Bombs, Brains, and Science

The Role of Human and Physical Capital for the Creation of Scientific Knowledge

Online Appendix

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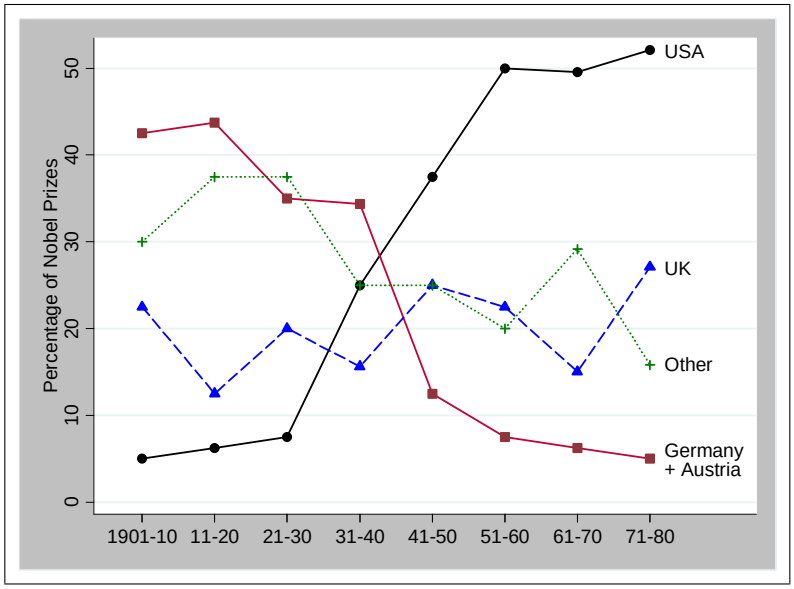
8 Appendix

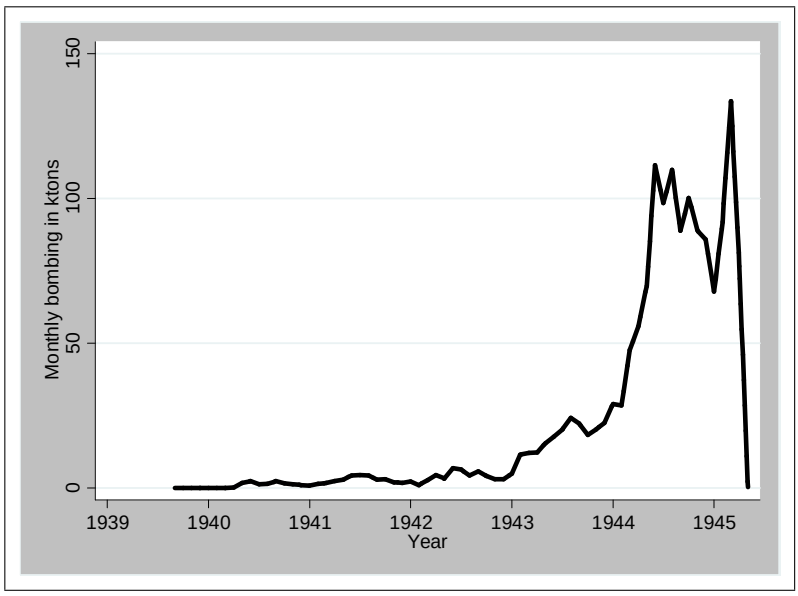
8.1 Appendix Figures

Figure A1: Nobel Prizes



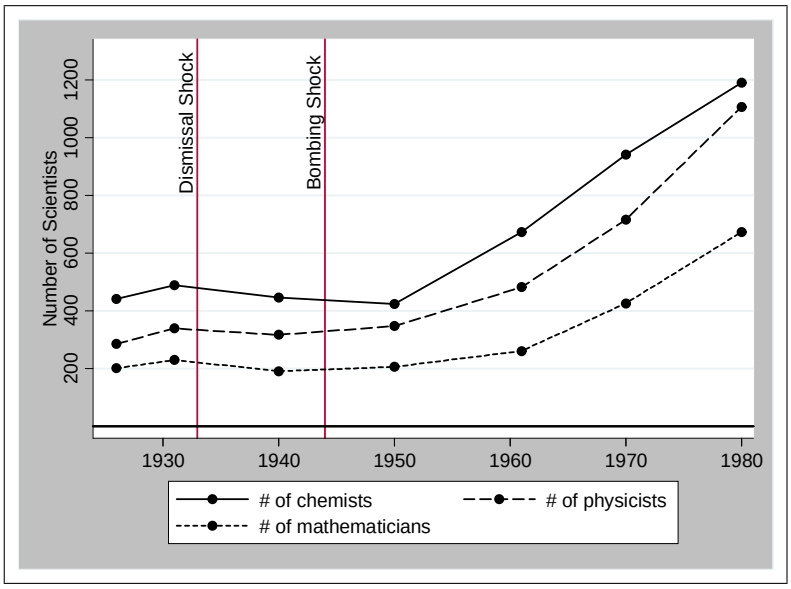
Note: The figure reports the percentage of Nobel Prizes awarded in physics and chemistry to scientists affiliated with a university in the respective country for each decade from 1901 to 1980. Prizes are weighted according to the fractions awarded by the Nobel committee (i.e. if the prize was awarded to 3 scientists in one year with one scientist getting 0.5 of the prize, and the other two scientists receiving 0.25 of the prize their countries would be assigned 0.5 and 0.25 respectively). Over the time period 1901 to 1980 scientists based in Austrian universities contribute 2 prizes to the combined total of 33.75 prizes awarded to scientists in German and Austrian universities. Data on Nobel Prizes and university affiliations come from http://www.nobelprize.org/nobel_prizes/.

Figure A2: Allied Bombs Dropped over German Territory



Note: The Figure reports monthly bomb loads dropped over German territory. Data source: Webster and Frankland (1961), Appendix.

Figure A3: Allied Bombs Dropped over German Territory

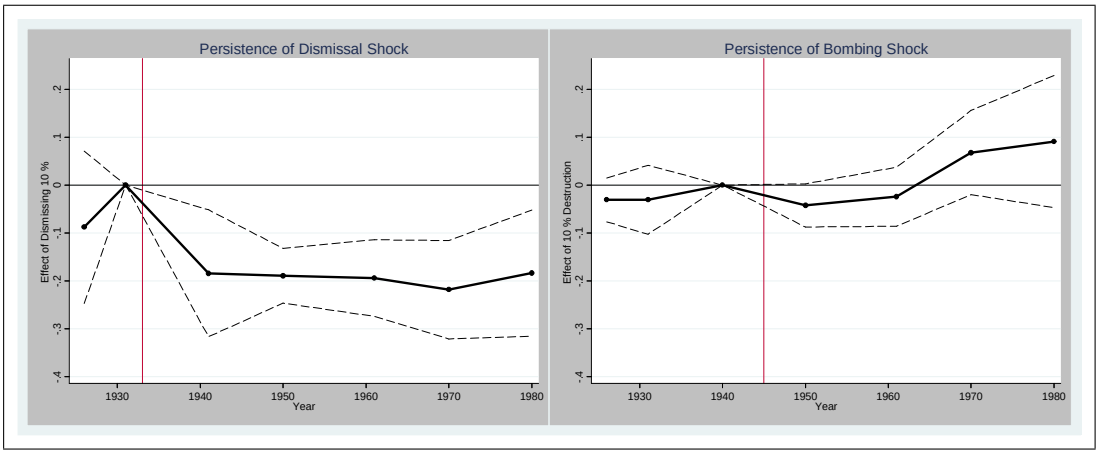


Note: The figure plots the number of scientists in the micro data from Kürschners Deutscher Gelehrtenkalender.

Figure A4: Bombing Destruction at the Technical University of Berlin

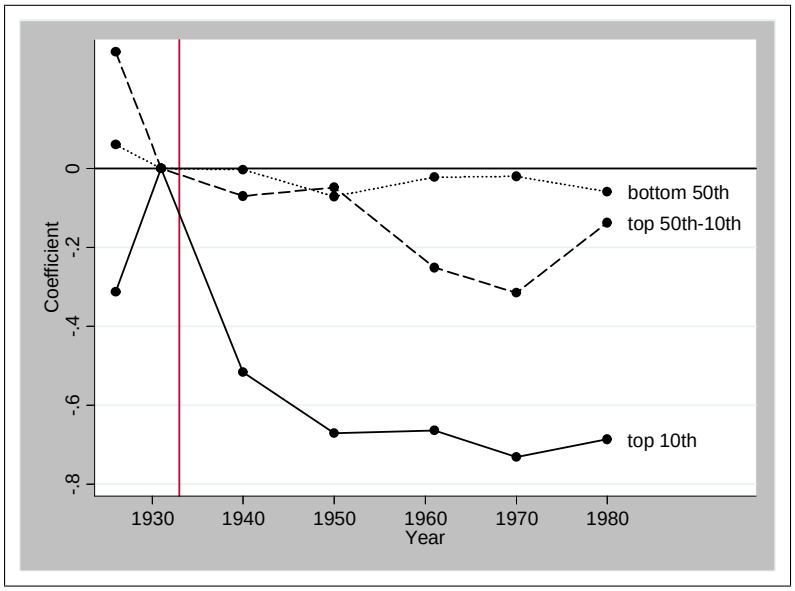
Note: The map shows bombing destruction at the Technical University of Berlin. The large building in the middle of the map is the main building. Circles indicate individual bombing impacts. Small triangles indicate destruction from artillery fire. Completely burned out buildings are shaded dark grey. Partially burned out buildings are shaded light grey. Destroyed roof structures are shaded with little dots. Crashed planes are marked by a plane symbol.

Figure A5: Including Controls - Citation-weighted Publications



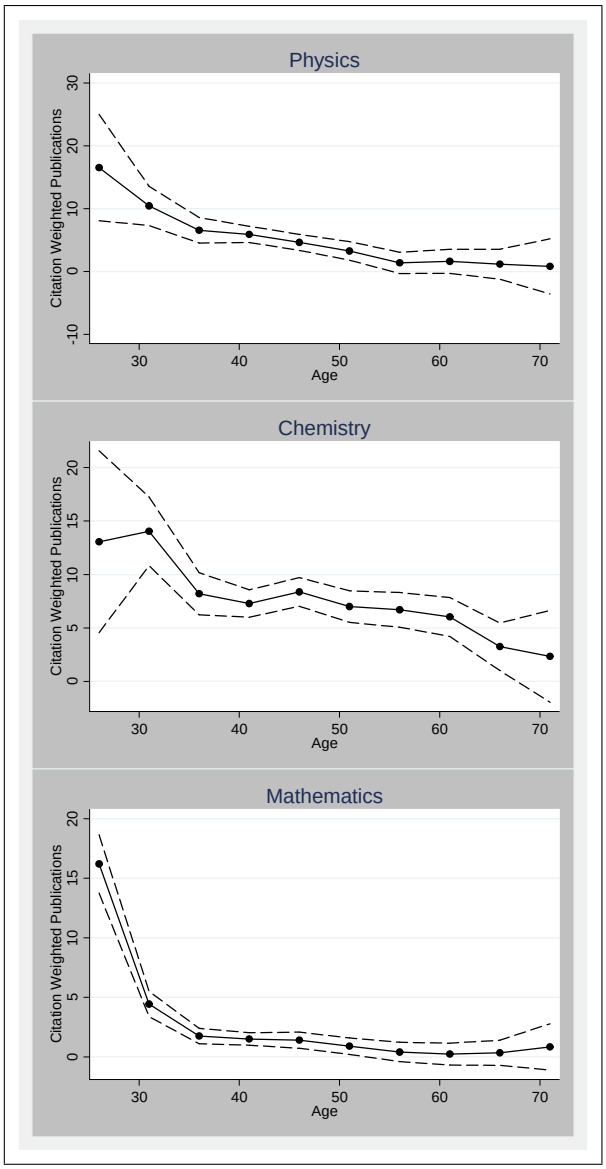
Note: The figure plots scaled regression coefficients and 95 percent confidence intervals obtained from the estimation of equation (1) as reported in column (6) of Table 6. Point estimates and confidence intervals are scaled to reflect a 10 percent shock to both human and physical capital.

Figure A6: Persistance of Different Quality Dismissals



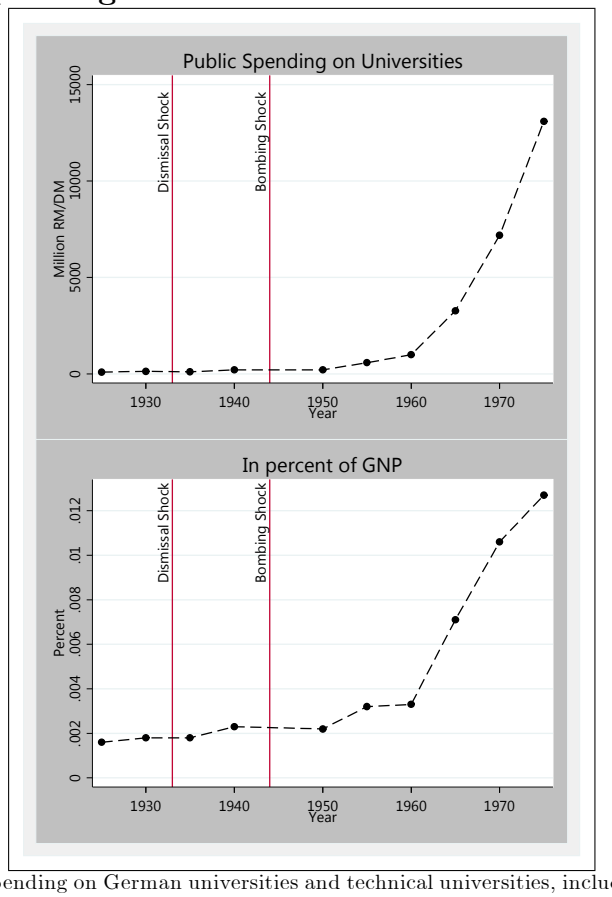
Note: The figure plots regression coefficients reported in column (1) of Table A6. The dependent variable is the total number of publications in department d and year t. All coefficients are estimated in one regression. The top line shows coefficients on the interation of the number of dismissals of below median quality (between 1933 and 1940) with year dummies. The middle line shows coefficients on the interation of the number of dismissals between the top 50th and 10th quality percentiles with year dummies. The bottom line shows coefficients on the interation of the number of dismissals in the top 10th percentile with year dummies.

Figure A7: Age-Output Profile



Note: The figure reports regression coefficients and 95 percent confidence intervals from a regression of citation-weighted publications on 5-year age dummies. The regression is estimated separately for each subject.

Figure A8: Public Spending on Universities



Note: The figure reports public spending on German universities and technical universities, including spending on university institutes. Data come from Pfetsch (1985). Before 1945 the data cover the whole German territory, after 1945 the data cover West Germany.

8.2 Appendix Tables

Table A1: Destruction of Equipment University of Cologne

Date of Bombing	Destroyed Equipment	Value in RM	In 1940 US $	In 2011 US $
Chemical Institute				
April 6th, 1942	Storage bottles in chemical storage	75	30	480
April 23rd, 1942	Damage to apparatuses, storage bottles	40	16	256
July 10th, 1942	Destruction to various apparatuses	15,000	6,002	96,038
February 14th, 1943	technologic collection	20,000	8,003	128,051
	glass and chemicals collection	8,000-12,000	3,201-4,802	51,220-76,831
	valuable apparatuses	3,000-5,000	1,200-2,001	19,208-32,013
June 16th, 1943	no destruction to equipment			
June 29th, 1943	no destruction to equipment			
July 9th, 1943	no destruction to equipment			
March 17th 1944	no destruction to equipment			
Total Chemical Inst.		46,115-52,115	18,453-20,854	295,254-333,670
Institute for Applied Physics				
April 25th, 1942	high voltage transformer	285	114	1,825
	capacitors of stable voltage system	468	187	2,996
	X-ray valve tube	645	258	4,130
	electrical instruments	8,209	3,285	52,559
	other instruments	12,089	4,838	77,401
	furniture (shelves, laborary tables)	7,696	3,080	49,275
May 31st, 1942	electrical instruments	8,209	3,285	52,559
	other instruments	3,880	1,553	24,843
	electrical equipment (switchboards)	4,565	1,827	29,228
	personal equipment of Prof. Malsch	3,655	1,463	23,401
	instruments destroyed by water damage	2,214	886	14,175
June/July 1943	damage to equipment	7,5000	30,012	480,192
Total Inst. of Appl. Phys.		126,915	50,786	812,584

Note: Table based on post-bombing reports from institute directors to the university administration. Material comes from the archive of the University of Cologne and was compiled by the author. Currency conversion rates for 1940 Reichsmark to 1940 U.S. Dollar come from Lawrence H. Officer (2011) "Exchange Rates Between the United States Dollar and Forty-one Currencies", MeasuringWorth, accessed online at www.measuringworth.com/exchangeglobal/ on April 13, 2012. Prices in 2011 U.S. Dollars were obtained by converting 1940 U.S. Dollars into 2011 using percentage increases in the CPI. Data come from www.measuringworth.com.

Table A2: Top Journals

Journal Name	Published in	Historical Top Journal	Current Top Journal
General Journals			
Nature	UK	yes	yes
Naturwissenschaften	Germany	yes	
Proceedings of the National Academy of Sciences	USA		yes
Proceedings of the Royal Society of London A (Mathematics and Physics)	UK	yes	
Science	USA	yes	yes
Sitzungsberichte der Pressischen Akademie der Wissenschaften	Germany	yes	
Physics			
Annalen der Physik	Germany	yes	
Applied Physics Letters	USA		yes
Astrophysical Journal	UK		yes
Journal of Applied Physics	USA		yes
Journal of Chemical Physics	USA		yes
Journal of Geophysical Research B: Solid Earth	USA		yes
Physical Review	USA	yes	yes
Physical Review A	USA		yes
Physical Review B	USA		yes
Physical Review C	USA		yes
Physical Review D	USA		yes
Physical Review Letters	USA		yes
Physikalische Zeitschrift	Germany	yes	
Zeitschrift für Physik	Germany	yes	
Chemistry			
Analytical Chemistry	USA		yes
Angewandte Chemie - International Edition in English	UK		yes
Berichte der Deutschen Chemischen Gesellschaft	Germany	yes	
Biochemische Zeitschrift	Germany	yes	
Chemical Communications	USA		yes
Inorganic Chemistry	USA		yes
Journal für Praktische Chemie	Germany	yes	
Journal of Biological Chemistry	USA		yes
Journal of Organic Chemistry	USA		yes
Journal of Physical Chemistry	USA	yes	yes
Journal of the American Chemical Society	USA		yes
Journal of the Chemical Society	UK	yes	
Justus Liebigs Annalen Chemie	Germany	yes	
Kolloid Zeitschrift	Germany	yes	
Tetrahedron Letters	Netherlands		yes
Zeitschrift für Anorganische Chemie und Allgemeine Chemie	Germany	yes	
Zeitschrift für Elektrochemie und Angewandte Physikalische Chemie	Germany	yes	
Zeitschrift für Physikalische Chemie	Germany	yes	
Mathematics			
Acta Mathematica	Sweden	yes	yes
Advances in Mathematics	USA		yes
Annals of Mathematics	USA	yes	yes
Bulletin of the American Mathematical Society	USA		yes
Inventiones Mathematicae			yes
Jounal für die reine und angewandte Mathematik	Germany	yes	
Journal of Functional Analysis	USA		yes
Journal of the London Mathematical Society	Germany	yes	
Mathematische Annalen	Germany	yes	
Mathematische Zeitschrift	Germany	yes	
Philosophical Transactions of the Royal Society A	UK		yes
Proceedings of the London Mathematical Society	UK	yes	
Zeitschrift für angewandte Mathematik und Mechanik	Germany	yes	

Table A3: Top Scientists

Name	University 1	University 2	Yearly Career Cit. weighted Publications	Nobel Prize	Dis-missal year	First year in data	Last year in data
Physics							
Wigner, Eugen	Berlin TU		619.8	yes	1933	1931	1931
Binder, Kurt	Köln		468.3			1980	1980
Cardona, Manuel	Stuttgart TU		284.3			1980	1980
Ewald, Peter Paul	Stuttgart TU		161.8		1937	1926	1931
Wegner, Franz	Heidelberg		148.3			1980	1980
Born, Max	Göttingen		144.2	yes	1933	1926	1931
Greiner, Walter	Frankfurt		135.6			1970	1980
Schrödinger, Erwin	Berlin		129.6	yes	1933	1926	1931
Schmidt, Michael	Heidelberg		112.5			1980	1980
Bergmann, Gerd	Köln		97.3			1980	1980
Haken, Hermann	Stuttgart TU		96.5			1961	1980
Hess, Karl	Wien		91.5			1980	1980
Schmid, Albert	Karlsruhe TU		88.2			1970	1980
Hohenberg, Pierre	München TU		87.9			1980	1980
Einstein, Albert	Berlin		82.2	yes	1933	1926	1931
Schatz, Gerd	Heidelberg		73.5			1980	1980
Müller, Bernd	Frankfurt		70.1			1980	1980
Fulde, Peter	Frankfurt	Darmstadt TU	68.4			1970	1980
Schlögl, Friedrich	Aachen TU		67.2			1961	1980
Gross, Ferdinand	Graz		66.2			1970	1980
Chemistry							
Meyerhof, Otto	Heidelberg		277.4	yes	1938	1931	1931
Sies, Helmut	München		172.6			1980	1980
Neuberg, Carl	Berlin		163.5		1938	1926	1931
Lynen, Feodor	München		160.2	yes		1961	1970
Eckstein, Fritz	Göttingen		159.2			1980	1980
Giese, Bernd	Darmstadt TU		153.0			1980	1980
Reetz Manfred T.	Marburg		151.0			1980	1980
Pette, Dirk	München		141.1			1970	1970
Lohmann, Karl	Heidelberg	Berlin	136.1			1931	1961
Neupert, Walter	München		135.8			1980	1980
Bergmann, Max	Dresden TU		129.6		1933	1926	1931
Vorbrüggen, Helmut	Berlin TU		125.2			1980	1980
von Raque Schleyer, Paul	Erlangen		110.8			1980	1980
Paulsen, Hans	Hamburg		110.0			1970	1980
Witkop, Bernhard	München		108.9			1950	1950
Hoppe, Rudolf	Gießen		106.3			1961	1980
Vögtlke, Fritz	Würzburg		104.7			1980	1980
Kessler, Horst	Frankfurt		103.8			1980	1980
Wieghardt, Karl	Hannover TU		95.0			1980	1980
Westphal, Otto	Freiburg		94.2			1961	1980
Mathematics							
von Neumann, Johann	Berlin		150.6		1933	1931	1931
Keller, Wilfried	Hamburg		75.6			1980	1980
Bott, Raoul	Bonn		51.8			1961	1970
Kaup, Wilhelm	Tübingen		43.2			1980	1980
Lorentz, George G.	Tübingen		39.7			1950	1950
von Mises, Richard	Berlin TU		38.2		1933	1926	1931
Friedrichs, Kurt	Göttingen		37.4		1937	1931	1931
Jensen, Ronald	Bonn		35.6			1980	1980
Krieger, Wolfgang	Heidelberg		35.3			1980	1980
Barth, Wolf	Erlangen		29.1			1980	1980
Szegö, Gabriel	Berlin		27.6		1933	1926	1931
Löh, Hans-Günter	Hamburg		26.2			1980	1980
Weyl, Hermann	Göttingen		26.0		1933	1926	1931
Schaeffer, Helmut	Hamburg		24.1			1980	1980
Lewy, Hans	Göttingen		23.4		1933	1931	1931
Dold, Albrecht	Heidelberg		22.3			1961	1980
Grauert, Hans	Göttingen		18.7			1961	1980
Becker, Jochen	Berlin TU		18.3			1980	1980
Hausdorff, Felix	Bonn		16.7			1926	1931
Menger, Karl	Wien		16.7		1938	1931	1931

Table A4: Robustness Checks - Citation-Weighted Publications Adding Controls

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent Variable:	Cit. weig. Pubs.	Cit. weig. Pubs.	Cit. weig. Pubs.	Cit. weig. Pubs.	Cit. weig. Pubs.	Cit. weig. Pubs.	Age-adj. Cit. weig. Pubs.
Sample:	Full Sample	Full Sample	Full Sample	Full Sample	Full Sample	Full Sample	Full Sample
# of Dismissals * 1926	-0.099	-0.098	-0.099	-0.087	-0.087	-0.087	-0.076
	(0.079)	(0.079)	(0.079)	(0.077)	(0.077)	(0.077)	(0.098)
# of Dismissals * 1940	-0.185***	-0.186***	-0.185***	-0.180***	-0.180***	-0.181***	-0.188**
	(0.059)	(0.060)	(0.060)	(0.062)	(0.064)	(0.064)	(0.076)
# of Dismissals * 1950	-0.188***	-0.190***	-0.204***	-0.191***	-0.191***	-0.187***	-0.150***
	(0.031)	(0.031)	(0.044)	(0.031)	(0.027)	(0.028)	(0.030)
# of Dismissals * 1961	-0.196***	-0.198***	-0.211***	-0.196***	-0.196***	-0.191***	-0.157***
	(0.038)	(0.039)	(0.046)	(0.038)	(0.037)	(0.039)	(0.047)
# of Dismissals * 1970	-0.206***	-0.209***	-0.223***	-0.220***	-0.220***	-0.215***	-0.194***
	(0.046)	(0.046)	(0.048)	(0.046)	(0.048)	(0.050)	(0.060)
# of Dismissals * 1980	-0.146**	-0.150**	-0.169**	-0.181***	-0.181***	-0.181***	-0.191***
	(0.066)	(0.066)	(0.070)	(0.061)	(0.064)	(0.064)	(0.067)
% Destruction * 1926	-0.002	-0.002	-0.002	-0.003	-0.003	-0.003	-0.004
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
% Destruction * 1931	-0.005	-0.005	-0.005	-0.003	-0.003	-0.003	-0.004
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.005)
% Destruction * 1950	-0.003	-0.003	-0.003	-0.004*	-0.004*	-0.004*	-0.005
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
% Destruction * 1961	-0.001	-0.001	-0.001	-0.002	-0.002	-0.002	-0.003
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
% Destruction * 1970	0.006	0.006	0.007	0.007	0.007	0.007	0.006
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)
% Destruction * 1980	0.005	0.005	0.005	0.009	0.009	0.009	0.010
	(0.005)	(0.005)	(0.005)	(0.007)	(0.007)	(0.007)	(0.008)
Standard Controls	yes	yes	yes	yes	yes	yes	yes
Länder Dummies * P45	yes	yes	yes	yes	yes	yes	yes
Quadratic in Uni. Age		yes	yes	yes	yes	yes	yes
# of Deps. within 50km			yes	yes	yes	yes	yes
Industries (1933) * Year				yes	yes	yes	yes
Fract. Jews (1933) * P45					yes	yes	yes
Dist. to Iron Curtain * P45						yes	yes
Observations	714	714	714	714	714	714	714
R-squared	0.525	0.525	0.526	0.550	0.550	0.552	0.367

***significant at 1% **significant at 5% *significant at 10% (s.e. clustered at university-level)

The dependent variable *Cit. weig. Pubs.* is the sum of citation-weighted publications published by all scientists in department d in a five-year window around year t. The variable is normalized to have a zero mean and a standard deviation of one within subjects. In column (7) the dependent variable is age adjusted citation-weighted publications, also normalized to have zero mean and a standard deviation of one. *# of Dismissals * 1926* is equal to the number of dismissals between 1933 and 1940 interacted with an indicator that is equal to 1 for observations from 1926. Interactions with other years are defined accordingly. The excluded interaction is the number of dismissals with 1931, the last observation before the dismissals. *% Destruction * 1926* is equal to percentage destruction caused by Allied bombings between 1940 and 1945 interacted with an indicator that is equal to 1 for observations from 1926. Interactions with other years are defined accordingly. The excluded interaction is % destruction with 1940, the last observation before the bombings. *Standard Controls* are all controls as reported in column (10) of Table 3, i.e. Department FE, Subject*Year FE, Occupation Zones * Post1945, and % City Destruction * Year FE. *Länder Dummies * Post45* is a set of dummy variables for each post-war German federal state (Land) interacted with a post-1945 dummy. *Quadratic in Uni. Age* is equal to the age of the university in each year and its square. *# of Deps. Within 50km* measures the number of departments with the same subject within 50 kilometers of each department in each year. *Armament Industries (1933) * Year* FE is the fraction of firms in a city belonging to each of 3 armament related universities in 1933 (1930 for Austria) interacted with a full set of year fixed effects. The 3 industries are: iron and steel production, mechanical engineering and vehicle construction, and chemical industry. *Fract. Jews (1933) * Post1933* is the fraction of Jews in each city in 1933 interacted with a post 1933 dummy. *Dist. to Iron Curtain * Post1945* is the distance to the iron curtain from each city interacted with a post-1945 dummy.

Table A5: Further Robustness Checks - Citation-Weighted Publications
Different Samples, Different Shock Measures, Controlling for University*Post1945 and Mean Reversion

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Depend. Variable:	Cit. weight. Pubs.	Cit. weight. Pubs.	Cit. weight. Pubs.	Cit. weight. Pubs.	Cit. weight. Pubs.	Cit. weight. Pubs.	Cit. weight. Pubs.	Cit. weight. Pubs.	Cit. weight. Pubs.	Cit. weight. Pubs.
Sample:	Dropping Austria	Dropping East Ger.	Swiss unis. as control	Full Sample	Full Sample	Full Sample	Full Sample	Full Sample	Full Sample	Full Sample
				% dismissals	only 33-34 dismissals	Same effect on output	Science Dest.	Instrument w/ uni. dest.	UniFE* Post45	Control for m reversion
Dismissals * 1926	-0.080	-0.154*	-0.093	-0.176	-0.080	-0.478	-0.084	-0.084	-0.086	-0.094
	(0.078)	(0.090)	(0.090)	(0.121)	(0.089)	(0.428)	(0.078)	(0.080)	(0.078)	(0.075)
Dismissals * 1940	-0.150*	-0.248***	-0.173**	-0.310**	-0.177**	-1.000***	-0.181**	-0.186***	-0.180**	-0.165**
	(0.087)	(0.057)	(0.076)	(0.150)	(0.074)	(0.376)	(0.067)	(0.066)	(0.067)	(0.064)
Dismissals * 1950	-0.156***	-0.177***	-0.184***	-0.300**	-0.173***	-1.028***	-0.182***	-0.171***	-0.117	-0.151***
	(0.040)	(0.048)	(0.051)	(0.142)	(0.031)	(0.260)	(0.029)	(0.033)	(0.087)	(0.040)
Dismissals * 1961	-0.163***	-0.196***	-0.200***	-0.268*	-0.192***	-1.054***	-0.188***	-0.177***	-0.122	-0.138**
	(0.054)	(0.062)	(0.060)	(0.143)	(0.048)	(0.327)	(0.041)	(0.044)	(0.103)	(0.056)
Dismissals * 1970	-0.186***	-0.221**	-0.232***	-0.286	-0.229***	-1.187***	-0.212***	-0.207***	-0.147	-0.149**
	(0.065)	(0.083)	(0.080)	(0.174)	(0.063)	(0.458)	(0.055)	(0.050)	(0.124)	(0.058)
Dismissals * 1980	-0.168**	-0.197**	-0.258**	-0.242*	-0.161*	-0.998*	-0.178**	-0.168**	-0.134	-0.111*
	(0.076)	(0.086)	(0.116)	(0.137)	(0.088)	(0.513)	(0.066)	(0.077)	(0.133)	(0.060)
Destruction * 1926	-0.004	-0.001	-0.002	-0.003	-0.003	-0.729	-0.004	-0.007	-0.003	-0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.481)	(0.003)	(0.004)	(0.002)	(0.002)
Destruction * 1931	-0.003	0.003	-0.003	-0.003	-0.002	-0.718	-0.001	-0.003	-0.003	-0.003
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.806)	(0.003)	(0.006)	(0.004)	(0.004)
Destruction * 1950	-0.005*	-0.002	0.002	-0.005*	-0.004*	-1.000	-0.008**	-0.015***	-0.003	-0.005**
	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.660)	(0.003)	(0.005)	(0.004)	(0.002)
Destruction * 1961	-0.003	0.001	0.002	-0.003	-0.002	-0.568	-0.004	-0.010*	-0.001	-0.003
	(0.003)	(0.005)	(0.004)	(0.003)	(0.003)	(0.826)	(0.003)	(0.006)	(0.005)	(0.003)
Destruction * 1970	0.007	0.013**	0.010	0.006	0.007	1.606	0.009**	0.008	0.008	0.006
	(0.005)	(0.006)	(0.007)	(0.004)	(0.004)	(1.092)	(0.004)	(0.007)	(0.006)	(0.004)
Destruction * 1980	0.009	0.012*	0.002	0.008	0.009	2.144	0.004	-0.020	0.010	0.008
	(0.009)	(0.007)	(0.008)	(0.007)	(0.007)	(1.653)	(0.005)	(0.019)	(0.009)	(0.007)
Extended Controls	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
UniFE*Post45									yes	
Quality1926*Years										yes
Observations	609	588	486	714	714	714	714	714	714	714
R-squared	0.558	0.571	0.507	0.543	0.548	0.552	0.548	0.509	0.563	0.557

***significant at 1% **significant at 5% *significant at 10% (s.e. clustered /block bootstrapped at university-level)

The dependent variable *Cit. weig. Pubs.* is the sum of normalized citation-weighted publications published by all scientists in department d in a five-year window around year t. In columns (1)-(3) and (7)-(10) *Dismissals* is equal to the number of dismissals between 1933 and 1940. In column (4) *Dismissals* is equal to % dismissals between 1933 and 1940 (divided by 10). In column (5) *Dismissals* is equal to the number of dismissals between 1933 and 1934. In column (6) *Dismissals* is equal to the predicted change in output between 1931 and 1940, calculated as the coefficient of losing one scientist (from column 6 in Table 5) multiplied by the number of dismissed scientists in each department. In columns (1)-(5) and (8)-(10) *Destruction* is equal to % destruction caused by Allied bombings between 1940 and 1945. In column (6) *Destruction* is equal to the predicted change in output between 1931 and 1940, calculated as the coefficient on percent destruction (from column 6 in Table 5) multiplied by percent destruction in each department. In column (7) *Destruction* is equal to average destruction in the three science departments in each university. In column (8) I instrument for *Destruction* at the department-level with percentage destruction at the university-level. *Extended Controls* are all controls as reported in column (6) of Table A4. In column (3) *Extended controls* do not include Armament Industries (1933) * Year FE because of missing data for Swiss cities. *UniFE*Post1945* is a full set of university fixed effects interacted with a post-1945 dummy. *Quality1926*Years* is the interaction of department quality in 1926, interacted with the number of years that have passed since 1926. As the regression in column (7) includes an estimated regressor, s.e. are block bootstrapped at the university-level.

Table A6: First Stages - Instrumenting with University Destruction for Subject Destruction

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable:	% Dep. Destruction * 1926	% Dep. Destruction * 1931	% Dep. Destruction * 1950	% Dep. Destruction * 1961	% Dep. Destruction * 1970	% Dep. Destruction * 1980
% Uni. Destruction * 1926	0.602***	-0.011	0.003	0.003	0.003	0.005
	(0.166)	(0.014)	(0.004)	(0.004)	(0.006)	(0.011)
% Uni. Destruction * 1931	-0.011	0.602***	0.003	0.003	0.003	0.004
	(0.013)	(0.167)	(0.004)	(0.004)	(0.005)	(0.008)
% Uni. Destruction * 1950	-0.001	0.001	0.608***	-0.002	0.001	0.015
	(0.026)	(0.026)	(0.148)	(0.024)	(0.023)	(0.017)
% Uni. Destruction * 1961	-0.000	0.001	-0.005	0.611***	0.001	0.014
	(0.026)	(0.026)	(0.025)	(0.148)	(0.023)	(0.020)
% Uni. Destruction * 1970	0.001	0.004	-0.013	-0.008	0.611***	0.026
	(0.027)	(0.027)	(0.027)	(0.025)	(0.148)	(0.031)
% Uni. Destruction * 1980	0.002	0.005	-0.041	-0.034	-0.021	0.715***
	(0.040)	(0.039)	(0.060)	(0.061)	(0.070)	(0.250)
# of Dismissals * Year FE	yes	yes	yes	yes	yes	yes
Extended controls	yes	yes	yes	yes	yes	yes
Observations	714	714	714	714	714	714
R-squared	0.814	0.813	0.810	0.810	0.811	0.865
Cragg-Donald EV Statistic				19.6		

***significant at 1% **significant at 5% *significant at 10% (s.e. clustered at university-level)

The dependent variable *% Dep. Destruction * 1926* reported in column (1) is equal to percentage destruction at the department-level caused by Allied bombings between 1940 and 1945 interacted with an indicator that is equal to 1 for observations from 1926. Dependent variables in columns (2) to (6) are defined accordingly. The instrumental variable *% Uni. Destruction * 1926* is equal to percentage destruction at the university-level caused by Allied bombings between 1940 and 1945 interacted with an indicator that is equal to 1 for observations from 1926. The other instrumental variables are defined accordingly. The control variables *# of Dismissals * Year FE* are equal to the number of dismissals in Nazi Germany between 1933 and 1940 interacted with a full set of year dummies as in the main specification. *Extended Controls* are all controls as reported in column (6) of Table 5, i.e. Department FE, Subject*Year FE, Occupation Zones * Post1945, % City Destruction * Year FE, Länder Dummies * Post1945, # of Deps. Within 50km, Armament Industries (1933) * Year FE, Fract. Jews (1933) * Post1933, and Dist. to Iron Curtain * Post1945.

Table A7: Interaction of Human and Physical Capital

	(1)	(2)	(3)	(4)
			Citation weighted	Citation weighted
Dependent Variable:	Publications	Publications	Publications	Publications
Number of Dismissals * 1926	0.026	0.026	-0.087	-0.087
	(0.026)	(0.026)	(0.077)	(0.077)
Number of Dismissals * 1940	-0.175***	-0.174***	-0.181***	-0.181***
	(0.038)	(0.039)	(0.064)	(0.064)
Number of Dismissals * 1950	-0.246**	-0.159	-0.187***	-0.162***
	(0.099)	(0.096)	(0.028)	(0.035)
Number of Dismissals * 1961	-0.286***	-0.271***	-0.191***	-0.174***
	(0.071)	(0.091)	(0.039)	(0.041)
Number of Dismissals * 1970	-0.323***	-0.316***	-0.215***	-0.244***
	(0.069)	(0.084)	(0.050)	(0.080)
Number of Dismissals * 1980	-0.272***	-0.284***	-0.181***	-0.222**
	(0.061)	(0.072)	(0.064)	(0.106)
% Destruction * 1926	-0.002	-0.002	-0.003	-0.003
	(0.002)	(0.002)	(0.002)	(0.002)
% Destruction * 1931	-0.005*	-0.005*	-0.003	-0.003
	(0.002)	(0.002)	(0.004)	(0.004)
% Destruction * 1950	-0.005**	-0.002	-0.004*	-0.003
	(0.002)	(0.002)	(0.002)	(0.002)
% Destruction * 1961	-0.003	-0.002	-0.002	-0.002
	(0.002)	(0.002)	(0.003)	(0.003)
% Destruction * 1970	0.003	0.004	0.007	0.006
	(0.002)	(0.003)	(0.004)	(0.004)
% Destruction * 1980	0.001	0.000	0.009	0.007
	(0.003)	(0.004)	(0.007)	(0.006)
Number of Dismissals * % Destruction * 1950		-0.003**		-0.001
		(0.001)		(0.001)
Number of Dismissals * % Destruction * 1961		-0.000		-0.001
		(0.001)		(0.001)
Number of Dismissals * % Destruction * 1970		-0.000		0.001
		(0.001)		(0.002)
Number of Dismissals * % Destruction * 1980		0.001		0.002
		(0.002)		(0.003)
Extended controls	yes	yes	yes	yes
Observations	714	714	714	714
R-squared	0.718	0.723	0.552	0.555

***significant at 1% **significant at 5% *significant at 10% (s.e. clustered at university-level)

The dependent variable *Publications* is the sum of publications published by all scientists in department d in a five-year window around year t. The dependent variable *citation-weighted Pubs.* is the sum of citation-weighted publications published by all scientists in department d in a five-year window around year t. Dependent variables are normalized to have zero mean and a standard deviation of one within subjects. *Number of Dismissals * 1926* is equal to the number of dismissals between 1933 and 1940 interacted with an indicator that is equal to 1 for observations from 1926. The other interactions are defined accordingly. The excluded interaction is the number of dismissals with 1931, the last observation before the dismissals. *% Destruction * 1926* is equal to percentage destruction caused by Allied bombings between 1940 and 1945 interacted with an indicator that is equal to 1 for observations from 1926. The other interactions are defined accordingly. The excluded interaction is % destruction with 1940, the last observation before the bombings. *Number of Dismissals * % Destruction * 1950* is the triple interaction of the number of dismissals, percentage destruction, and an indicator for 1950. The other triple interactions are defined accordingly. *Extended Controls* are all controls as reported in column (6) of Table 5, i.e. Department FE, Subject*Year FE, Occupation Zones * Post1945, % City Destruction * Year FE, Länder Dummies * Post1945, # of Deps. Within 50km, Armament Industries (1933) * Year FE, Fract. Jews (1933) * Post1933, and Dist. to Iron Curtain * Post1945.

Table A8: Individual Subjects

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable:	Pubs.	Citation weighted Pubs.	Pubs.	Citation weighted Pubs.	Pubs.	Citation weighted Pubs.
	Physics		Chemistry		Mathematics	
# of Dismissals * 1926	0.164	-0.033	0.026	0.012	-0.180	-0.469**
	(0.140)	(0.286)	(0.016)	(0.038)	(0.181)	(0.187)
# of Dismissals * 1940	-0.112**	-0.181	-0.178***	-0.053**	-0.295*	-0.553***
	(0.044)	(0.227)	(0.060)	(0.020)	(0.162)	(0.192)
# of Dismissals * 1950	-0.059	-0.122	-0.317***	-0.101*	-0.445**	-0.606***
	(0.190)	(0.248)	(0.110)	(0.054)	(0.182)	(0.182)
# of Dismissals * 1961	-0.215**	-0.277	-0.309***	-0.060	-0.440**	-0.472**
	(0.089)	(0.189)	(0.089)	(0.084)	(0.178)	(0.202)
# of Dismissals * 1970	-0.271***	-0.314	-0.346***	-0.101	-0.454**	-0.500**
	(0.080)	(0.204)	(0.096)	(0.061)	(0.177)	(0.200)
# of Dismissals * 1980	-0.291**	-0.436**	-0.247***	0.078	-0.404**	-0.475**
	(0.119)	(0.186)	(0.089)	(0.082)	(0.165)	(0.175)
% Destruction * 1926	-0.002	-0.001	0.005	0.003	-0.007	-0.007
	(0.005)	(0.002)	(0.005)	(0.003)	(0.005)	(0.006)
% Destruction * 1931	-0.002	-0.000	0.001	-0.001	-0.013**	-0.005
	(0.003)	(0.002)	(0.007)	(0.004)	(0.006)	(0.009)
% Destruction * 1950	0.000	-0.001	0.000	0.002	-0.007	-0.004
	(0.005)	(0.004)	(0.007)	(0.006)	(0.005)	(0.006)
% Destruction * 1961	0.001	-0.002	0.003	0.005	-0.007	-0.005
	(0.003)	(0.003)	(0.008)	(0.010)	(0.006)	(0.006)
% Destruction * 1970	0.003	0.001	0.008	0.018	0.008	0.006
	(0.004)	(0.003)	(0.007)	(0.012)	(0.005)	(0.007)
% Destruction * 1980	-0.002	0.002	0.017*	0.023**	-0.003	0.002
	(0.007)	(0.008)	(0.009)	(0.011)	(0.007)	(0.008)
Extended controls	yes	yes	yes	yes	yes	yes
Observations	238	238	238	238	238	238
R-squared	0.761	0.645	0.868	0.761	0.750	0.666

***significant at 1% **significant at 5% *significant at 10% (s.e. clustered at university-level)

The dependent variable *Pubs.* reported in odd columns is the sum of publications published by all scientists in department d in a five-year window around year t. The dependent variable *Citation-Weighted Pubs.* reported in even columns is the sum of citation-weighted publications published by all scientists in department d in a five-year window around year t. Dependent variables are normalized to have zero mean and a standard deviation of one within subjects. *# of Dismissals * 1926* is equal to the number of dismissals in Nazi Germany between 1933 and 1940 interacted with an indicator that is equal to 1 for observations from 1926. The other interactions are defined accordingly. The excluded interaction is the number of dismissals with 1931, the last observation before the dismissals. *% Destruction * 1926* is equal to percentage destruction caused by Allied bombings between 1940 and 1945 interacted with an indicator that is equal to 1 for observations from 1926. The other interactions are defined accordingly. The excluded interaction is % destruction with 1940, the last observation before the bombings. *Extended Controls* are all controls as reported in column (6) of Table 5, i.e. Department FE, Subject*Year FE, Occupation Zones * Post1945, % City Destruction * Year FE, Länder Dummies * Post1945, # of Deps. Within 50km, Armament Industries (1933) * Year FE, Fract. Jews (1933) * Post1933, and Dist. to Iron Curtain * Post1945.

Table A9: Dismissals in Different Quality Groups

	(1)	(2)
	Publications	Citation-weighted Publications
# of Dismissals (below median quality) * 1926	0.060	-0.039
	(0.084)	(0.176)
# of Dismissals (below median quality) * 1940	-0.003	-0.065
	(0.087)	(0.136)
# of Dismissals (below median quality) * 1950	-0.071	-0.039
	(0.163)	(0.137)
# of Dismissals (below median quality) * 1961	-0.022	-0.149
	(0.132)	(0.139)
# of Dismissals (below median quality) * 1970	-0.020	-0.099
	(0.120)	(0.157)
# of Dismissals (below median quality) * 1980	-0.059	-0.056
	(0.156)	(0.208)
# of Dismissals (top 50th - 10th perc.) * 1926	0.295***	0.418***
	(0.094)	(0.151)
# of Dismissals (top 50th - 10th perc.) * 1940	-0.070	0.272***
	(0.057)	(0.094)
# of Dismissals (top 50th - 10th perc.) * 1950	-0.048	0.227
	(0.199)	(0.189)
# of Dismissals (top 50th - 10th perc.) * 1961	-0.251**	0.173
	(0.123)	(0.112)
# of Dismissals (top 50th - 10th perc.) * 1970	-0.315***	0.316*
	(0.107)	(0.184)
# of Dismissals (top 50th - 10th perc.) * 1980	-0.137	0.315
	(0.201)	(0.297)
# of Dismissals (top 10th perc.) * 1926	-0.313**	-0.703***
	(0.153)	(0.122)
# of Dismissals (top 10th perc.) * 1940	-0.516**	-0.834***
	(0.207)	(0.109)
# of Dismissals (top 10th perc.) * 1950	-0.671***	-0.860***
	(0.241)	(0.169)
# of Dismissals (top 10th perc.) * 1961	-0.664***	-0.660***
	(0.220)	(0.180)
# of Dismissals (top 10th perc.) * 1970	-0.732***	-0.974***
	(0.229)	(0.202)
# of Dismissals (top 10th perc.) * 1980	-0.686**	-0.908***
	(0.295)	(0.258)
% Destruction * Year Dummies	yes	yes
Department FE	yes	yes
Subject*Year FE	yes	yes
Occupation Zones * Post45	yes	yes
% City Destruction * Year Dummies	yes	yes
All additional controls	yes	yes
Observations	714	714
R-squared	0.735	0.586

***significant at 1% **significant at 5% *significant at 10% (s.e. clustered at university-level)

The dependent variable *Publications* reported in column (1) is the sum of publications published by all scientists in department d in a five-year window around year t. The dependent variable *citation-weighted Publications* reported in column (2) is the sum of citation-weighted publications published by all scientists in department d in a five-year window around year t. Dependent variables are normalized to have zero mean and a standard deviation of one within subjects. The top part of the table reports coefficients on the interation of the number of dismissals of below median quality (between 1933 and 1940) with year dummies. The middle part of the table reports coefficients on the interation of the number of dismissals between the top 50th and 10th quality percentiles with year dummies. The bottom part of the table reports coefficients on the interation of the number of dismissals in the top 10th percentile with year dummies. The excluded interaction is the number of dismissals with 1931, the last observation before the dismissals. *% Destruction * Year FE* is equal to percentage destruction caused by Allied bombings between 1940 and 1945 interacted with a set of year indicators as in the main specification. All other controls are defined as in previous regressions.

Table A10: Persistence of Dismissal and Bombing Shocks - Department Size

	(1)	(2)	(3)
Dependent Variable:	Department Size	Department Size	Department Size
Number of Dismissals * 1926	-0.217***		-0.218***
	(0.060)		(0.056)
Number of Dismissals * 1940	-0.612***		-0.604***
	(0.078)		(0.083)
Number of Dismissals * 1950	-1.129***		-1.124***
	(0.353)		(0.336)
Number of Dismissals * 1961	-1.045***		-1.064***
	(0.267)		(0.257)
Number of Dismissals * 1970	-0.935**		-1.009**
	(0.381)		(0.374)
Number of Dismissals * 1980	0.063		0.024
	(0.665)		(0.656)
% Destruction * 1926		0.005	0.006
		(0.013)	(0.013)
% Destruction * 1931		0.005	0.004
		(0.011)	(0.010)
% Destruction * 1950		-0.034	-0.029
		(0.025)	(0.024)
% Destruction * 1961		-0.008	-0.003
		(0.029)	(0.029)
% Destruction * 1970		0.050*	0.056**
		(0.025)	(0.027)
% Destruction * 1980		0.034	0.041
		(0.055)	(0.056)
Extended controls	yes	yes	yes
Observations	714	714	714
R-squared	0.882	0.878	0.884

***significant at 1% level **significant at 5% level *significant at 10% level

(All standard errors clustered at university-level)

The dependent variable *Department Size* measures department size in department d and year t. *Number of Dismissals * 1926* is equal to the number of dismissals between 1933 and 1940 interacted with an indicator that is equal to 1 for observations from 1926. The other interactions are defined accordingly. The excluded interaction is the number of dismissals with 1931, the last observation before the dismissals. *% Destruction * 1926* is equal to percentage destruction caused by Allied bombings between 1940 and 1945 interacted with an indicator that is equal to 1 for observations from 1926. The other interactions are defined accordingly. The excluded interaction is % destruction with 1940, the last observation before the bombings. *Extended Controls* are all controls as reported in column (6) of Table 5, i.e. Department FE, Subject*Year FE, Occupation Zones * Post1945, % City Destruction * Year FE, Länder Dummies * Post1945, # of Deps. Within 50km, Armament Industries (1933) * Year FE, Fract. Jews (1933) * Post1933, and Dist. to Iron Curtain * Post1945.

Table A11: Quality of Hires and Age of Dismissed Scientists

	(1)	(2)	(3)	(4)	(5)
Dependent Variable:	Quality of Hires	Quality of Hires	Quality of Hires	Quality of Hires	Quality of Hires
	All Dismissals	Above median Quality	Top 25th percentile	Top 10th percentile	Top 5th percentile
Panel A: Quality measured by lifetime citation-weighted publications					
# of Young Dismissals * 1940	-0.246**	-0.346**	-0.444**	-0.579**	-0.545**
	(0.106)	(0.133)	(0.193)	(0.275)	(0.242)
# of Young Dismissals * 1950	-0.211**	-0.279**	-0.417**	-0.511**	-0.500**
	(0.091)	(0.120)	(0.174)	(0.240)	(0.186)
# of Young Dismissals * 1961	-0.202**	-0.259**	-0.422**	-0.556**	-0.514**
	(0.090)	(0.117)	(0.176)	(0.248)	(0.215)
# of Young Dismissals * 1970	-0.203**	-0.265**	-0.430**	-0.578**	-0.595***
	(0.093)	(0.124)	(0.180)	(0.247)	(0.189)
# of Young Dismissals * 1980	-0.178**	-0.257**	-0.412**	-0.515**	-0.574***
	(0.078)	(0.107)	(0.161)	(0.217)	(0.193)
# of Old Dismissals * 1940	0.089	0.155**	0.166*	0.154	-0.075
	(0.057)	(0.074)	(0.088)	(0.302)	(0.487)
# of Old Dismissals * 1950	0.068	0.097	0.139	0.083	-0.096
	(0.067)	(0.091)	(0.109)	(0.303)	(0.528)
# of Old Dismissals * 1961	0.062	0.078	0.151*	0.154	-0.123
	(0.057)	(0.079)	(0.088)	(0.247)	(0.458)
# of Old Dismissals * 1970	0.061	0.081	0.145	0.091	-0.143
	(0.064)	(0.093)	(0.120)	(0.310)	(0.529)
# of Old Dismissals * 1980	0.022	0.019	0.054	-0.042	-0.474
	(0.060)	(0.087)	(0.141)	(0.283)	(0.601)
Panel B: Quality measured by pre-hiring citation-weighted publications					
# of Young Dismissals * 1940	-0.165	-0.174	-0.126	-0.277	-0.254
	(0.116)	(0.149)	(0.184)	(0.293)	(0.196)
# of Young Dismissals * 1950	-0.150*	-0.209**	-0.258**	-0.358*	-0.317**
	(0.080)	(0.094)	(0.122)	(0.176)	(0.140)
# of Young Dismissals * 1961	-0.154*	-0.188	-0.250*	-0.367*	-0.186
	(0.082)	(0.114)	(0.141)	(0.211)	(0.187)
# of Young Dismissals * 1970	-0.147*	-0.172*	-0.230*	-0.381**	-0.308*
	(0.080)	(0.096)	(0.116)	(0.178)	(0.163)
# of Young Dismissals * 1980	-0.146*	-0.199**	-0.225*	-0.373**	-0.379***
	(0.073)	(0.088)	(0.114)	(0.166)	(0.137)
# of Old Dismissals * 1940	0.113*	0.083	0.007	-0.032	0.067
	(0.065)	(0.110)	(0.153)	(0.412)	(0.749)
# of Old Dismissals * 1950	0.027	-0.015	-0.070	-0.069	-0.195
	(0.046)	(0.074)	(0.087)	(0.215)	(0.529)
# of Old Dismissals * 1961	0.067**	0.038	0.001	0.114	-0.235
	(0.030)	(0.064)	(0.066)	(0.197)	(0.560)
# of Old Dismissals * 1970	0.024	-0.036	-0.070	-0.050	-0.274
	(0.047)	(0.079)	(0.089)	(0.218)	(0.553)
# of Old Dismissals * 1980	0.020	-0.045	-0.214*	-0.204	-0.459
	(0.052)	(0.088)	(0.114)	(0.225)	(0.574)
% Destruction * Year FE	yes	yes	yes	yes	yes
Extended Controls	yes	yes	yes	yes	yes
Observations	602	602	602	602	602

The dependent variable *Quality of Hires* measures average quality of hires in department *d* between year *t* and year *t-1*. In panel A, quality of hires is measured as the career average of citation-weighted publications averaged across all hires in a department. In panel B, quality of hires is measured by age-adjusted average citation-weighted publications measured before year *t* , averaged across all hires in a department. The average is calculated for 5 years at the midpoint between year *t* and year *t-1*. The dependent variables are normalized to have zero mean and a standard deviation of one within subjects. *Number of Young Dismissals * 1926* is equal to the number of dismissals of below median age between 1933 and 1940 interacted with an indicator that is equal to 1 for observations from 1926. *Number of Old Dismissals * 1926* is equal to the number of dismissals of equal or above median age interacted with an indicator that is equal to 1 for observations from 1926. Median age is 49 in physics, 46 in mathematics, and 49 in chemistry. The other interactions are defined accordingly. In column (1) number of dismissals are all dismissals, in column (2) number of dismissals measure dismissals of above median quality, and so on. Excluded interactions are the number of dismissals with 1931. *% Destruction * Year FE* measures percentage destruction caused by bombings between 1940 and 1945 interacted with a set of year fixed effects. *Extended Controls* are all controls as reported in column (6) of Table 5.

8.3 Contribution of Human and Physical Capital Shocks to the Decline of German Science

Dismissal Shock

The effect of the dismissals on German science is calculated using the regression results including all controls as in column (6) of Tables 5 and 6. Using the number of dismissals in each department I calculate the reduction in (citation-weighted) publications in each department for 1940, 1950, 1961, 1970, and 1980 in terms of standard deviations. For each department and year I therefore calculate:

$\Delta y_{1940} = \widehat{\beta}_{1940}^{dismissals} * (\#$ of Dismissals 33-40),..., $\Delta y_{1980} = \widehat{\beta}_{1980}^{dismissals} * (\#$ of Dismissals 33-40)

Multiplying the Δy's with the subject level standard deviations of (citation-weighted) publications I calculate the fall in output in each department in terms of (citation-weighted) publications (call them ΔY_{year}). The ΔY_{year}'s compute the reduction in (citation-weighted) publications for the years 1940, 1950, 1961, 1970, and 1980. To obtain the total reduction in (citations weighted) publications for all years since 1933, I assume that the decline in output between April 1933 and December 1945 was ΔY_{1940} in each year. Similarly, between January 1946 and December 1955 the annual loss in output was ΔY_{1950}, and so on. Total reduction in output between 1933 and 1980 was therefore:

$$\Delta Y_{1933-1980} = 12.75 * \Delta Y_{1940} + 10 * \Delta Y_{1950} + 10 * \Delta Y_{1961} + 10 * \Delta Y_{1970} + 5 * \Delta Y_{1990}$$

Adding $\Delta Y_{1933-1980}$'s for all departments in a subject, I obtain the total loss in (citation-weighted) publications in each subject from 1933 to 1980 ($\Delta Y_{1933-1980}^{all}$).
To calculate percentage losses I obtain the total number of (citation-weighted) publications that were published in a subject in 1940, 1950, 1961, 1970, and 1980:

Y_{1940}^{tot}, Y_{1950}^{tot},..., Y_{1980}^{tot}

Average yearly (citation-weighted) publications are obtained as follows:

$$Y_{yearly}^{tot} = \tfrac{1}{5}(\ Y_{1940}^{tot} + Y_{1950}^{tot} + Y_{1961}^{tot} + Y_{1970}^{tot} + Y_{1980}^{tot})$$

Total publications between April 1933 and December 1980 are calculated as:

$$Y_{1933-1980}^{tot} = 47.75 * Y_{yearly}^{tot}$$

Finally, percentage loss between 1933 and 1980 is calculated as:[1]

$$\%\Delta Y_{1933-1980}^{all} = \frac{\Delta Y_{1933-1980}^{all}}{(Y_{1933-1980}^{tot} - \Delta Y_{1933-1980}^{all})} * 100$$

The top panel of Table A8 summarizes the total loss of (citation-weighted) publications between 1933 and 1980 that was caused by the dismissal of scientists in Nazi Germany.

Bombing Shock

[1] Note: $\Delta Y_{1933-1980}^{all} < 0$.

I calculate the effect of Allied bombings on German science in a similar way. The calculations also rely on the regression results including all controls as in column (6) of Tables 5 and 6. Using percentage destruction in each department I calculate the reduction in (citation-weighted) publications in each department for 1950, 1961, 1970, and 1980 in terms of standard deviations. For each department and year I therefore calculate:[2]

$\Delta y_{1950} = \widehat{\beta}_{1950}^{bombings} * (\%$ Destruction 42-45),..., $\Delta y_{1980} = \widehat{\beta}_{1980}^{bombings} * (\%$ Destruction 42-45)

Multiplying the Δy's with the subject level standard deviations of (citation-weighted) publications I calculate the fall in output in each department in terms of (citation-weighted) publications (call them ΔY_{year}). The ΔY_{year}'s compute the reduction in (citation-weighted) publications for the years 1950, 1961, 1970, and 1980. To obtain the total reduction in (citations weighted) publications for all years since 1944, I assume that the loss in output between January 1944 and December 1955 was ΔY_{1950} in each year. Similarly, between January 1956 and December 1965 the annual loss in output was ΔY_{1961}, and so on. Total reduction in output between 1944 and 1980 is therefore:

$$\Delta Y_{1944-1980} = 11 * \Delta Y_{1950} + 10 * \Delta Y_{1961} + 10 * \Delta Y_{1970} + 5 * \Delta Y_{1990}$$

Adding the $\Delta Y_{1944-1980}$'s for all departments in a subject, I obtain the total loss in (citation-weighted) publications that was caused by Allied bombings in each subject from 1944 to 1980 ($\Delta Y_{1944-1980}^{all}$).
To calculate percentage losses I obtain the total number of (citation-weighted) publications that were published in a subject in 1950, 1961, 1970, and 1980:

Y_{1950}^{tot}, Y_{1961}^{tot},..., Y_{1980}^{tot}

Average yearly (citation-weighted) publications are obtained as follows:

$$Y_{yearly}^{tot} = \frac{1}{4}(Y_{1950}^{tot} + Y_{1961}^{tot} + Y_{1970}^{tot} + Y_{1980}^{tot})$$

Total publications between January 1944 and December 1980 are calculated as:

$$Y_{1944-1980}^{tot} = 36 * Y_{yearly}^{tot}$$

Finally, percentage loss between 1944 and 1980 is calculated as:[3]

$$\%\Delta Y_{1944-1980}^{all} = \frac{\Delta Y_{1944-1980}^{all}}{(Y_{1944-1980}^{tot} - \Delta Y_{1944-1980}^{all})} * 100$$

The bottom panel of Table A7 summarizes the total loss of (citation-weighted) publications between 1944 and 1980 that was caused by Allied bombings.

[2] I only consider $\widehat{\beta}_{x}^{bombings}$ if the coefficient is at least significant at the 10 percent level for year X. For all other years I set $\Delta y = 0$. As a result, Δy_{1961},Δy_{1970}, Δy_{1980} are set to 0. See column (6) of Tables 5 and 6.

[3] Note: $\Delta Y_{1933-1980}^{all} < 0$.

Table A12: Total Productivity Loss of Dismissals and Bombings

	Physics	Chemistry	Mathematics	Total
Dismissal Loss				
Number of publications lost 1933-1980	2029	6848	699	9576
Number of citation-weighted publication lost 1933-1980	60703	122248	8969	191920
Percentage of publications lost 1933-1980	30.5	36.5	33.5	33.5
Percentage of citation-weighted publications lost 1933-1980	34.0	33.2	36.6	34.6
Publications by dismissed scientists	362	594	225	1181
citation-weighted publications by dismissed	14826	12708	4835	32369
Bombing Loss				
Number of publications lost 1944-1980	231	710	87	1028
Number of citation-weighted publication lost 1944-1980	7410	13589	1195	22194
Percentage of publications lost 1944-1980	5.0	5.9	6.2	5.7
Percentage of citation-weighted publications lost 1944-1980	6.2	5.5	7.6	6.4

8.4 Data Appendix

8.4.1 Panel Data Set of Scientists in German and Austrian Universities from 1926 to 1980

As described in the main text I use "Kürschners Deutscher Gelehrtenkalender" (KDG) to construct a panel data set of scientists in German and Austrian universities at 7 points in time between 1926 and 1980. The KDG covers all researchers in German speaking universities. To compile the KDG the editors contacted all German speaking universities to obtain faculty rosters and then sent out questionnaires to all faculty members. The response rate to these questionnaires was very high. If a scholar did not answer the questionnaire the editors of the KDG tried to find as much information as possible on the scholar.

Sometimes a slight delay occurred until a young researcher was included in the KDG or until a university change was recorded. A *Privatdozent*, for example, may have been appointed in 1926 but may not appear in the 1926 volume because she was not a *Privatdozent* at the time the questionnaires were sent out. The same scientist, however, would appear in the 1931 volume with her complete appointment history. If that history indicates that she had already been a *Privatdozent* in 1926 I also include her in the 1926 roster. This gives a more accurate picture of each department's faculty in the relevant year.

The KDGs list researchers who occupied different university positions. I focus on all researchers who had the right to teach ('venia legendi') at a German university, i.e. all researchers who were at least *Privatdozent*. The data therefore include ordinary professors, extraordinary professors, honorary professors, and *Privatdozenten*. The Nazi government renamed the *Privatdozent* position into *Dozent* which affects the data in 1940. To have a comparable set of researchers across different years I also add all *Dozenten* to the data.

8.4.2 Output Measures for German and Austrian Science Departments

The publications and citations data cover historical and current top science journals and were downloaded from the ISI Web of Science. The set of journals is based on historical accounts of relevant top journals and on current journal rankings.

Historical top journals

The list of top journals in the 1920s and 1930s includes mostly German journals but also the major international journals. As German science was leading at the time, many of the German journals were among the best journals worldwide which is underlined by an article published in Science in 1941: "Before the advent of the Nazis the German physics journals (Zeitschrift für Physik, Annalen der Physik, Physikalische Zeitschrift) had always served as the central organs of world science in this domain [...] In 1930 approximately 700 scientific papers were printed in its [the Zeitschrift für Physik´s] seven volumes of which 280 were by foreign scientists" (American Association for the Advancement of Science, 1941).

I obtain the list of historical journals using a three step process. First, I obtain all German science journals published in the 1920s to 1940s that are included in the Web of Science. Second, I include three general science journals that were relevant outlets for German scientists publishing in the 1920s and 1930s: Nature, Science, and the Proceedings of the Royal Society. Finally, the list of historical top journals is augmented by four international field journals that have been recommended by historians of science as important outlets for German scientists. Relevant chemistry journals were suggested by Ute Deichmann and John Andraos who work on chemistry in the early 20th century. Historical mathematics journals were suggested by Reinhard Siegmund-Schultze and David Wilkins who are specialists in the history of mathematics.

Current top journals

The definition of top journals for German (and international) scientists changed substantially since the 1920s and 30s. To reflect this change in my output measure I also compile a second list of top journals based on current international journal rankings. I use rankings provided by SCImago Journal & Country Rank to obtain the ten most cited journals in general science, physics, and chemistry. SCImago does not rank mathematics journals.[4] I therefore obtain the current most cited mathematics journals from a commonly used ranking provided by the University of Texas.[5]

Universe of Articles in Top Science Journals Published Between 1920 and 1985

The overall list of top science journals includes 51 journals. I download all articles published in these journals between 1920 and 1985. I.e. even if a journal only became a top journal in later years I download all articles published in the journal since 1920. A

[4] See http://www.scimagojr.com, accessed 13th of May 2010.

[5] See http://www.ma.utexas.edu/users/lsilvest/rankings/mranking.html, accessed 13th of May, 2010.

small number of journals were only founded after 1920. For these journals I download all articles since the creation of the journal. The publication of a few journals was interrupted towards the end of WWII. As a result these journals have missing data during those years. Furthermore, some journals have missing data in the Web of Science for some years even though the journal was published in that year.[6] The inclusion of year fixed effects in all regressions addresses this limitation.

8.4.3 Data on Bombings of German Universities and Science Departments

Data on university-level bombing destruction come from university websites and from Tietze (1995), Phillips (1983), Samuel and Thomas (1949), Schneider (1990), and Cheval (1991).

As outlined in the main text, data on department-level bombing destruction is obtained by contacting university archivists and asking them to provide destruction information for buildings used by physicists, chemists, and mathematicians.[7] Detailed data sources for department-level destruction are listed in Table A8.

If a department occupied more than one building (e.g. one building for the institute of experimental physics and a different building accommodating the institute for theoretical physics) I average percentage destruction across all buildings that were used by the department.

In some cases the historical sources only provide verbal descriptions of bombing destruction. I convert these descriptions into percentage destruction according to the following rule:

Verbal description	Percentage destruction
"completely destroyed"	100%
"heaviest destruction" or "destroyed to a large extent"	75%
"heavy destruction"	50%
"part destruction" or "burnt out"	25%
"light destruction"	10%

8.4.4 Data Sources of Control Variables

I obtain data on control variables from a number of sources.

Number of Departments Within 50km

[6] I have highlighted this problem to Thomson Scientific. It is caused by error prone scanning of historical journals.

[7] The following university archivists put in a lot of time and effort to gather information on department level bombing destruction or to provide access to the relevant sources: Klaus Graf (Aachen TU), Claudia Schülzky (Berlin TU), Thomas Becker (Bonn), Klaus Oberdieck (Braunschweig TU), Matthias Lienert (Dresden TU), Michael Maaser (Frankfurt), Dieter Speck (Freiburg), Eva-Maria Felschow (Gießen), Ulrich Hunger (Göttingen), Alois Kernbauer (Graz), Marieluise Vesulak (Graz TU), Ralf-Torsten Speler (Halle), Eckart Krause (Hamburg), Lars Nebelung (Hannover TU), Peter Goller (Innsbruck), Joachim Bauer (Jena), Klaus Nippert (Karlsruhe TU), Dagmar Bickelmann (Kiel), Andreas Freitäger (Köln), Jens Blecher and Roy Lämmel (Leipzig), Katharina Schaal (Marburg), Hans-Michael Körner (München), Margot Fuchs (München TU), Sabine Happ (Münster), Norbert Becker (Stuttgart), Thomas Maisel (Wien), Juliane Mikoletzky (Wien TU), Marcus Holtz (Würzburg).

For each university I calculate the number of departments in the same subject within 50km. The measure also includes universities that were founded after 1945. The full list of universities in Germany as of 2010 was obtained from "Personal and Hochschulen - Fachserie 11, Reihe 4.4, 2010" accessed online at http://www.destatis.de/jetspeed/portal/cms/Sites/destatis/Internet/DE/Content/Publikationen/Fachveroeffentlichungen/BildungForschungKultur/Hochschulen/PersonalHochschulen2110440107004,property=file.pdf, a publication of the German statistical agency (Statistisches Bundesamt). A list of Austrian universities in 2011 was obtained from the Austrian statistical agency (Statistik Austria) accessed online at: http://www.statistik.at/web_de/statistiken/bildung_und_kultur/formales_bildungswesen/universitaeten_studium/index.html. Using university websites I check for their founding year and whether they have a physics, chemistry, or mathematics department. This allows me to calculate the number of departments within 50km for each department and year in my sample.

Armament Related Industries in 1933

Data on the share of firms in three armament related industries (iron and steel production, mechanical engineering and vehicle construction, chemical industry) come from the establishment census of 1933 that was published in "Statistik des Deutschen Reichs – Band 463: Gewerbliche Betriebszählung, 1935". Data on industry shares in Austria come from the establishment census of 1930 that was published by the Bundesamt für Statistik in "Gewerbliche Betriebszählung in der Republik Österreich, 1932". The data measure the share of firms that belong to a certain industry (among all firms) at the city level.

Fraction of Jews in 1933

The fraction of Jews in 1933 is based on German census data from 1933. The data were obtained from "Statistik des Deutschen Reiches: Die Bevölkerung des Deutschen Reichs nach den Ergebnissen der Volkszählung 1933, Band 451, Heft 3 (1936)". As the German census of 1933 did not cover Austrian cities data on the Jewish population in the three Austrians cities in my sample were obtained from a number of different sources. Data for Vienna are for the year 1934 and come from "Statistisches Jahrbuch der Stadt Wien 1930-1935 Neue Folge, 3. Band". Data for Graz are from 1938 and come from „Israelitische Kultusgemeinde für Steiermark, Kärnten und die politischen Bezirke des Burgenlandes Oberwart, Güssing und Jennersdorf" and were accessed online at http://www.ikg-graz.at/. Data on Innsbruck are from 1938 and come from Salinger (2007).

Distance to the Iron Curtain

Distance to the Iron Curtain for German cities come from Redding and Sturm (2008). Distance to the Iron Curtain for Austrian cities is measured equivalently using the original

Redding and Sturm method.[8]

Table A13: Detailed Data Sources for Department-Level Destruction Data

University	Source for Department-Level Destruction
Aachen TU	Kriegsschäden Akten 438, 1189, 1234a
Berlin	Humboldt Universität Berlin, Universitätsarchiv, Bestand des Universitätskurators, Aktennr. 655
Berlin TU	Universitätsarchiv der Technischen Universität Berlin in der Universitätsbibliothek, 602-44
Bonn	van Rey (1995)
Braunschweig TU	Kuhlenkamp (1976)
Darmstadt TU	missing
Dresden TU	Technische Universität Dresden (1996)
Erlangen	no bombing destruction
Frankfurt	Universitätsarchiv Frankfurt (1947), Abteilung 50, Nr. 3046 BII, 241-244
Freiburg	Rösiger (1957)
Gießen	Universitätsarchiv Gießen, PrA. Nr. 2208
Göttingen	Brinkmann (1985)
Graz	e-mail communication with university archivist Prof. Dr. Alois Kernbauer
Graz TU	Weingand (1995), p. 58, p. 103
Greifswald	no bombing destruction
Halle	Eberle (2002)
Hamburg	e-mail communication with university archivist Eckart Krause, Kröplin (1951), pp.422-428 Senat Hamburg (1955), Giles (1985), p. 297
Hannover TU	Wolters (1950)
Heidelberg	no bombing destruction
Innsbruck	Klebelsberg (1953), pp. 193-196
Jena	Schmidt, Elm, Steiger, Böhlaus (1983), pp. 301-302
Karlsruhe TU	Hoepke (2007)
Kiel	Jaeger (1965), pp. 117-202
Köln	Universitätsarchiv documents
Leipzig	Füssler (1961)
Marburg	Fritzsche, Hardt, and Schade (2003), p. 30
München	Mager (1958), p. 255
München TU	Technische Hochschule München (1968)
Münster	Niemer (2010)
Rostock	no bombing destruction
Stuttgart TU	Technische Hochschule Stuttgart (1947)
Tübingen	no bombing destruction
Wien	Adamovich (1947)
Wien TU	e-mail communication with university archivist Dr. Juliane Mikoletzky
Würzburg	e-mail communication with university archivist Dr. Marcus Holtz

The table shows detailed data sources for department level destruction. Detailed citations can be found below.

[8] I thank Daniel Sturm for kindly offering to use his material to measure distances to the iron curtain for Austrian cities.

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