

Technological Substitution of Jobs and the Transferability of Human Capital

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Motivation

- Existing literature on the aggregate **decline of manual-routine occupations** due to substitution by automation capital (e.g., Autor and Dorn, 2003; Goos et al., 2014)
- But: Evidence on how **individuals** working in these occupations **fare** after (technology-induced) displacement and on the **sources of adjustment costs** is lacking
- Occupation- and task-specific **human capital** (e.g., Gibbons and Waldman, 2004; Gathmann and Schönberg, 2010) and changes in the **occupational structure** may be a major reason why **manual-routine** workers might face **particular difficulties** to adjust to labor market shocks

Research Question

Do workers initially employed in manual-routine occupations face **more difficult transitions** after job displacement than other displaced workers and, if so, **why**?

Empirical Strategy

Exploit exogenous job losses due to plant closures

- Plant closures** as job separations arguably exogenous to worker characteristics and productivity (e.g., Jacobson et al., 1993; Schmieder et al., 2022)

Matching on pre-displacement characteristics and wages

- Match displaced workers to non-displaced workers on pre-displacement outcomes and a large number of worker characteristics ("**statistical twins**")
- Accounts for remaining concerns of treatment selection at the establishment level

Summary Statistics of Unmatched and Matched Samples

	All Baseline	All Displaced	Difference	Matched Controls	Matched Displaced	Difference
% Manufacturing	59.02	65.62	6.6	63.91	63.91	0 (exact matching)
% Female	32.16	32.45	0.29	30.73	30.73	0 (exact matching)
% East Germany	11.43	19.09	7.66	6.07	6.07	0 (exact matching)
% College degree	7.42	5.53	1.89	3.69	3.69	0 (exact matching)
% Manual-routine intensive	17.4	15.6	1.8	17.0	17.0	0 (exact matching)
Age	41.50	41.43	0.07	41.28	41.28	0 (exact matching)
Real daily wage	111.96	110.89	11.29	110.89	109.54	1.35 (1.07)
Days working per year	362.03	361.80	0.14	362.12	362.35	0.23 (0.84)
Number of workers	731,643	21,776		17,420	17,420	

Notes: This table shows summary statistics of our data. The displaced sample is the subset of workers from the baseline sample that are displaced once due to a plant closure in the period 1980–2016. The matched displaced sample consists of displaced workers from the baseline sample that can be matched to an observationally similar never-displaced (control) workers. t-statistics for the differences in observables between non-displaced (control) workers and displaced workers after the matching procedure are provided in parentheses.
Data: Administrative German labor market records (SIAB).

Data and Variables

Employee Panel: Sample of Integrated Labor Market Biographies (SIAB)

- Administrative** German labor market data
- 2% random sample from the **universe of employees** in Germany subject to social security contributions from 1975–2019
- Complete labor market biographies** of workers exact to the day:
 - Employment, wage, establishment, and occupational **histories**
 - Information about worker **demographics** (e.g., age, gender, and education), and **establishment characteristics** (e.g., industry, size, and location)
 - Wages:** During unemployment, individuals are assigned their social security benefits as wage income
 - Task distance:** Change in the share of the main pre-displacement task in the post-displacement occupation conditional on occupational switching; main pre-displacement task is the task that was performed most often in the last job before displacement

Establishment Panel: Betriebs-Historik-Panel (BHP)

- Administrative German firm level panel, **universe of establishments** in Germany from 1975–2019
- Plant closure:** Establishment ceases to exist from one year to another, no more than 30% of the plant's original employees re-employed in the same plant in the subsequent year (e.g., Hethey-Maier and Schmieder, 2013)

Occupational Task Composition: BERUFENET

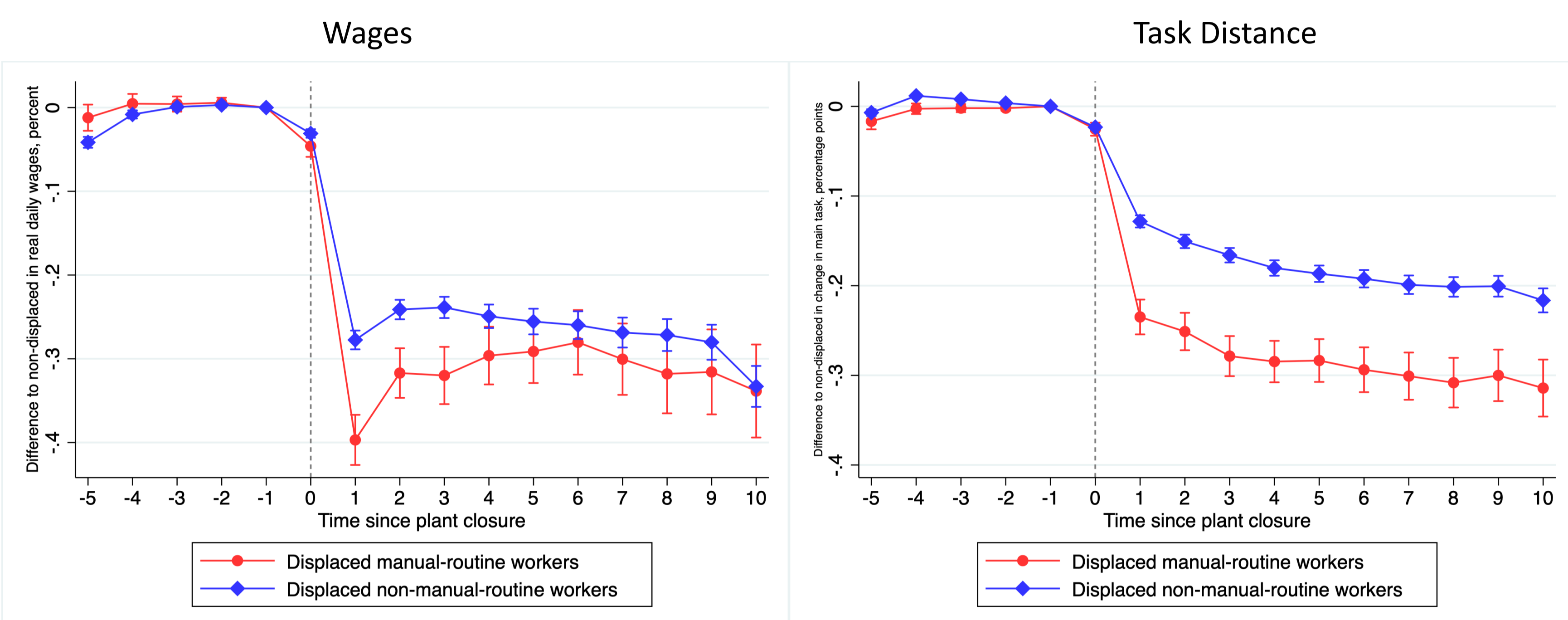
- German **dictionary of occupational titles** (BERUFENET), similar to US-O*NET
- 144 occupations at the 3-digit level
- Share of (1) manual-routine tasks, (2) manual non-routine tasks, (3) cognitive routine tasks, (4) analytical non-routine tasks, (5) interactive non-routine tasks
- Manual-routine workers:** Above-median share of manual-routine tasks; all other workers are classified as **non-manual-routine** (e.g., Dengler and Matthes, 2015)

Empirical Specification

$$Y_{it} = \sum_{k=j}^J \beta_k^1 T_{it}^k + \sum_{k=j}^J \beta_k^2 T_{it}^k \times Disp_i + \sum_{k=j}^J \beta_k^3 T_{it}^k \times Occ_i + \sum_{k=j}^J \beta_k^4 T_{it}^k \times Disp_i \times Occ_i + \alpha_i + \tau_t + X_{it}' \Gamma + \epsilon_{it}$$

- Y_{ij} : Outcome of interest (e.g., wages, employed, occupational switching) of individual i at time t
- T_{it}^k : Indicators for being observed at time k relative to the displacement event at $k = 0$
- $Disp_i$: Indicator for being a worker affected by job displacement due to plant closure
- Occ_i : Indicator for being employed in a manual-routine-intensive occupation pre-displacement
- α_i : Individual fixed effects; τ_t : Calendar year fixed effects
- X_i : Vector of time-varying controls (i.e., quadratic polynomial in age)
- ϵ_{it} : Idiosyncratic error term
- Implement alternative event-study estimators to account for heterogeneous treatment effects over time (e.g., Callaway and Sant'Anna, 2021)

Main Results



- Wages:** Manual-routine workers face significantly **larger reductions in real daily wages** than non-manual-routine workers immediately after displacement (39% vs. 28%).
- Differences persist up to 3 years after displacement**
- Task distance:** Manual-routine workers switch to **more distant occupations**, experience a larger decline in their main task share compared to non-manual-routine workers (23% vs. 12%)
- Consistent with the secular decline in routine occupations, manual-routine workers have **fewer re-employment opportunities in the same or skill-related occupations**
- **Larger losses in occupation- and task-specific human capital**, shown to be an important component of workers' wages (e.g., Gibbons and Waldman, 2004; Poletaev and Robinson, 2008; Kambourov and Manovskii, 2009; Gathmann and Schönberg, 2010; Nedelkoska et al., 2022)

Further Results and Robustness

Further Results

- Larger displacement-induced wages losses** for manual-routine workers result from both
 - Extensive margin** (52% higher propensity of being **unemployed**)
 - Intensive margin** (41% larger **wage losses conditional on being employed**)
- Compared to non-manual-routine workers, **manual-routine workers are**
 - 33% more likely to **switch (4-digit) occupations** directly after displacement (conditional on re-employment)
 - 11% less likely to **change district of workplace** directly after displacement (conditional on re-employment)

Entropy Balancing

- Manual-routine and non-manual-routine workers differ along various dimensions (e.g., education, age, gender, industry)
- Reweight manual-routine workers to obtain **covariate balance** between manual-routine and non-manual-routine workers (e.g., Hainmueller, 2012; Illing et al., 2021)

Conclusions

More difficult transitions after labor market shocks for workers who are initially employed in **manual-routine occupations**:

- Larger wages losses** for manual-routine workers, which stem from both a higher propensity of being **unemployed** and larger **wage losses conditional on finding re-employment**
- Switch to **more distant occupations** than non-manual-routine workers
- Patterns are consistent with **declining re-employment opportunities** in (skill-related) manual-routine occupations