted statistics calculated from the IAB LIAB MM 9308. If one or more cells contained too few observations, at least two cell frequencies could not be disclosed (to prevent calculation from totals), which is indicated by /.

Table A3: Summary Statistics for Time Invariant Individual Characteristics

	Full Sample		Low Educ. Sample	
	Mean	SD	Mean	SD
Female	42.72%	49.47%	43.50%	49.58%
<i>Nationality, grouped</i>				
Germany	92.17%	26.86%	91.95%	27.21%
Turkey	2.25%	14.83%	2.39%	15.27%
Italy	0.89%	9.39%	0.93%	9.60%
Yugoslavia, Serbia and Montenegro	0.83%	9.07%	0.88%	9.34%
Greece	0.37%	6.07%	0.39%	6.23%
France	0.26%	5.09%	0.25%	4.99%
Poland	0.27%	5.19%	0.27%	5.19%
Austria	0.29%	5.38%	0.28%	5.28%
Croatia	0.19%	4.35%	0.20%	4.47%
Portugal	0.21%	4.58%	0.22%	4.69%
Spain	0.16%	4.00%	0.16%	4.00%
Netherlands, Luxembourg	0.14%	3.74%	0.13%	3.60%
Russia, Belarus, Former Soviet Union	0.11%	3.31%	0.10%	3.16%
Bosnia and Herzegovina	0.12%	3.46%	0.12%	3.46%
Great Britain, Ireland and Northern Ireland	0.14%	3.74%	0.13%	3.60%
Romania	0.08%	2.83%	0.08%	2.83%
Czech Republic, Slovakia, Former Czechoslovakia	0.09%	3.00%	0.09%	3.00%
Ukraine, Moldova	0.06%	2.45%	0.06%	2.45%
Hungary	0.06%	2.45%	0.06%	2.45%
Albania	0.04%	2.00%	0.04%	2.00%
Belgium	0.03%	1.73%	0.03%	1.73%
Macedonia	0.03%	1.73%	0.03%	1.73%
Switzerland	0.03%	1.73%	0.03%	1.73%
Bulgaria	0.03%	1.73%	0.03%	1.73%
Slovenia	0.02%	1.41%	0.02%	1.41%
Denmark, Sweden	0.04%	2.00%	0.03%	1.73%
Finland	0.02%	1.41%	0.01%	1.00%
Estonia, Latvia, Lithuania	0.02%	1.41%	0.02%	1.41%
Europe (other)	0.02%	1.41%	0.02%	1.41%
Ethiopia	0.01%	1.00%	0.01%	1.00%
Ghana	0.03%	1.73%	0.03%	1.73%
Morocco	0.08%	2.83%	0.09%	3.00%
Tunisia	0.04%	2.00%	0.04%	2.00%
Africa (other)	0.12%	3.46%	0.12%	3.46%
USA, Canada	0.10%	3.16%	0.09%	3.00%
America (other)	0.06%	2.45%	0.06%	2.45%
Afghanistan	0.03%	1.73%	0.03%	1.73%
Sri Lanka	0.05%	2.24%	0.05%	2.24%
Vietnam	0.04%	2.00%	0.04%	2.00%
India	0.03%	1.73%	0.03%	1.73%
Iraq	0.04%	2.00%	0.04%	2.00%
Iran	0.06%	2.45%	0.06%	2.45%
Lebanon	0.03%	1.73%	0.03%	1.73%
Philippines	0.03%	1.73%	0.03%	1.73%
Thailand	0.03%	1.73%	0.03%	1.73%
China, incl. Tibet	0.03%	1.73%	0.03%	1.73%
Asia (other)	0.18%	4.24%	0.17%	4.12%
Oceania	0.01%	1.00%	0.01%	1.00%
Missing	0.04%	2.00%	0.04%	2.00%
<i>School education and vocational training</i>				
Secondary school w/o completed vocational training	15.52%	36.21%	16.65%	37.25%
Secondary school with completed vocational training	58.22%	49.32%	62.47%	48.42%

	Full Sample		Low Educ. Sample	
	Mean	SD	Mean	SD
Upper secondary school (general/subject-specific aptitude for higher education) w/o completed vocational training	1.66%	12.78%	1.78%	13.22%
Upper secondary school (general/subject-specific aptitude for higher education) with completed vocational training	3.79%	19.10%	4.06%	19.74%
Completion of a university of applied sciences	2.78%	16.44%		
College / university degree	4.02%	19.64%		
Missing	14.01%	34.71%	15.04%	35.75%
<i>Year of first employment</i>				
1975 or earlier	23.78%	42.57%	24.58%	43.06%
1976	3.13%	17.41%	3.15%	17.47%
1977	2.53%	15.70%	2.49%	15.58%
1978	2.41%	15.34%	2.37%	15.21%
1979	2.56%	15.79%	2.50%	15.61%
1980	2.58%	15.85%	2.54%	15.73%
1981	2.45%	15.46%	2.41%	15.34%
1982	2.26%	14.86%	2.22%	14.73%
1983	2.29%	14.96%	2.25%	14.83%
1984	2.52%	15.67%	2.46%	15.49%
1985	2.59%	15.88%	2.52%	15.67%
1986	2.84%	16.61%	2.76%	16.38%
1987	2.84%	16.61%	2.76%	16.38%
1988	3.03%	17.14%	2.93%	16.86%
1989	3.66%	18.78%	3.58%	18.58%
1990	4.88%	21.54%	4.80%	21.38%
1991	2.11%	14.37%	2.18%	14.60%
1992	1.78%	13.22%	1.84%	13.44%
1993	2.26%	14.86%	2.26%	14.86%
1994	2.17%	14.57%	2.17%	14.57%
1995	2.22%	14.73%	2.23%	14.77%
1996	2.07%	14.24%	2.05%	14.17%
1997	2.19%	14.64%	2.12%	14.41%
1998	2.18%	14.60%	2.09%	14.30%
1999	5.19%	22.18%	5.14%	22.08%
2000	2.87%	16.70%	2.85%	16.64%
2001	2.19%	14.64%	2.20%	14.67%
2002	1.61%	12.59%	1.63%	12.66%
2003	1.28%	11.24%	1.31%	11.37%
2004	0.99%	9.90%	1.01%	10.00%
2005	0.84%	9.13%	0.86%	9.23%
2006	0.78%	8.80%	0.80%	8.91%
2007	0.64%	7.97%	0.65%	8.04%
2008	0.30%	5.47%	0.30%	5.47%
Age at first employment	24.09	7.64	23.98	7.72

Note: Weighted statistics calculated from the IAB LIAB MM 9308.

Table A4: Summary Statistics for Time Invariant Match Characteristics

	Full Sample		Low Educ. Sample	
	Mean	SD	Mean	SD
Part time job (at beginning of match)	22.98%	42.07%	23.60%	42.46%
<i>Employment Status 8 days before current match</i>				
No previous record	17.75%	38.21%	18.18%	38.57%
Unknown, previous spell not benefits	16.12%	36.77%	15.70%	36.38%
Unknown, previous spell was benefit spell	3.93%	19.43%	3.96%	19.50%
Benefit receipt	19.77%	39.83%	20.26%	40.19%
Employment at other firm	40.22%	49.03%	39.60%	48.91%
Apprentice/trainee at other firm	2.19%	14.64%	2.28%	14.93%
Missing	0.02%	1.41%	0.02%	1.41%
<i>Employment status 8 days before current match, condensed</i>				
No previous record	17.75%	38.21%	18.18%	38.57%
Benefits/gap	39.82%	48.95%	39.92%	48.97%
Employment at other firm	40.22%	49.03%	39.60%	48.91%
Apprentice/trainee at other firm	2.19%	14.64%	2.28%	14.93%
Missing	0.02%	1.41%	0.02%	1.41%
Number of days in emp. status 8 days before current match	1117.21	1635.52	1109.38	1650.03
<i>Year match started</i>				
1993	18.35%	38.71%	18.69%	38.98%
1994	5.15%	22.10%	5.21%	22.22%
1995	3.11%	17.36%	3.12%	17.39%
1996	3.59%	18.60%	3.61%	18.65%
1997	2.56%	15.79%	2.57%	15.82%
1998	5.21%	22.22%	5.20%	22.20%
1999	5.95%	23.66%	5.98%	23.71%
2000	9.14%	28.82%	9.23%	28.94%
2001	7.41%	26.19%	7.36%	26.11%
2002	6.06%	23.86%	6.02%	23.79%
2003	5.26%	22.32%	5.23%	22.26%
2004	5.59%	22.97%	5.50%	22.80%
2005	5.47%	22.74%	5.40%	22.60%
2006	5.47%	22.74%	5.34%	22.48%
2007	5.66%	23.11%	5.60%	22.99%
2008	6.02%	23.79%	5.95%	23.66%
Days of benefit receipt up to beginning of current match	234.37	488.28	243.15	498.10
Days since first employment at beginning of current match	3127.01	3112.95	3117.67	3140.79
Age at beginning of current match	37.43	12.11	37.36	12.27
<i>Match count</i>				
1	93.31%	24.98%	93.93%	23.88%
2	6.36%	24.40%	5.80%	23.37%
3	0.32%	5.65%	0.26%	5.09%
4	0.01%	1.00%	0.01%	1.00%
5	/	/	/	/
6	/	/	/	/
Female	42.24%	49.39%	43.12%	49.52%

Note: Weighted statistics calculated from the IAB LIAB MM 9308. If one or more cells contained too few observations, at least two cell frequencies could not be disclosed (to prevent calculation from totals), which is indicated by /.

Appendix F: Results

Table A5: Regressions of log of Daily Wage on Time Variant Characteristics, All Coefficients

	Full Sample, Match	Full Sample, TWFE	Reduced Sample, Match	Reduced Sample, TWFE
Total number of employees	0.000004* (0.000001)	0.000004** (0.000001)	0.000003* (0.000001)	0.000003* (0.000001)
<i>Business volume, categorical</i>				
72,000 to 120,000	0.0196 (0.0158)	0.0204 (0.017)	0.0042 (0.0115)	0.0016 (0.0118)
120,000 to 166,200	0.0221 (0.0157)	0.0288 (0.0171)	0.0049 (0.0127)	0.0064 (0.013)
166,200 to 245,400	-0.0036 (0.0147)	-0.0002 (0.0162)	-0.0277* (0.0108)	-0.0319** (0.0114)
245,400 to 332,300	0.0063 (0.0148)	0.0094 (0.0163)	-0.0175 (0.0107)	-0.0196 (0.0111)
332,300 to 490,000	-0.0023 (0.0149)	0.0009 (0.0163)	-0.0301** (0.0107)	-0.0316** (0.0111)
490,000 to 715,800	0.0053 (0.0141)	0.0091 (0.0156)	-0.0158 (0.0093)	-0.0177 (0.0097)
715,800 to 1,227,100	0.0116 (0.014)	0.0141 (0.0155)	-0.0083 (0.0091)	-0.0111 (0.0095)
1,227,100 to 3,163,900	0.0131 (0.0139)	0.0149 (0.0154)	-0.0067 (0.009)	-0.0098 (0.0093)
more than 3,163,900	0.0124 (0.0139)	0.0116 (0.0154)	-0.0053 (0.0089)	-0.009 (0.0093)
Missing	0.019 (0.0138)	0.0235 (0.0152)	-0.0033 (0.0087)	-0.0056 (0.0091)
<i>Business volume per employee, categorical</i>				
21,300 to 30,700	0.0054* (0.0022)	0.0055* (0.0026)	0.0067** (0.0021)	0.0068** (0.0023)
30,700 to 39,800	0.0026 (0.0023)	0.0024 (0.0028)	0.0041 (0.0023)	0.0049 (0.0025)
39,800 to 50,000	0.0038 (0.0024)	0.0051 (0.0028)	0.0052* (0.0022)	0.006* (0.0025)
50,000 to 59,700	0.0016 (0.0024)	0.0004 (0.0029)	0.0006 (0.0023)	0.0009 (0.0025)
59,700 to 71,600	0.0019 (0.0025)	0.0021 (0.003)	0.0009 (0.0024)	0.0016 (0.0026)
71,600 to 92,900	-0.0011 (0.0025)	0.0011 (0.0029)	-0.0041 (0.0024)	-0.0032 (0.0027)
92,900 to 128,600	0.0006 (0.0024)	0.0031 (0.0029)	-0.0029 (0.0023)	-0.0025 (0.0026)
128,600 to 230,100	0.0027 (0.0024)	0.0059* (0.0029)	-0.0008 (0.0023)	-0.0004 (0.0026)
more than 230,100	0.0105*** (0.0024)	0.0143*** (0.0029)	0.007** (0.0023)	0.0076** (0.0026)
Fraction of employees working part time	-0.0034 (0.004)	-0.0011 (0.0044)	-0.0029 (0.0041)	-0.0002 (0.0043)
<i>Investment per employee, categorical</i>				
2,100 to 3,000	0.002 (0.0012)	0.0016 (0.0013)	0.001 (0.0013)	0.001 (0.0013)
3,000 to 4,200	0.0017 (0.0009)	0.0025** (0.0009)	0.0007 (0.0009)	0.0012 (0.0009)
4,200 to 6,100	0.0031*** (0.001)	0.0038*** (0.001)	0.0027** (0.001)	0.003** (0.001)

	Full Sample, Match	Full Sample, TWFE	Reduced Sample, Match	Reduced Sample, TWFE
6,100 to 10,000	0.0041*** (0.0009)	0.0048*** (0.0009)	0.0034*** (0.0009)	0.0039*** (0.0009)
10,000 to 18,600	0.0057*** (0.001)	0.0066*** (0.001)	0.0048*** (0.001)	0.0051*** (0.001)
more than 18,600	0.0058*** (0.0009)	0.0068*** (0.001)	0.0055*** (0.0009)	0.006*** (0.001)
Missing	0.0039*** (0.001)	0.0047*** (0.001)	0.0036*** (0.001)	0.0043*** (0.001)
Fraction of female employees	-0.0056 (0.0036)	-0.0031 (0.0039)	-0.0103** (0.0035)	-0.0091* (0.0036)
DHS employment growth index	0.0082*** (0.002)	0.0098*** (0.002)	0.0083*** (0.002)	0.0093*** (0.0021)
More employees than previous year	0.0037*** (0.0004)	0.0042*** (0.0005)	0.0037*** (0.0005)	0.0036*** (0.0005)
<i>Wanted to hire people, but did not</i>				
Wanted to hire people, but did not	-0.0002 (0.0011)	0.0005 (0.0012)	0.0001 (0.0012)	0.0004 (0.0012)
Missing	-0.0002 (0.0022)	0.0008 (0.0023)	0.001 (0.0022)	0.0015 (0.0023)
<i>Expected business volume relative to last year</i>				
Increasing	0.0013** (0.0005)	0.0015** (0.0005)	0.0012* (0.0005)	0.0013* (0.0005)
Decreasing	-0.0044*** (0.0005)	-0.0048*** (0.0006)	-0.0045*** (0.0006)	-0.0047*** (0.0006)
Missing	-0.0009 (0.001)	-0.0013 (0.001)	-0.0007 (0.0011)	-0.0008 (0.0011)
Total number of new employees	0.000013* (0.000006)	0.000012* (0.000005)	0.00002*** (0.000005)	0.000019*** (0.000005)
Firm was hiring in current year	0.0048*** (0.0006)	0.0057*** (0.0006)	0.0046*** (0.0006)	0.005*** (0.0006)
Total number of employees that left	-0.000005 (0.000003)	-0.000007* (0.000003)	-0.000005 (0.000003)	-0.000006 (0.000003)
Employees have left in current year	0.0021*** (0.0006)	0.0028*** (0.0006)	0.002** (0.0006)	0.0022*** (0.0006)
Number of days in current establishment	0.000027*** (0.000005)	0.000018*** (0.000001)	0.000042*** (0.000006)	0.000021*** (0.000001)
Age at end of year, squared	-0.002209*** (0.000128)	-0.003944*** (0.000139)	-0.00285*** (0.000123)	-0.004645*** (0.000132)
Age at end of year^3	0.000039*** (0.000002)	0.000063*** (0.000002)	0.000048*** (0.000002)	0.000075*** (0.000002)
Age at end of year^4	-0.00000027*** (0.00000001)	-0.00000039*** (0.00000001)	-0.00000032*** (0.00000001)	-0.00000047*** (0.00000001)
Part time job	-0.3395*** (0.0046)	-0.4446*** (0.0059)	-0.3227*** (0.0042)	-0.3922*** (0.0046)
Daily wage topcoded	0.0185*** (0.0012)	0.0231*** (0.0013)	0.0247*** (0.0012)	0.032*** (0.0013)
<i>Year</i>				
1994	-0.0351*** (0.0044)	0.0757*** (0.0044)	-0.0303*** (0.0044)	0.0636*** (0.0043)
1995	-0.0562*** (0.0082)	0.1658*** (0.0082)	-0.0429*** (0.0083)	0.1446*** (0.008)
1996	-0.0969*** (0.0122)	0.2365*** (0.0122)	-0.0777*** (0.0123)	0.204*** (0.0119)
1997	-0.1403*** (0.0162)	0.3022*** (0.0162)	-0.1148*** (0.0163)	0.2599*** (0.0158)

	Full Sample, Match	Full Sample, TWFE	Reduced Sample, Match	Reduced Sample, TWFE
1998	-0.183*** (0.0202)	0.369*** (0.0202)	-0.1505*** (0.0203)	0.3173*** (0.0197)
1999	-0.2154*** (0.0243)	0.4417*** (0.0242)	-0.176*** (0.0244)	0.382*** (0.0237)
2000	-0.2521*** (0.0283)	0.5178*** (0.0283)	-0.2063*** (0.0284)	0.4464*** (0.0276)
2001	-0.2868*** (0.0324)	0.5946*** (0.0323)	-0.2347*** (0.0325)	0.5114*** (0.0316)
2002	-0.3231*** (0.0364)	0.6707*** (0.0363)	-0.2643*** (0.0365)	0.576*** (0.0355)
2003	-0.3506*** (0.0404)	0.7543*** (0.0404)	-0.2893*** (0.0405)	0.6444*** (0.0394)
2004	-0.3986*** (0.0445)	0.8177*** (0.0444)	-0.3307*** (0.0446)	0.6965*** (0.0433)
2005	-0.4413*** (0.0485)	0.8871*** (0.0485)	-0.3673*** (0.0487)	0.7535*** (0.0473)
2006	-0.4837*** (0.0525)	0.9556*** (0.0525)	-0.4028*** (0.0527)	0.8112*** (0.0512)
2007	-0.5172*** (0.0566)	1.034*** (0.0566)	-0.4293*** (0.0567)	0.8781*** (0.0551)
2008	-0.5461*** (0.0607)	1.1169*** (0.0606)	-0.4525*** (0.0609)	0.9483*** (0.0592)
Experience in years	0.1579*** (0.0026)	0.1171*** (0.0014)	0.1525*** (0.003)	0.1193*** (0.0014)
Experience in years^2	-0.003233*** (0.000109)	-0.004723*** (0.000152)	-0.002067*** (0.000056)	-0.00233*** (0.000059)
Experience in years^3	0.000097*** (0.000004)	0.00016*** (0.000006)	0.000057*** (0.000002)	0.000069*** (0.000002)
Experience in years^4	-0.000001*** (0.00000005)	-0.000002*** (0.00000008)	-0.00000055*** (0.00000003)	-0.00000072*** (0.00000003)
Number of observations	9792405	9792405	8693593	8693593
Number of individuals	3068373	3068373	2726651	2726651
Number of firms	24323	24323	23348	23348
Number of matches	3413921		2996587	
Total Sum of Squares	4104476	4104476	3588938	3588938
Residual sum of squares	175455	244647	151418	195440
R2	0.9573	0.9404	0.9578	0.9455
F-stat of all coefficients	1042.7	1037.6	979.3	1001.5
p-value	0	0	0	0
F-stat of all fixed effects	19.1	15.2	19.2	16.4
p-value	0	0	0	0
F-stat individual FE		11.7		12.4
p-value		0		0
F-stat firm FE		52.2		51.3
p-value		0		0

Omitted Categories: *Business volume*, categorical: 0 to 72,000; *Business volume per employee*, categorical: 0 to 21,300; *Investment per employee*, categorical: 0 to 500; *Wanted to hire people, but did not:* successfully hired or did not want to; *Expected business volume relative to last year:* same; *Year:* 1993

Notes: Standard errors are clustered at the firm and individual level. Significance levels: *: Significant at 5%; **: Significant at 1%; ***: Significant at 0.1%.

Table A6: Regressions of Firm Fixed Effects on Time Invariant Firm Characteristics, All Coefficients

<i>Industry</i>	Full Sample, Match	Full Sample, TWFE	Reduced Sample, Match	Reduced Sample, TWFE
Agriculture and forestry	0.0097 (0.1517)	0.023 (0.1482)	-0.0178 (0.1427)	-0.0186 (0.143)
Mining, quarrying and electricity	-0.0222 (0.1826)	-0.0342 (0.1815)	-0.0444 (0.2213)	-0.0518 (0.2182)
Food products	0.0111 (0.083)	0.0005 (0.0827)	-0.02 (0.0813)	-0.0335 (0.0824)
Clothing and textile	0.0923 (0.1003)	0.0581 (0.0996)	-0.015 (0.1051)	-0.0203 (0.1033)
Paper and printing	0.1463 (0.1497)	0.1269 (0.1483)	0.0751 (0.1531)	0.0694 (0.1545)
Wood products, furniture, jewellery and toys	0.353*** (0.0914)	0.3296*** (0.0925)	0.3384*** (0.0951)	0.3285*** (0.0971)
Chemical industry	0.2447* (0.1203)	0.2355* (0.1073)	0.2226 (0.1395)	0.2382 (0.1223)
Rubber/plastic	0.2319** (0.0757)	0.2242** (0.072)	0.1788** (0.0683)	0.1766** (0.0678)
Non-metallic mineral products	0.2292* (0.0967)	0.2386* (0.0955)	0.2078* (0.0938)	0.2189* (0.0921)
Basic metals, steel, light metal	0.2922*** (0.0633)	0.2799*** (0.0606)	0.2444*** (0.0638)	0.2463*** (0.0627)
Recycling	-0.6061 (0.8601)	-0.6308 (0.8529)	-0.6119 (0.8785)	-0.6555 (0.8869)
Machinery	0.3259*** (0.0892)	0.2903** (0.0884)	0.3036** (0.0924)	0.2811** (0.0922)
Motor vehicles: production/sales/repair/fuel	-0.0523 (0.0753)	-0.0459 (0.0744)	-0.0614 (0.0704)	-0.0521 (0.0716)
Other transport equipment	0.2208 (0.1267)	0.182 (0.1282)	0.1701 (0.1212)	0.1473 (0.1212)
Electrical equipment	0.1582 (0.0913)	0.1857 (0.0955)	0.0964 (0.0932)	0.1217 (0.0958)
Precision and optical equipment	0.1238 (0.0948)	0.1145 (0.0944)	0.112 (0.0947)	0.0992 (0.0963)
Main construction trade	0.2746*** (0.0668)	0.2828*** (0.0656)	0.241*** (0.0683)	0.2514*** (0.0679)
Building installation/completion	0.2129*** (0.0643)	0.2182*** (0.0629)	0.1888** (0.062)	0.2021** (0.0623)
Transportation	0.0196 (0.074)	-0.0077 (0.0724)	-0.0017 (0.0744)	-0.026 (0.0739)
Communication	-0.2788 (0.2347)	-0.2588 (0.2263)	-0.2873 (0.2201)	-0.2823 (0.2184)
Credit and financial intermediation	0.0569 (0.0974)	0.0585 (0.0928)	0.0972 (0.1087)	0.1043 (0.1055)
Insurance	0.001 (0.1713)	-0.0476 (0.1684)	-0.0059 (0.1704)	-0.0456 (0.1693)
Computer and related activities	0.3042* (0.1259)	0.3454** (0.1125)	0.2972* (0.1422)	0.3314* (0.1317)
Research and development	0.219** (0.0814)	0.2032* (0.0808)	0.2881** (0.098)	0.2671** (0.0995)
Legal consulting, advertising	-0.0672 (0.1026)	-0.0626 (0.1011)	-0.1207 (0.1166)	-0.1145 (0.1171)
Real estate	-0.211 (0.1292)	-0.1993 (0.123)	-0.2738 (0.1506)	-0.2701 (0.146)
Renting, business activities	0.0377 (0.0702)	0.0197 (0.068)	-0.0408 (0.0769)	-0.0619 (0.0753)

	Full Sample, Match	Full Sample, TWFE	Reduced Sample, Match	Reduced Sample, TWFE
Hotel and restaurant	-0.3776*** (0.0794)	-0.3595*** (0.0771)	-0.395*** (0.0794)	-0.3912*** (0.0785)
Education/teaching	0.0995 (0.0987)	0.0811 (0.092)	0.0988 (0.1012)	0.0912 (0.0976)
Human health, veterinary and social work	0.0285 (0.0652)	-0.0026 (0.0639)	-0.0264 (0.0655)	-0.0511 (0.0653)
Sanitation	0.1615 (0.149)	0.1295 (0.1394)	0.0359 (0.114)	0.0058 (0.1112)
Recreation, culture, sports	-0.4495** (0.1677)	-0.451** (0.1604)	-0.5665*** (0.1683)	-0.5782*** (0.1665)
Other services	-0.1998* (0.1)	-0.1856 (0.1002)	-0.2485* (0.1035)	-0.2425* (0.1054)
Organizations, lobbying, etc.	-0.395** (0.1442)	-0.4172** (0.138)	-0.3177* (0.1532)	-0.3513* (0.1502)
Public administration and social security	0.0378 (0.0903)	0.0195 (0.087)	0.0152 (0.0932)	0.0101 (0.0924)
<i>State</i>				
Schleswig-Holstein	0.149* (0.0675)	0.1147 (0.0664)	0.1704** (0.0658)	0.1416* (0.0655)
Hamburg	0.1895** (0.0712)	0.178** (0.0688)	0.238*** (0.0718)	0.2336** (0.0713)
Lower Saxony	-0.0497 (0.0619)	-0.0524 (0.0597)	-0.0351 (0.0634)	-0.0369 (0.0623)
Bremen	0.2206*** (0.0632)	0.2132*** (0.062)	0.1776** (0.0677)	0.1825** (0.0685)
Hesse	0.0594 (0.0604)	0.0603 (0.0584)	0.0747 (0.0592)	0.0763 (0.0589)
Rhineland-Palatinate	-0.1463* (0.068)	-0.1623* (0.0685)	-0.0919 (0.0695)	-0.1106 (0.0705)
Baden-Wuerttemberg	0.0046 (0.054)	0.0037 (0.0524)	0.0325 (0.0557)	0.0311 (0.0552)
Bavaria	0.1849*** (0.0547)	0.1706** (0.0534)	0.1601** (0.0563)	0.1568** (0.0562)
Saarland	0.0867 (0.0581)	0.055 (0.0549)	0.1081 (0.0576)	0.0843 (0.0562)
Berlin	0.058 (0.0644)	0.0528 (0.063)	0.1185 (0.066)	0.1158 (0.0651)
Brandenburg	-0.0266 (0.0809)	-0.0053 (0.0774)	-0.0566 (0.0841)	-0.0311 (0.0816)
Mecklenburg-Western Pomerania	0.091 (0.0699)	0.1104 (0.0673)	0.0955 (0.0722)	0.1178 (0.0706)
Saxony	0.0005 (0.0788)	0.0344 (0.0763)	-0.0351 (0.0796)	-0.0012 (0.0779)
Saxony-Anhalt	-0.0365 (0.0818)	-0.0033 (0.0785)	-0.0969 (0.087)	-0.0626 (0.0846)
Thuringia	0.0183 (0.0819)	0.0484 (0.079)	-0.0191 (0.0839)	0.0198 (0.0821)
<i>Legal Form</i>				
Individually-owned firm	-0.3585*** (0.0399)	-0.3462*** (0.0389)	-0.3453*** (0.0405)	-0.3427*** (0.0403)
Partnership	-0.1603*** (0.0479)	-0.1479** (0.047)	-0.1735*** (0.0466)	-0.1624*** (0.0467)
Company limited by shares	0.0728 (0.0619)	0.0734 (0.0641)	0.0785 (0.0663)	0.0847 (0.0688)

	Full Sample, Match	Full Sample, TWFE	Reduced Sample, Match	Reduced Sample, TWFE
Public corporation	-0.058 (0.0795)	-0.0635 (0.076)	-0.0412 (0.0797)	-0.0532 (0.0782)
Other legal form	-0.1069 (0.0733)	-0.101 (0.0709)	-0.137 (0.0742)	-0.1381 (0.0737)
Missing/don't know	0.0281 (0.2088)	-0.0125 (0.2011)	0.0068 (0.2251)	-0.0313 (0.2162)
<i>Main/Exclusive Ownership</i>				
Eastern German property	0.1201* (0.0573)	0.1185* (0.0561)	0.1106 (0.0592)	0.115* (0.0579)
Foreign property	0.2526*** (0.0756)	0.2415** (0.0746)	0.244** (0.0822)	0.2363** (0.082)
Public property	0.0829 (0.0675)	0.0951 (0.0643)	0.0697 (0.0698)	0.0805 (0.0693)
No principal shareholder	0.1496 (0.0881)	0.1461 (0.083)	0.1283 (0.0791)	0.1381 (0.0763)
Unknown	-0.0961 (0.0985)	-0.0976 (0.0983)	-0.0652 (0.1053)	-0.0669 (0.1064)
Missing	0.3172*** (0.088)	0.3807*** (0.0781)	0.3054*** (0.0921)	0.3725*** (0.0855)
<i>Year founded (only after 1990)</i>				
1990	0.0111 (0.0715)	0.0061 (0.0686)	-0.0022 (0.0726)	-0.0067 (0.0711)
1991	0.049 (0.0951)	0.0421 (0.0882)	0.0478 (0.0992)	0.0389 (0.0935)
1992	-0.1807 (0.1104)	-0.1885 (0.1096)	-0.1615 (0.1151)	-0.1759 (0.1152)
1993	-0.0171 (0.0772)	-0.0352 (0.0742)	-0.033 (0.0764)	-0.0477 (0.0754)
1994	-0.0531 (0.1086)	-0.0516 (0.1056)	-0.0436 (0.1102)	-0.0445 (0.1082)
1995	0.018 (0.0865)	0.0042 (0.0861)	-0.0064 (0.0858)	-0.014 (0.0869)
1996	-0.055 (0.0816)	-0.0564 (0.0762)	-0.0257 (0.0875)	-0.0332 (0.0843)
1997	-0.145 (0.0945)	-0.1476 (0.0869)	-0.1792 (0.0982)	-0.1891* (0.0932)
1998	-0.0483 (0.1126)	-0.0556 (0.1087)	-0.1158 (0.1125)	-0.1226 (0.1093)
1999	-0.0718 (0.0927)	-0.1115 (0.0898)	-0.0365 (0.0891)	-0.0723 (0.0883)
2000	0.1873 (0.1023)	0.1291 (0.1014)	0.1945 (0.1072)	0.1491 (0.1079)
2001	-0.2087 (0.1475)	-0.2301 (0.1432)	-0.1473 (0.1592)	-0.1783 (0.1572)
2002	-0.0678 (0.1128)	-0.102 (0.1117)	0.0169 (0.1112)	-0.0221 (0.1109)
2003	-0.0607 (0.1189)	-0.1207 (0.1123)	-0.0099 (0.1207)	-0.0661 (0.1151)
2004	-0.0577 (0.1302)	-0.1243 (0.1292)	0.048 (0.1156)	-0.0155 (0.1121)
2005	0.0726 (0.1008)	-0.0112 (0.0975)	0.1659 (0.1046)	0.0829 (0.1032)
2006	0.3205** (0.1172)	0.2202 (0.1155)	0.3881** (0.118)	0.2903* (0.1178)

	Full Sample, Match	Full Sample, TWFE	Reduced Sample, Match	Reduced Sample, TWFE
2007	0.238 (0.1364)	0.1263 (0.1349)	0.3013* (0.1381)	0.1975 (0.1341)
2008	-0.1132 (0.0928)	-0.2126* (0.089)	-0.0995 (0.0942)	-0.2126* (0.0922)
Missing	-0.0309 (0.0907)	-0.0165 (0.0816)	-0.0823 (0.0946)	-0.0574 (0.0888)
<i>Establishment/Department is...</i>				
Place of business/office/branch	0.0365 (0.0444)	0.0436 (0.0424)	0.0306 (0.0469)	0.0344 (0.0459)
Head office	0.0713 (0.0561)	0.0655 (0.0537)	0.0537 (0.0573)	0.0572 (0.0563)
Middle-level authority	0.0597 (0.0829)	0.0667 (0.0775)	0.0159 (0.079)	0.0143 (0.0799)
Missing	0.0412 (0.1655)	0.1051 (0.1531)	0.1107 (0.1867)	0.1502 (0.1764)
<i>Company pays for job training/courses</i>				
Yes	-0.119*** (0.0355)	-0.1113** (0.0345)	-0.1187*** (0.0359)	-0.1077** (0.0356)
Missing	-0.1222* (0.0574)	-0.1007 (0.0562)	-0.1208* (0.0583)	-0.1087 (0.0583)
<i>Has Worker's Council</i>				
Yes	0.1215*** (0.0359)	0.1385*** (0.0347)	0.1149** (0.0381)	0.1313*** (0.0376)
Missing	-0.1565 (0.1848)	-0.1277 (0.174)	-0.1649 (0.1985)	-0.1466 (0.1904)
<i>Collective Wage Agreement</i>				
Company agreement	-0.0448 (0.0726)	-0.0388 (0.0701)	-0.0594 (0.0759)	-0.0505 (0.0748)
No collective agreement	-0.1009** (0.0346)	-0.1187*** (0.0338)	-0.1074** (0.0351)	-0.1261*** (0.0349)
Missing	-0.0453 (0.074)	-0.0317 (0.0728)	-0.0542 (0.0777)	-0.0325 (0.0778)
<i>Owner working in Company</i>				
No	0.06 (0.0391)	0.0538 (0.0375)	0.0644 (0.0406)	0.0606 (0.0398)
Missing	-0.3195* (0.1469)	-0.3009* (0.1293)	-0.0562 (0.0985)	-0.0688 (0.0962)
Constant	4.0106*** (0.0581)	5.344*** (0.0566)	4.3716*** (0.0593)	5.6099*** (0.0588)
Number of Observations	24291	24291	23318	23318
R-squared	0.1619	0.1814	0.1567	0.1760

Omitted Categories: *Industry:* Sales: Retail and Wholesale; *State:* North Rhine-Westphalia; *Legal Form:* Limited liability company; *Main/Exclusive Ownership:* Western German property; *Year founded:* Founded before 1990; *Establishment/Department is...:* independent company/organisation w/o other places of business; *Company pays for job training/courses:* No; *Has Worker's Council:* No; *Collective Wage Agreement:* Industry-wide wage agreement; *Owner working in Company:* Yes;

Notes: Significance levels: *: Significant at 5%; **: Significant at 1%; ***: Significant at 0.1%.

Table A7: Regressions of Individual FE on Time Invariant Individual Characteristics, All Coefficients

	Full Sample, Match	Full Sample, TWFE	Reduced Sample, Match	Reduced Sample, TWFE
Female	-0.0559*** (0.0032)	-0.1035*** (0.0029)	-0.0514*** (0.0034)	-0.0797*** (0.0031)
<i>Nationality, grouped</i>				
Turkey	-0.0288*** (0.0072)	-0.0073 (0.0067)	-0.0334*** (0.0073)	-0.0213** (0.0068)
Italy	-0.0128 (0.0123)	-0.0192 (0.0108)	-0.0244 (0.0128)	-0.0318** (0.0113)
Yugoslavia, Serbia and Montenegro	-0.0465*** (0.0126)	-0.0183 (0.0118)	-0.0566*** (0.0127)	-0.0425*** (0.0122)
Greece	0.0152 (0.0187)	0.0097 (0.0171)	0.0086 (0.0199)	0.0022 (0.0187)
France	0.0855*** (0.0256)	0.0798*** (0.0208)	0.0967** (0.0309)	0.0865** (0.0265)
Poland	0.1499*** (0.0293)	0.1187*** (0.0254)	0.1539*** (0.0304)	0.1308*** (0.0279)
Austria	0.0062 (0.0279)	0.0301 (0.0261)	0.0061 (0.033)	0.0134 (0.0309)
Croatia	0.0279 (0.0208)	0.0415* (0.0184)	0.0118 (0.022)	0.0231 (0.0201)
Portugal	-0.0852*** (0.0229)	-0.0354 (0.0217)	-0.1062*** (0.0238)	-0.0716** (0.0228)
Spain	-0.1055*** (0.025)	-0.0778*** (0.0213)	-0.1202*** (0.0278)	-0.1023*** (0.0249)
Netherlands, Luxembourg	0.218*** (0.0341)	0.2009*** (0.0298)	0.2042*** (0.0377)	0.1873*** (0.0346)
Russia, Belarus, Former Soviet Union	0.1182*** (0.0336)	0.0955** (0.0311)	0.1167** (0.036)	0.1004** (0.0349)
Bosnia and Herzegovina	0.0722 (0.041)	0.0501 (0.0328)	0.0692 (0.0435)	0.0498 (0.0374)
Great Britain, Ireland and Northern Ireland	0.0759* (0.0328)	0.0788* (0.0309)	0.1212*** (0.0284)	0.1164*** (0.026)
Romania	0.1272** (0.0449)	0.1034* (0.0414)	0.091 (0.0475)	0.0697 (0.0448)
Czech Republic, Slovakia, Former Czechoslovakia	0.2572*** (0.0702)	0.2676*** (0.0785)	0.2795*** (0.0799)	0.2852** (0.088)
Ukraine, Moldova	0.1916 (0.1666)	0.1719 (0.1622)	0.1703 (0.1486)	0.1554 (0.1425)
Hungary	-0.0843 (0.167)	-0.1087 (0.1742)	-0.0532 (0.1284)	-0.0719 (0.1387)
Albania	0.2473** (0.0916)	0.2286* (0.0917)	0.1797** (0.0557)	0.169** (0.0523)
Belgium	0.1845*** (0.0387)	0.1981*** (0.0337)	0.1896*** (0.0468)	0.1946*** (0.0409)
Macedonia	0.0632 (0.0771)	0.0456 (0.0739)	0.0454 (0.0806)	0.0369 (0.0776)
Switzerland	0.1497*** (0.0413)	0.1257*** (0.0349)	0.1325** (0.0507)	0.1139** (0.0435)
Bulgaria	0.0117 (0.1148)	0.0523 (0.1197)	-0.2161** (0.0792)	-0.196* (0.0765)
Slovenia	-0.0439 (0.0681)	-0.0243 (0.0603)	-0.0263 (0.0582)	-0.0213 (0.054)
Denmark, Sweden	0.232*** (0.0592)	0.2214*** (0.0454)	0.2315*** (0.0687)	0.2196*** (0.0547)

	Full Sample, Match	Full Sample, TWFE	Reduced Sample, Match	Reduced Sample, TWFE
Finland	0.0323 (0.0895)	0.0075 (0.0669)	0.0794 (0.0966)	0.0309 (0.0734)
Estonia, Latvia, Lithuania	0.0977 (0.0683)	0.1153 (0.0626)	0.0797 (0.0787)	0.1001 (0.0715)
Europe (other)	0.5538*** (0.131)	0.3933** (0.1387)	0.5417*** (0.1446)	0.4083** (0.1343)
Ethiopia	0.043 (0.0689)	0.0284 (0.0737)	-0.001 (0.073)	-0.0112 (0.0754)
Ghana	0.0987 (0.0538)	0.0615 (0.0563)	0.0945* (0.0447)	0.0749 (0.0501)
Morocco	-0.0627* (0.0298)	-0.0562* (0.0281)	-0.0909** (0.029)	-0.0849** (0.0274)
Tunisia	0.0908 (0.0503)	0.0432 (0.0421)	0.0847 (0.0551)	0.0521 (0.0474)
Africa (other)	0.1093** (0.0343)	0.0857** (0.0322)	0.0914** (0.0349)	0.075* (0.0331)
USA, Canada	0.1646*** (0.0336)	0.1415*** (0.0321)	0.14*** (0.0357)	0.1071*** (0.0301)
America (other)	-0.0066 (0.0605)	-0.0235 (0.0572)	-0.0192 (0.076)	-0.0333 (0.0734)
Afghanistan	0.1216 (0.0726)	0.131* (0.0585)	0.0636 (0.07)	0.0743 (0.0582)
Sri Lanka	0.2474*** (0.0476)	0.2144*** (0.0457)	0.1069*** (0.0293)	0.0946*** (0.0275)
Vietnam	-0.0471 (0.06)	-0.052 (0.0622)	-0.0366 (0.0584)	-0.0392 (0.0592)
India	0.0325 (0.0837)	0.0355 (0.0875)	0.0141 (0.0786)	0.0231 (0.0822)
Iraq	0.3026*** (0.0668)	0.2805*** (0.0646)	0.2552*** (0.0632)	0.2463*** (0.0633)
Iran	0.1635** (0.0569)	0.1134* (0.0511)	0.1383* (0.0679)	0.1049 (0.0623)
Lebanon	0.0698 (0.0759)	0.0195 (0.0611)	0.0811 (0.082)	0.0434 (0.0685)
Philippines	-0.0187 (0.0545)	-0.0015 (0.0538)	-0.0475 (0.0587)	-0.0334 (0.0572)
Thailand	-0.1378 (0.1041)	-0.0994 (0.1005)	-0.163 (0.105)	-0.1431 (0.1047)
China, incl. Tibet	-0.1812* (0.0779)	-0.1856** (0.0684)	-0.3155** (0.1146)	-0.3139** (0.1029)
Asia (other)	0.1114** (0.0405)	0.0963* (0.0386)	0.0842* (0.0429)	0.0735 (0.0421)
Oceania	0.2028** (0.0661)	0.1453* (0.0595)	0.1891* (0.0766)	0.1519* (0.0713)
Missing	-0.0722 (0.1032)	-0.0951 (0.0739)	-0.0829 (0.1092)	-0.1017 (0.0883)
<i>School education and vocational training</i>				
Secondary / intermediate school w/o completed vocational training	-0.2325*** (0.0042)	-0.2605*** (0.0038)	-0.2233*** (0.0042)	-0.2434*** (0.0039)
Upper secondary school w/o completed vocational training	-0.3391*** (0.0152)	-0.3914*** (0.0136)	-0.3507*** (0.0167)	-0.3909*** (0.0158)
Upper secondary school with completed vocational training	0.2338*** (0.007)	0.1849*** (0.0065)	0.2385*** (0.007)	0.2019*** (0.0067)
Completion of a university of applied sciences	0.3861*** (0.007)	0.3147*** (0.0064)		

	Full Sample, Match	Full Sample, TWFE	Reduced Sample, Match	Reduced Sample, TWFE
College / university degree	0.5251*** (0.006)	0.4205*** (0.0053)		
Missing	-0.0248*** (0.0061)	-0.1286*** (0.0056)	-0.0143* (0.0062)	-0.0903*** (0.0058)
<i>Year of first employment</i>				
1976	0.1695*** (0.0096)	-0.0001 (0.0078)	0.1761*** (0.0107)	0.0425*** (0.0092)
1977	0.2175*** (0.0096)	-0.0577*** (0.0081)	0.2127*** (0.0104)	-0.0067 (0.0092)
1978	0.2692*** (0.0122)	-0.1032*** (0.0105)	0.2501*** (0.0133)	-0.0486*** (0.0119)
1979	0.2881*** (0.0111)	-0.1924*** (0.0094)	0.2506*** (0.0121)	-0.1355*** (0.0108)
1980	0.3088*** (0.0111)	-0.2679*** (0.0097)	0.2658*** (0.012)	-0.2011*** (0.011)
1981	0.3446*** (0.0093)	-0.3277*** (0.0083)	0.288*** (0.0097)	-0.2553*** (0.0088)
1982	0.3539*** (0.0099)	-0.4104*** (0.009)	0.2737*** (0.0106)	-0.3467*** (0.0098)
1983	0.3846*** (0.0103)	-0.4804*** (0.0093)	0.2946*** (0.0113)	-0.4088*** (0.0105)
1984	0.4202*** (0.0105)	-0.5414*** (0.0092)	0.3155*** (0.0123)	-0.4678*** (0.0114)
1985	0.4444*** (0.01)	-0.615*** (0.0094)	0.3359*** (0.0109)	-0.529*** (0.0104)
1986	0.4523*** (0.0097)	-0.7006*** (0.0091)	0.3266*** (0.0106)	-0.6165*** (0.0101)
1987	0.5063*** (0.0086)	-0.7474*** (0.0077)	0.369*** (0.0093)	-0.657*** (0.0086)
1988	0.5408*** (0.0087)	-0.8142*** (0.0081)	0.3885*** (0.0091)	-0.721*** (0.0086)
1989	0.579*** (0.0077)	-0.8784*** (0.0071)	0.4203*** (0.0082)	-0.7748*** (0.0078)
1990	0.6343*** (0.0072)	-0.9326*** (0.0066)	0.4754*** (0.0075)	-0.8104*** (0.007)
1991	0.6729*** (0.0095)	-1.0128*** (0.0088)	0.503*** (0.0098)	-0.8778*** (0.0093)
1992	0.6705*** (0.0112)	-1.0868*** (0.0105)	0.4827*** (0.0117)	-0.9605*** (0.0112)
1993	0.7112*** (0.01)	-1.134*** (0.0094)	0.5086*** (0.0102)	-1.0113*** (0.0098)
1994	0.7472*** (0.0088)	-1.1981*** (0.0081)	0.5335*** (0.0094)	-1.0692*** (0.0087)
1995	0.772*** (0.0095)	-1.2728*** (0.009)	0.5552*** (0.0097)	-1.1314*** (0.0093)
1996	0.8177*** (0.0094)	-1.3224*** (0.0089)	0.5755*** (0.0099)	-1.1892*** (0.0096)
1997	0.8261*** (0.0108)	-1.4073*** (0.0103)	0.5841*** (0.011)	-1.2603*** (0.0107)
1998	0.8605*** (0.0099)	-1.4658*** (0.0093)	0.605*** (0.0108)	-1.3163*** (0.0104)
1999	0.6538*** (0.0087)	-1.7615*** (0.0083)	0.3744*** (0.0093)	-1.6194*** (0.009)
2000	0.7696*** (0.011)	-1.7423*** (0.0105)	0.4832*** (0.0117)	-1.592*** (0.0113)

	Full Sample, Match	Full Sample, TWFE	Reduced Sample, Match	Reduced Sample, TWFE
2001	0.7744*** (0.0106)	-1.829*** (0.01)	0.4731*** (0.0106)	-1.6797*** (0.0102)
2002	0.7907*** (0.0127)	-1.9012*** (0.0121)	0.4934*** (0.0128)	-1.7337*** (0.0123)
2003	0.7585*** (0.0155)	-2.0238*** (0.0151)	0.4462*** (0.0154)	-1.8594*** (0.0151)
2004	0.7291*** (0.0148)	-2.1341*** (0.0141)	0.3967*** (0.0155)	-1.9774*** (0.0149)
2005	0.7176*** (0.0166)	-2.2329*** (0.0159)	0.3691*** (0.0177)	-2.0809*** (0.0171)
2006	0.7364*** (0.0187)	-2.3*** (0.0171)	0.3755*** (0.0197)	-2.146*** (0.0185)
2007	0.7236*** (0.02)	-2.4004*** (0.0185)	0.3523*** (0.0219)	-2.2461*** (0.0205)
2008	0.755*** (0.0274)	-2.4621*** (0.0261)	0.3536*** (0.0276)	-2.3267*** (0.0264)
Age at first employment	0.0455*** (0.0003)	0.1075*** (0.0002)	0.0644*** (0.0003)	0.1208*** (0.0003)
Constant	-1.4123*** (0.0078)	-1.7287*** (0.0071)	-1.652*** (0.0081)	-2.0611*** (0.0076)
Number of observations	3062118	3062118	2720888	2720888
R-squared	0.2509	0.7443	0.27981496	0.737457

Omitted Categories: *Nationality, grouped:* Germany; *School education and vocational training:* Secondary/intermediate school with completed vocational training; *Year of first employment:* 1975 or earlier;

Notes: Significance levels: *: Significant at 5%; **: Significant at 1%; ***: Significant at 0.1%.

Table A8: Regression of Match and Firm Fixed Effects on Pre-Match Characteristics, All Coefficients

	Match Effect	Firm Effect
Part time job (at beginning of match)	-0.1187*** (0.0047)	-0.6257*** (0.0151)
<i>Employment status 8 days before current match</i>		
No previous record	-0.04*** (0.0066)	-0.0796*** (0.0176)
Previous spell was benefits or gap	-0.0012 (0.0039)	-0.057*** (0.0107)
Apprentice/trainee at other firm	0.0074 (0.0155)	-0.0164 (0.0488)
Number of Days in Labor Market Status 8 Days before current match (main effect)	-0.000001 (0.000001)	0.000009*** (0.000002)
...if previous spell was benefits or gap (interaction)	0.000001 (0.000003)	0.000003 (0.000008)
...if previous spell was training (interaction)	0.000016 (0.000019)	0.000009 (0.000058)
<i>Year Match Started</i>		
1994	0.0024 (0.0059)	0.0315 (0.0172)
1995	0.0115 (0.0079)	-0.0106 (0.0243)
1996	0.0145* (0.0071)	0.0104 (0.0173)
1997	0.0126 (0.0081)	0.0105 (0.0236)
1998	0.0217** (0.0067)	-0.015 (0.0168)
1999	-0.0181 (0.0104)	-0.1885*** (0.029)
2000	-0.0035 (0.0071)	-0.0955*** (0.0189)
2001	0.0138* (0.0063)	-0.0263 (0.0163)
2002	0.0189** (0.0059)	-0.0035 (0.0166)
2003	0.0243*** (0.0069)	-0.1059*** (0.0213)
2004	0.0223*** (0.0059)	-0.0391 (0.0267)
2005	0.026*** (0.0062)	-0.0119 (0.0189)
2006	0.0353*** (0.0063)	-0.0048 (0.0194)
2007	0.0436*** (0.006)	0.0327 (0.0185)
2008	0.0561*** (0.0065)	0.025 (0.0188)
Female	-0.0529 (0.0433)	-0.376*** (0.1055)
Number of days of benefit receipt up to beginning of current match	0.000007* (0.000003)	-0.000082*** (0.000009)
Years since first employment at beginning of current match	0.0024** (0.0009)	-0.0046* (0.0022)
...interacted with female dummy	-0.0024 (0.0014)	-0.0132*** (0.0036)

	Match Effect	Firm Effect
Years since first employment squared	-0.000129*** (0.00003)	-0.000058 (0.000077)
...interacted with female dummy	0.000082 (0.000048)	0.000457*** (0.000131)
Age at beginning of current match	0.0024 (0.0015)	0.0364*** (0.0038)
...interacted with female dummy	0.0043 (0.0025)	0.0221*** (0.0059)
Age squared	-0.00002 (0.000019)	-0.000387*** (0.000048)
<i>Match Count</i>		
2	-0.0063 (0.0043)	0.0612*** (0.0117)
...interacted with female dummy	0.0071 (0.0065)	0.0027 (0.0207)
3	-0.0229** (0.0087)	0.0958*** (0.0236)
...interacted with female dummy	0.0208 (0.0142)	-0.0253 (0.052)
4	-0.0576* (0.0252)	0.1722*** (0.0401)
...interacted with female dummy	0.0807 (0.0562)	0.1501 (0.1395)
5	0.1193*** (0.0188)	-0.05 (0.0573)
...interacted with female dummy	-0.0815 (0.0757)	0.1983 (0.1426)
6	-0.2742*** (0.0055)	0.2965*** (0.0263)
...interacted with female dummy	0.0918*** (0.0086)	-0.3977*** (0.0315)
Constant	-0.0565* (0.0258)	3.7472*** (0.0691)
Number of observations	665080	665080
R-squared	0.0343	0.2189
Omitted Categories: <i>Emp. Status 8 days before current match:</i> Employment at other Firm; <i>Year Match Started:</i> 1993; <i>Match Count:</i> 1		
Note: Estimates of Match and Firm Fixed Effects are from main regression on full sample. Significance levels: *: Significant at 5%; **: Significant at 1%; ***: Significant at 0.1%.		