Online Appendix

to “War, Coal, And Forced labor”

Online Appendix I––The potential-outcomes framework

Suppose one wishes to explore the causal effect of a treatment on a continuous outcome variable *Yjd* observed for a range of subjects *j* = 1, ..., *J*. Let *d* = 0 denote the case of no-treatment (the control case) and *d* = 1 the case of treatment. Hence, *Yj0* is the potential outcome for subject *j* when being the control and *Yj1* is the potential outcome when being treated. The baseline problem of observational data is that one either observes *Yj0*or*Yj1* for subject *j*, but never both. Here the potential-outcomes framework comes into play; it can be described by the following three equations (e.g., Wooldridge 2010, pp. 903–907):

(1) *Yj0* = *Xjβ0* + *uj0* ,

(2) *Yj1* = *Xjβ1* + *uj1* ,

1 if *Wjδ* + *vj* > 0

0, otherwise

(3) *dj* = .

Equations (1) and (2) model the outcome process as dependent on a set of covariates *X* and error terms *u* unrelated to either *X* or *W*. Equation (3) models the treatment-assignment process where selection into treatment is assumed dependent on a vector of covariates *W* and an error term *v* likewise unrelated to either *X* or *W*. If *u* is independent of *v* the assumption of exogenously assigned treatment holds. We can alternatively say that *W* includes *all* variables that affect treatment assignment, such that there are no unobserved confounders left.

Two measures are of particular interest for the empiricist, when applying treatment effects methodology, namely, the *average treatment effect in the populatio*n (ATE) and the *average treatment effect on the treated* (ATET):

(4) ATE = E[*Y1j –Y0j*] , and

(5) ATET = E[*Y1j –Y0j* ǀ *dj* = 1] .

The ATET commonly is the effect of interest when evaluating policies (Heckman and Vyt-lacil 2001, p. 107; Ho et al. 2007, p. 204; Smith and Sweetman 2016, p. 874).

In order to derive (4) and (5), two other assumptions, besides unconfoundedness (or conditional mean independence), have to be met, namely that the distribution of outcomes given controls *X* is the same in both states *dj* and that both groups of subjects––treated and untreated––sufficiently overlap, i.e., each subject faces the same probability to be selected into treatment based on its individual characteristics.

Online Appendix II––Checking for the identifying assumptions

To start with the assumption of unconfoundedness, there is no easy-to-apply statistical test applicable. My choice of covariates for the auxiliary regressions is informed by the mean comparison tests; insofar the choice is not arbitrary. From a theoretical-philosophical point of view, this may reduce the risk of running into the problem of confoundedness. Be it as it may, endogeneity may still be a potential problem. To get a hold on whether it might be, I tested the baseline model *without* interactions (see the main text) for possible correlation between the unobservables in the outcome model and those in the treatment assignment model using the control-function approach described in Wooldridge (2010, pp. 945–50). I did not find evidence of endogeneity which supports the conclusion that treatment assignment is, as to be wished, *conditionally* random (test results available upon request), and, thus, correctly specified. This implies that––to bring the doubly-robust property of IPWRA into play––my model of the outcome process may even be missspecified; the causal effect of POW employment on labor-productivity growth as inherent in the results displayed in Table 5 in the main text can still be considered as estimated consistently.

Second, the balancing effect of the inverse-probability weighting can be assessed by comparing the standardized differences or the variance ratios of the covariates’ raw distributions with their weighted distributions. I settle for standardized differences. These are shown in Table A.5 for the baseline model without additional interactions as well as for a second model which I extended for all interactions, namely six, between the four continuous covariates in *W*. The reason for including these additional interactions is that it is a recommended tool for improving the covariate balance. After weighting with the inverse propensity score, the standardized differences should be close(r) to zero. Comparing the raw with the weighted standardized differences, this broadly holds for both specifications. In a number of cases, adding additional interactions further improved the covariate balance, as the column on the far right in Table A.5 indicates.

Finally, third, we can graphically test whether the overlap assumption holds. It states that, after controlling for the determinants of treatment assignment, the *ex-ante* probability of being selected into treatment has to be, broadly, equal for every observational unit. As Figure A.2 illustrates for the specification including interactions, the distributions of the propensity scores by treatment level indeed show sufficient overlap.

Taken together, the tests lend support to view that the extended specification, for which I discuss the output in the main text, meets the basic assumptions of the potential-outcomes framework and thus provides consistent estimates of the ATET.

Online Appendix III––Additional Tables and Figures

Table A.1: Variable description and sources

|  |  |  |
| --- | --- | --- |
|  |  |  |
| Variable | Description | Source |
|  |  |  |
|  |  |  |
| *(A) Mine characteristics* |  |  |
|  Location | 1, 2, …, 23 for the mining offices (*Bergreviere*) the Ruhr coal district was subdivided into | Jahrbuch |
|  Mine age | Years since mine i’s first year of operation | Gebhardt (1957); Huske (1998) |
|  Mine output (scale) | Annual hard coal production in tons | Jahrbuch |
|  Mine-output growth | [scale (t) – scale(t-1)] / scale(t-1) | Author’s calculation |
|  Total employment | # of overall employed mineworkers | Jahrbuch |
|  Regular employment | # of employed regular mineworkers | Jahrbuch |
|  Regular-employment growth | [regular employment(t) – regular employment(t-1)] / regular employment(t-1) | Author’s calculation |
|  POWS | # of prisoners of war employed | Jahrbuch |
|  POW share | POWS divided by total employment  | Author’s calculation |
|  Labor productivity | Mine output divided by total employment | Author’s calculation |
|  Labor-productivity growth | [labor productivity(t) – labor productivity(t-1)] / labor productivity(t-1) | Author’s calculation |
| *(B) Firm characteristics*  |  |  |
|  Single-mine firm | 1 if mine is a firm’s only mine | Jahrbuch |
|  Joint-stock company | 1 if firm is joint-stock company | Jahrbuch |
|  Gewerkschaft | 1 if firm is Gewerkschaft | Jahrbuch |
|  Limited-liability company | 1 if firm is limited-liability company | Jahrbuch |
|  Other company type | 1 if firm has other company form | Jahrbuch |
|  State owned | 1 if firm is state owned | Gebhardt (1957) |
|  Vertically integrated | 1 if firm is vertically integrated (e.g., foundry) | Gebhardt (1957) |
|  Firm output | Sum of output over mines belonging to firm j | Jahrbuch |
|  Market share | Firm j’s output in percent of total Ruhr output | Author’s calculation |
|  |  |  |

Notes: All variables collected year by year. “Jahrbuch” is short for *Jahrbuch für den Oberbergamtsbezirk Dortmund* (and the respective supplement) edited by the Verein für die bergbaulichen Interessen (1913–21).

Table A.2: Characteristics of mines across groups in 1914­­––Which mines started to employ POWs first?

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  |  |  |
| Variable | All mines | No POWsemployed in 1915 | POWsemployed in 1915 | Difference |
|  |  |  |  |  |
|  |  |  |  |  |
| *(A) Mine characteristics* |  |  |  |  |
|  Location | 12.3 | 13.2 | 12.0 | 1.2 |
|  | [6.6] | [6.2] | [6.8] | (1.1) |
|  Mine age | 42.3 | 43.3 | 41.9 | 1.4 |
|  | [19.8] | [21.4] | [19.1] | (3.4) |
|  Mine output (scale) | 586,490 | 330,740 | 707,515 | 376,776\*\*\* |
|  | [501,354] | [259,551] | [542,036] | (62,404) |
|  Mine-output growth | –0.14 | –0.15 | –0.14 | –0.01 |
|  | [0.17] | [0.27] | [0.11] | (0.04) |
|  Total employment | 2,267 | 1,280 | 2,734 | –1,453\*\*\* |
|  | [1,809] | [995] | [1,920] | (227) |
|  Regular-employment growth | –0.07 | –0.09 | –0.06 | –0.03 |
|  | [0.14] | [0.22] | [0.06] | (0.03) |
|  Labor productivity | 252.7 | 244.7 | 256.5 | –11.8 |
|  | [44.6] | [64.5] | [30.8] | (9.3) |
|  Labor-productivity growth | –0.08 | –0.07 | –0.08 | –0.01 |
|  | [0.10] | [0.16] | [0.06] | (0.02) |
|  Single-mine firm | 0.3 | 0.3 | 0.3 | 0.1 |
|  | [0.5] | [0.5] | [0.4] | (0.1) |
| *(B) Firm characteristics* |  |  |  |  |
|  Joint-stock company | 0.58 | 0.55 | 0.60 | –0.05 |
|  | [0.49] | [0.50] | [0.49] | (0.08) |
|  Gewerkschaft | 0.29 | 0.32 | 0.28 | 0.04 |
|  | [0.45] | [0.47] | [0.45] | (0.08) |
|  Limited-liability company | 0.06 | 0.07 | 0.05 | 0.02 |
|  | [0.24] | [0.27] | [0.23] | (0.04) |
|  Other company type | 0.06 | 0.06 | 0.06 | –0.00 |
|  | [0.24] | [0.23] | [0.24] | (0.04) |
|  State owned | 0.07 | 0.09 | 0.06 | 0.03 |
|  | [0.26] | [0.29] | [0.24] | (0.05) |
|  Vertically integrated | 0.34 | 0.17 | 0.43 | –0.26\*\*\* |
|  | [0.48] | [0.38] | [0.50] | (0.07) |
|  Market share | 0.03 | 0.02 | 0.03 | –0.01\* |
|  | [0.03] | [0.02] | [0.03] | (0.00) |
|  |  |  |  |  |
|  |  |  |  |  |
|  Number of mines | 165 | 112 | 53 |  |
|  |  |  |  |  |

Notes: Compared are the 1914 values of the mines starting to employ POWs in 1915 with the 1914 values of those mines that did not start using POWs in 1915. The latter group here includes all mines that never employed POWS as well as the mines that started to employ POWs in 1916 or later. Shown are the results of t-test on the equality of the means across groups. Unequal variance in the groups is assumed. Standard deviations are in brackets and standard errors are in parentheses. Significance levels are as follows: \* p<0.10, \*\* p<0.05, \*\*\* p<0.01.

Sources: Author’s computations.

Table A.3: Coefficient estimates on the outcome and treatment-assignment processes underlying Table 5 in the main text––binary treatment

|  |  |  |
| --- | --- | --- |
|  |  |  |
| Variable | Coefficient estimate | Standard error |
|  |  |  |
|  |  |  |
| *Outcome model for treatment = 0* |  |  |
|  |  |  |
|  Labor productivity (-1) | –0.0008\*\*\* | (0.0002) |
|  Mine size | +0.0000\*\*\* | (0.0000) |
|  Mine age | –0.0002  | (0.0003) |
|  Firm’s market share | –0.0019 | (0.0018) |
|  Average mining district-level capital intensity | +0.0001\*\*\* | (0.0000) |
|  Average mining district-level shifts per employee | +0.0017\*\*\* | (0.0003) |
|  Average mining-district-level real wage | +0.0017\*\*\* | (0.0003) |
|  Constant | –4.0820\*\*\* | (0.6196) |
|  |  |  |
|  |  |  |
| *Outcome model for treatment = 1* |  |  |
|  |  |  |
|  Labor productivity (-1) | –0.0002 | (0.0002) |
|  Mine size | –0.0000 | (0.0000) |
|  Mine age | +0.0001 | (0.0003) |
|  Firm’s market share | +0.0012 | (0.0018) |
|  Average mining district-level capital intensity | –0.0000 | (0.0000) |
|  Average mining district-level shifts per employee | –0.0042\*\*\* | (0.0005) |
|  Average mining-district-level real wage | +0.0001 | (0.0001) |
|  Constant | +1.7479\*\*\* | (0.5076) |
|  |  |  |
|  |  |  |
| *Treatment assignment model (treated = yes)* |  |  |
|  |  |  |
|  Mine size (-1) | +0.0000\* | (0.0000) |
|  Labor productivity (-1) | –0.0017 | (0.0025) |
|  Vertically integrated firm | +0.1013 | (0.1676) |
|  Single-mine firm | –0.1721 | (0.1980) |
|  Regular-employment growth (-1) | –0.0078 | (0.0092) |
|  Firm’s market share (-1) | +0.3526\* | (0.2068) |
|  Mine size (-1) × Labor productivity (-1) | –0.0000\* | (0.0000) |
|  Mine size (-1) × Regular-employment growth (-1) | –0.0000\*\*\* | (0.0000) |
|  Mine size (-1) × Firm’s market share (-1) | –0.0000 | (0.0000) |
|  Labor productivity (-1) × Regular-employment growth (-1) | +0.0000 | (0.0000) |
|  Labor productivity (-1) × Firm’s market share (-1) | –0.0014\* | (0.0008) |
|  Regular-employment growth (-1) × Firm’s market share (-1) | +0.0007 | (0.0018) |
|  Constant | +1.2333\* | (0.7128) |
|  |  |  |

Notes: Results on the extended specification including interactions reported. The number of observations is 993. The dependent variable in the underlying outcome model is labor productivity growth. Robust standard errors are in parentheses.

Sources: Author’s computations.

Table A.4: Coefficient estimates on the outcome and treatment assignment processes underlying Table 5 in the main text––multivalued treatment

|  |  |  |
| --- | --- | --- |
|  |  |  |
| Variable | Coefficient estimate | Standard error |
|  |  |  |
|  |  |  |
| *Outcome model for treatment = 0* |  |  |
|  |  |  |
|  Labor productivity (-1) | –0.0006\*\* | (0.0002) |
|  Mine size | +0.0000\*\*\* | (0.0000) |
|  Mine age | +0.0004 | (0.0003) |
|  Firm’s market share | +0.0008 | (0.0019) |
|  Average mining district-level capital intensity | +0.0001\*\*\* | (0.0000) |
|  Average mining district-level shifts per employee | +0.0014\*\*\* | (0.0003) |
|  Average mining-district-level real wage | +0.0016\*\*\* | (0.0002) |
|  Constant | –3.7732\*\*\* | (0.5334) |
|  |  |  |
|  |  |  |
| *Outcome model for treatment = 1* |  |  |
|  |  |  |
|  Labor productivity (-1) | –0.0004\*\* | (0.0001) |
|  Mine size | –0.0000 | (0.0000) |
|  Mine age | –0.0010\*\*\* | (0.0004) |
|  Firm’s market share | –0.0034 | (0.0022) |
|  Average mining district-level capital intensity | –0.0000 | (0.0000) |
|  Average mining district-level shifts per employee | –0.0033\*\*\* | (0.0007) |
|  Average mining-district-level real wage | +0.0001 | (0.0002) |
|  Constant | +1.4630\* | (0.8266) |
|  |  |  |
|  |  |  |
| *Outcome model for treatment = 2* |  |  |
|  |  |  |
|  Labor productivity (-1) | –0.0002\* | (0.0001) |
|  Mine size | –0.0000 | (0.0000) |
|  Mine age | –0.0006 | (0.0004) |
|  Firm’s market share | –0.0011 | (0.0023) |
|  Average mining district-level capital intensity | +0.0000 | (0.0000) |
|  Average mining district-level shifts per employee | –0.0048\*\*\* | (0.0012) |
|  Average mining-district-level real wage | +0.0005\*\* | (0.0002) |
|  Constant | +0.9737\* | (0.5983) |
|  |  |  |
|  |  |  |
| *Outcome model for treatment = 3* |  |  |
|  |  |  |
|  Labor productivity (-1) | –0.0007\*\* | (0.0003) |
|  Mine size | +0.0000\* | (0.0000) |
|  Mine age | –0.0012\*\*\* | (0.0004) |
|  Firm’s market share | –0.0111\*\* | (0.0048) |
|  Average mining district-level capital intensity | +0.0000 | (0.0000) |
|  Average mining district-level shifts per employee | –0.0001 | (0.0011) |
|  Average mining-district-level real wage | –0.0002 | (0.0003) |
|  Constant | +0.1445 | (0.8852) |
|  |  |  |

Table A.4 continued.

|  |  |  |
| --- | --- | --- |
|  |  |  |
| Variable | Coefficient estimate | Standard error |
|  |  |  |
|  |  |  |
| *Treatment assignment model (treated = yes for mines treated with treatment level 1)* |  |  |
|  |  |  |
|  Mine size (-1) | +0.0000\*\*\* | (0.0000) |
|  Labor productivity (-1) | +0.0045 | (0.0034) |
|  Vertically integrated firm | +0.0513 | (0.2108) |
|  Single-mine firm | –0.0937 | (0.2626) |
|  Regular-employment growth (-1) | –0.0450\* | (0.0261) |
|  Firm’s market share (-1) | +0.5146\*\* | (0.2597) |
|  Mine size (-1) × Labor productivity (-1) | –0.0000\*\*\* | (0.0000) |
|  Mine size (-1) × Regular-employment growth (-1) | –0.0000\*\*\* | (0.0000) |
|  Mine size (-1) × Firm’s market share (-1) | –0.0000\*\* | (0.0000) |
|  Labor productivity (-1) × Regular-employment growth (-1) | +0.0001 | (0.0001) |
|  Labor productivity (-1) × Firm’s market share (-1) | –0.0015 | (0.0010) |
|  Regular-employment growth (-1) × Firm’s market share (-1) | +0.0023 | (0.0022) |
|  Constant | –2.3178\*\* | (0.9712) |
|  |  |  |
|  |  |  |
| *Treatment assignment model (treated = yes for mines treated with treatment level 2)* |  |  |
|  |  |  |
|  Mine size (-1) | +0.0000\*\* | (0.0000) |
|  Labor productivity (-1) | +0.0002 | (0.0030) |
|  Vertically integrated firm | +0.1214 | (0.2054) |
|  Single-mine firm | –0.5610\*\* | (0.2406) |
|  Regular-employment growth (-1) | –0.0074 | (0.0102) |
|  Firm’s market share (-1) | +0.4830\* | (0.2590) |
|  Mine size (-1) × Labor productivity (-1) | –0.0000\*\* | (0.0000) |
|  Mine size (-1) × Regular-employment growth (-1) | –0.0000\*\* | (0.0000) |
|  Mine size (-1) × Firm’s market share (-1) | –0.0000\* | (0.0000) |
|  Labor productivity (-1) × Regular-employment growth (-1) | –0.0000 | (0.0000) |
|  Labor productivity (-1) × Firm’s market share (-1) | –0.0020\*\* | (0.0010) |
|  Regular-employment growth (-1) × Firm’s market share (-1) | +0.0040\* | (0.0023) |
|  Constant | –0.5647 | (0.8576) |
|  |  |  |
|  |  |  |
| *Treatment assignment model (treated = yes for mines treated with treatment level 3)* |  |  |
|  |  |  |
|  Mine size (-1) | +0.0000 | (0.0000) |
|  Labor productivity (-1) | –0.0033 | (0.0041) |
|  Vertically integrated firm | +1.0017\*\*\* | (0.2779) |
|  Single-mine firm | –0.2759 | (0.3388) |
|  Regular-employment growth (-1) | –0.0296 | (0.0223) |
|  Firm’s market share (-1) | +0.9821\* | (0.5283) |
|  Mine size (-1) × Labor productivity (-1) | –0.0000 | (0.0000) |
|  Mine size (-1) × Regular-employment growth (-1) | +0.0000 | (0.0000) |
|  Mine size (-1) × Firm’s market share (-1) | –0.0000\*\* | (0.0000) |
|  Labor productivity (-1) × Regular-employment growth (-1) | –0.0000 | (0.0001) |
|  Labor productivity (-1) × Firm’s market share (-1) | –0.0040\* | (0.0040) |
|  Regular-employment growth (-1) × Firm’s market share (-1) | –0.0023 | (0.0035) |
|  Constant | –0.6734 | (1.0939) |
|  |  |  |

Notes: Results on the extended specification including interactions reported. The number of observations is 993. The dependent variable in the underlying outcome model is labor-productivity growth. Robust standard errors are in parentheses.

Sources: Author’s computations.

Table A.5: A nonparametric test for covariate balance based on standardized differences

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |
| Variable | Model 1:Baseline |  | Model 2:Additional interactions | Improvement from model 1 towards model 2 |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  | Raw | Weighted |  | Raw | Weighted |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| *(A) Binary treatment model* |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  Mine size (-1) | –0.155 | +0.002 |  | –0.155 | +0.080 | No |
|  Labor productivity (-1) | –0.293 | +0.020 |  | –0.293 | +0.024 | No |
|  Vertically integrated firm | +0.074 | +0.012 |  | +0.074 | +0.007 | Yes |
|  Single-mine firm | –0.008 | –0.015 |  | –0.008 | –0.006 | Yes |
|  Regular-employment growth (-1) | –0.283 | +0.005 |  | –0.283 | –0.055 | No |
|  Firm’s market share (-1) | –0.027 | +0.015 |  | –0.027 | +0.019 | No |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| *(B) Multivalued treatment* *model* |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| (B1) Treatment Level 1 |  |  |  |  |  |  |
|  Mine size (-1) | +0.068 | +0.029 |  | +0.068 | –0.021 | Yes |
|  Labor productivity (-1) | –0.052 | +0.085 |  | –0.052 | –0.032 | Yes |
|  Vertically integrated firm | +0.132 | +0.011 |  | +0.132 | –0.050 | No |
|  Single-mine firm | –0.151 | –0.034 |  | –0.151 | +0.07 | Yes |
|  Regular-employment growth (-1) | –0.460 | –0.203 |  | –0.460 | –0.171 | Yes |
|  Firm’s market share (-1) | +0.192 | +0.026 |  | +0.192 | +0.008 | Yes |
|  |  |  |  |  |  |  |
| (B2) Treatment level 2 |  |  |  |  |  |  |
|  Mine size (-1) | +0.124 | +0.025 |  | +0.124 | +0.113 | No |
|  Labor productivity (-1) | –0.253 | –0.002 |  | –0.253 | +0.042 | No |
|  Vertically integrated firm | +0.179 | +0.050 |  | +0.179 | +0.015 | Yes |
|  Single-mine firm | –0.154 | +0.001 |  | –0.154 | +0.026 | No |
|  Regular-employment growth (-1) | –0.269 | +0.098 |  | –0.269 | +0.006 | Yes |
|  Firm’s market share (-1) | +0.008 | +0.010 |  | +0.008 | +0.006 | Yes |
|  |  |  |  |  |  |  |
| (B3) Treatment level 3 |  |  |  |  |  |  |
|  Mine size (-1) | –0.160 | –0.077 |  | –0.160 | –0.027 | Yes |
|  Labor productivity (-1) | –0.368 | +0.185 |  | –0.368 | +0.283 | No |
|  Vertically integrated firm | +0.400 | +0.044 |  | +0.400 | +0.018 | Yes |
|  Single-mine firm | –0.001 | –0.082 |  | –0.001 | –0.061 | Yes |
|  Regular-employment growth (-1) | –0.481 | –0.136 |  | –0.481 | –0.333 | No |
|  Firm’s market share (-1) | –0.200 | –0.114 |  | –0.200 | +0.112 | Yes |
|  |  |  |  |  |  |  |

Notes: Output on interactions omitted for reasons of space.

Sources: Author’s computations.

Table A.6: Summary results on the doubly robust estimation of the treatment effect when outliers are kept

|  |  |  |
| --- | --- | --- |
|  |  |  |
| Effect | Level comparison | Estimates |
|  |  |  |
|  |  |  |
| *(A) Binary treatment model* |  |  |
|  |  |  |
|  ATET | 1 vs. 0 | –0.720\* (0.403) |
|  POM | 0 | +0.772\* (0.405) |
|  |  |  |
| *(B) Multivalued treatment model* |  |  |
|  |  |  |
|  ATET | 1 vs. 0 | –0.013 (0.110) |
|  | 2 vs. 0 | –0.156 (0.099) |
|  | 3 vs. 0 | –0.260\*\*\* (0.098) |
|  POM | 0 | +0.158 (0.099) |
|  |  |  |

Notes: The number of observations is 1,027. The dependent variable in the underlying outcome model is labor productivity growth. Robust standard errors are in parentheses. ATET is “average treatment effect on the treated”. POM is “potential-outcome mean”.

Sources: Author’s computations.

Table A.7: Summary results on the doubly robust estimation of the treatment effect when the years 1919 and 1920 are included as additional control years

|  |  |  |
| --- | --- | --- |
|  |  |  |
| Effect | Level comparison | Estimates |
|  |  |  |
|  |  |  |
| *(A) Binary treatment model* |  |  |
|  |  |  |
|  ATET | 1 vs. 0 | –0.065\*\*\* (0.020) |
|  POM | 0 | +0.038\* (0.020) |
|  |  |  |
| *(B) Multivalued treatment model* |  |  |
|  |  |  |
|  ATET | 1 vs. 0 | –0.002 (0.015) |
|  | 2 vs. 0 | –0.007\*\* (0.017) |
|  | 3 vs. 0 | –0.115\*\*\* (0.022) |
|  POM | 0 | +0.008 (0.013) |
|  |  |  |

Notes: The number of observations is 1,341. The dependent variable in the underlying outcome model is labor productivity growth. Robust standard errors are in parentheses. The growth rate of regular employment had to be dropped from the multivalued regression in order to make it estimable. Robust standard errors are in parentheses. ATET is “average treatment effect on the treated”. POM is “potential-outcome mean”.

Sources: Author’s computations.

Figure A.1: Assessing the parallel trends-assumption (1911–20)

Notes: Depicted is the evolution of average labor productivity among the “treated” and the “untreated” mines over 1911–20. Over 1911–14, treated mines’ productivity exhibits a positive trend, while untreated mines’ productivity shows a negative one. When looking only at the years 1913 and 1914, the trends are both negative, but not parallel implying that the difference in outcomes in the absence of treatment would not remain stable as is required. To lend formal support to this finding, I additionally ran a placebo regression at the mine-level estimated over 1911–1914 where labor productivity in levels is regressed on mine fixed effects, year effects, and interactions of a dummy variable taking the value 1 if a mine would use POW labor after 1914 with the year effects. As expected, some interactions are statistically different from zero formally suggesting that the parallel trends assumption is indeed violated in my data. These are the interactions for 1913 and 1914 (each significant on the one-percent level). The regression results are available upon request.

Sources: Author’s depiction based on Jopp (2020).

Figure A.2: A graphical test of the overlap assumption based on propensity score distributions

(a) Binary treatment



(b) Multivalued treatment



Notes: Propensity scores are given for the model with interactions. Epanechnikov kernel is used.

Sources: Author’s computations.

ONLINe appendix References

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