Online Appendix

Inventors and Firm Innovation: Evidence from the World War I Draft
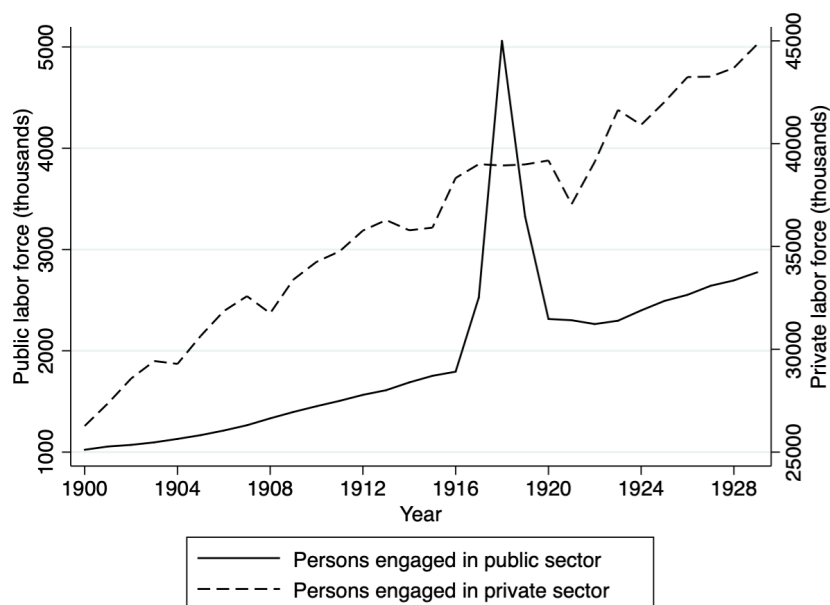
Chungeun Yoon, University of Notre Dame

Online Appendix Figure B and Table B

Figure B.1: LABOR FORCE IN PUBLIC/PRIVATE SECTOR
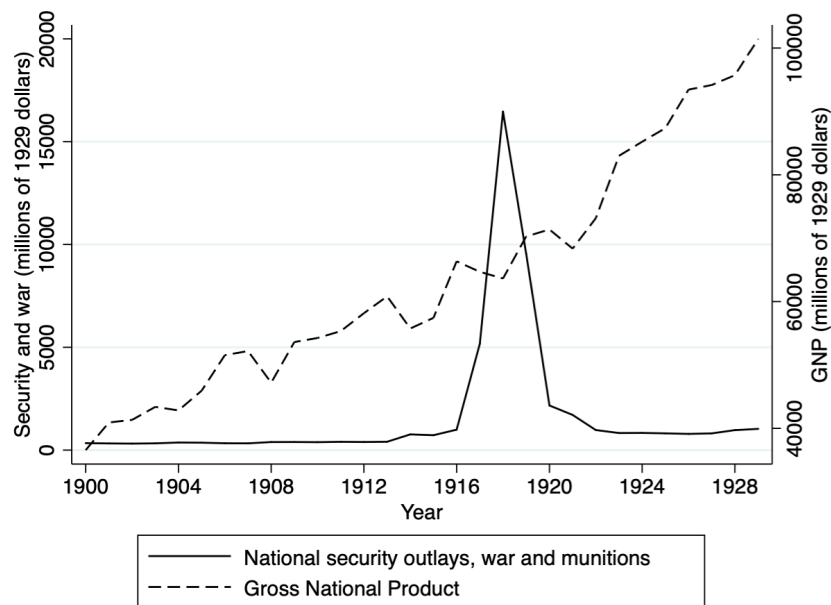

(a) Persons engaged in public/private sector (ratio)

(b) Persons engaged in public/private sector (thousands)

Notes: The figures show persons engaged in public/private sector across the years from administrative data (Kendrick, 1961).

Figure B.2: MILITARY EXPENDITURE

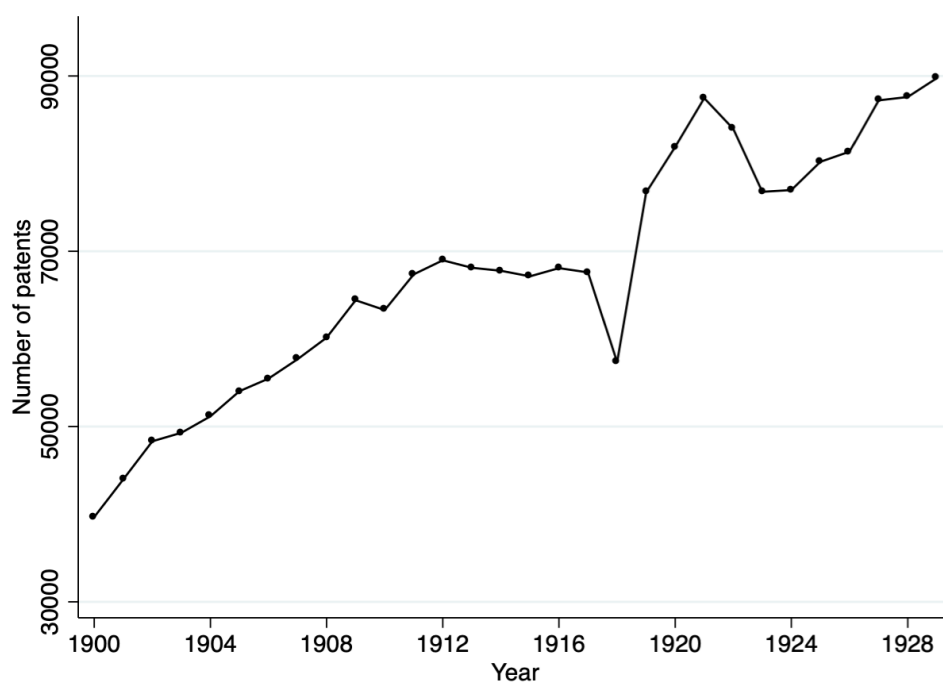

(a) Military expenditure, percentage of GNP


(b) Military expenditure and GNP (millions of 1929 dollars)

Notes: The figures show persons military expenditure across the years from administrative data (Kendrick, 1961).

Figure B.3: PATENT APPLICATIONS PER YEAR

Notes: The figure shows the total number of patent applications to the U.S. Patent and Trademark Office (Marco et al., 2015).

Figure B.4: IMPACT OF SUPPLY SHOCK ON THE POOL OF INVENTORS
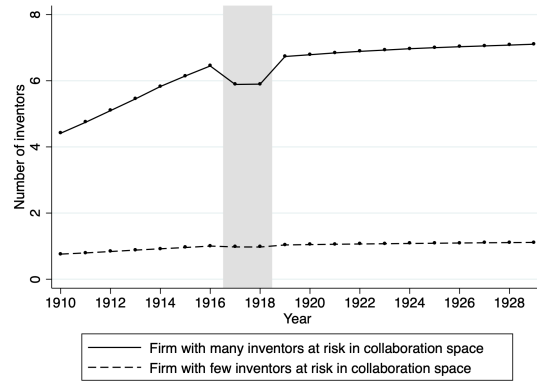
(a) Collaboration space
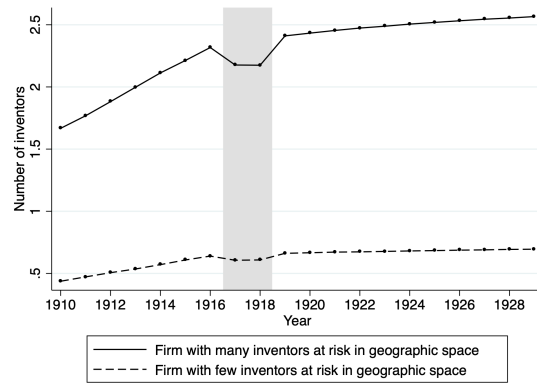
(b) Geographic space
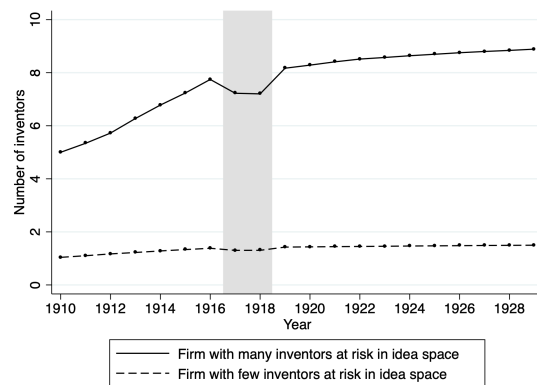
(c) Idea space

Notes: The figures show the pool of inventors for treated firms and control firms in each supply shock. New inventors who file a patent application for the first time are added to the pool of inventors every year. Inventors who serve in the military are excluded from the pool between the years 1917 to 1918.

Figure B.5: IMPACT OF SUPPLY SHOCK ON INNOVATION RATES, PLACEBO WWI DRAFT YEARS
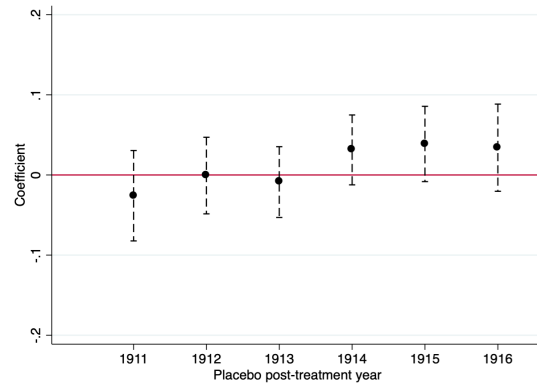
(a) Collaboration space
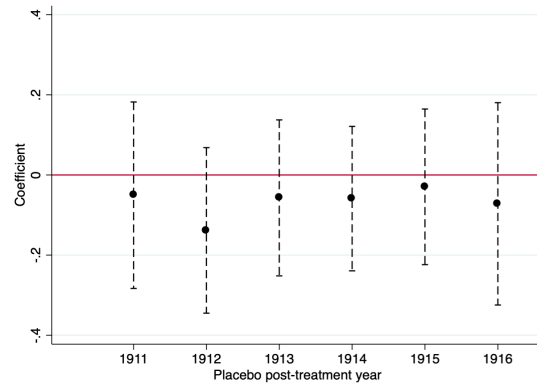
(b) Geographic space

(c) Idea space

Notes: The figures show each of coefficients corresponding to each placebo year.

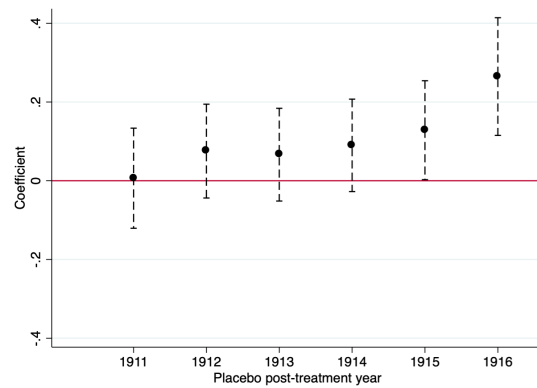Table B.1: LONG-RUN IMPACT OF SUPPLY SHOCK ON INNOVATION RATES,
MORE INNOVATIVE FIRM

	Specification			
	(1)	(2)	(3)	(4)

Dependent variable: Patent applications per year

A. Year: 1910-1929, Post-treatment years: 1917-1929

	(1)	(2)	(3)	(4)
Supply shock in Collaboration space	-0.0414*** (0.0154)	–	–	-0.0398*** (0.0154)
Geographic space	–	-0.1124 (0.1153)	–	-0.1167 (0.1153)
Idea space	–	–	0.1257*** (0.0460)	0.1212*** (0.0459)
Dependent variable mean	0.3481			
Number of observations	181,860			
Number of firms	9,093			

B. Year: 1910-1950, Post-treatment years: 1917-1950

	(1)	(2)	(3)	(4)
Supply shock in Collaboration space	-0.0445*** (0.0146)	–	–	-0.0455*** (0.0146)
Geographic space	–	-0.1570 (0.1135)	–	-0.1619 (0.1135)
Idea space	–	–	-0.0444 (0.0351)	-0.0496 (0.0351)
Dependent variable mean	0.3481			
Number of observations	372,813			
Number of firms	9,093			

C. Year: 1900-1950, Post-treatment years: 1917-1950

	(1)	(2)	(3)	(4)
Supply shock in Collaboration space	-0.0322*** (0.0093)	–	–	-0.0325*** (0.0093)
Geographic space	–	-0.0687 (0.0715)	–	-0.0721 (0.0717)
Idea space	–	–	-0.0118 (0.0228)	-0.0153 (0.0227)
Dependent variable mean	0.3056			
Number of observations	463,743			
Number of firms	9,093			

Notes: The sample consists of firms which had at least one patent application prior to the WWI draft and had no patent application relevant for the arms industry such as weapons, ammunition, and explosives. The outcome variable is the number of patent applications per year not relevant for the arms industry. The number of patent applications is winsorized at 10. Standard errors are clustered by firms.

Table B.2: LONG-RUN IMPACT OF SUPPLY SHOCK ON INNOVATION RATES,
LESS INNOVATIVE FIRM

	Specification			
	(1)	(2)	(3)	(4)
Dependent variable: Patent applications per year				
A. Year: 1910-1929, Post-treatment years: 1917-1929				
Supply shock in Collaboration space	-0.0021 (0.0015)	–	–	-0.0022 (0.0015)
Geographic space	–	-0.0273*** (0.0104)	–	-0.0269*** (0.0104)
Idea space	–	–	-0.0389*** (0.0057)	-0.0390*** (0.0057)
Dependent variable mean	0.0768			
Number of observations	398,760			
Number of firms	19,938			
B. Year: 1910-1950, Post-treatment years: 1917-1950				
Supply shock in Collaboration space	-0.0054*** (0.0015)	–	–	-0.0057*** (0.0015)
Geographic space	–	-0.0225** (0.0111)	–	-0.0217* (0.0111)
Idea space	–	–	-0.0636*** (0.0053)	-0.0639*** (0.0053)
Dependent variable mean	0.0768			
Number of observations	817,458			
Number of firms	19,938			
C. Year: 1900-1950, Post-treatment years: 1917-1950				
Supply shock in Collaboration space	-0.0042*** (0.0009)	–	–	-0.0044*** (0.0009)
Geographic space	–	-0.0184*** (0.0067)	–	-0.0178*** (0.0067)
Idea space	–	–	-0.0346*** (0.0029)	-0.0348*** (0.0029)
Dependent variable mean	0.0710			
Number of observations	1,016,838			
Number of firms	19,938			

Notes: The sample consists of firms which had at least one patent application prior to the WWI draft and had no patent application relevant for the arms industry such as weapons, ammunition, and explosives. The outcome variable is the number of patent applications per year not relevant for the arms industry. The number of patent applications is winsorized at 10. Standard errors are clustered by firms.

Table B.3: LONG-RUN IMPACT OF SUPPLY SHOCK ON INNOVATION RATES,
HIGHLY INNOVATIVE FIRM

	Specification			
	(1)	(2)	(3)	(4)

Dependent variable: Patent applications per year

A. Year: 1910-1929, Post-treatment years: 1917-1929

Supply shock in Collaboration space	-0.6037*** (0.1155)	–	–	-0.5406*** (0.1135)
Geographic space	–	-0.6589 (0.9828)	–	-0.9558 (0.9503)
Idea space	–	–	2.5571*** (0.2635)	2.5080*** (0.2636)
Dependent variable mean	1.2970			
Number of observations	58,660			
Number of firms	2,933			

B. Year: 1910-1950, Post-treatment years: 1917-1950

Supply shock in Collaboration space	-0.6380*** (0.1249)	–	–	-0.5911*** (0.1240)
Geographic space	–	-1.0400 (0.9958)	–	-1.2396 (0.9724)
Idea space	–	–	1.9617*** (0.2558)	1.9109*** (0.2555)
Dependent variable mean	1.2970			
Number of observations	120,253			
Number of firms	2,933			

C. Year: 1900-1950, Post-treatment years: 1917-1950

Supply shock in Collaboration space	-0.2837*** (0.1042)	–	–	-0.2426** (0.1031)
Geographic space	–	-0.4538 (0.8517)	–	-0.6881 (0.8308)
Idea space	–	–	1.7479*** (0.2479)	1.7297*** (0.2475)
Dependent variable mean	1.0379			
Number of observations	149,583			
Number of firms	2,933			

Notes: The sample consists of firms which had at least one patent application prior to the WWI draft and had no patent application relevant for the arms industry such as weapons, ammunition, and explosives. Highly innovative firms are those with pre-WWI patents in the top 10 percentile. The outcome variable is the number of patent applications per year not relevant for the arms industry. The number of patent applications is winsorized at 10. Standard errors are clustered by firms.

Table B.4: CORRELATIONS BETWEEN POSSIBLE SUPPLY SHOCK
AND ACTUAL SUPPLY SHOCK

	Actual supply shock of served inventors		
	Collaborator (1)	Geographic (2)	Idea (3)
A. Supply shock of more likely draftable inventors (age 30 or below)			
Collaborator	0.2585	0.0110	-0.0156
Geographic	0.0075	0.9581	0.0022
Idea	0.0186	0.0041	0.9499
B. Supply shock of less likely draftable inventors (age 31-45)			
Collaborator	0.0356	0.0214	0.0022
Geographic	0.0267	0.0363	-0.0021
Idea	-0.0002	0.0031	0.0790
C. Supply shock of not draftable inventors (age 46 or above)			
Collaborator	0.0104	0.0199	-0.0124
Geographic	0.0129	0.0166	-0.0050
Idea	0.0037	-0.0003	0.0736

Notes: This table reports correlation between each of possible supply shocks captured by draftable inventors and each of actual supply shocks captured by served inventors. In panel A, supply shocks of more likely draftable inventors are the instruments for supply shocks of served inventors. Panel B and C show correlation between placebo supply shocks and supply shocks of served inventors. The sample consists of firms which had at least one patent application prior to the WWI draft. Standard errors are clustered by firms.

Table B.5: FIRST-STAGE REGRESSIONS, PLACEBO AGE GROUPS

	Dependent variable					
Instrument	Collaborator (1)	Geographic (2)	Idea (3)	Collaborator (4)	Geographic (5)	Idea (6)
A. Supply shock of less likely draftable inventors (age 31-45)						
Collaborator (S_{iC}^*)	0.0389*** (0.0077)	–	–	0.0376*** (0.0077)	0.0039*** (0.0009)	0.0070** (0.0031)
Geographic (S_{iG}^*)	–	0.0100** (0.0044)	–	-0.0026 (0.0044)	0.0097** (0.0044)	0.0373*** (0.0099)
Idea (S_{iF}^*)	–	–	0.0238*** (0.0015)	-0.0007 (0.0020)	0.0002 (0.0004)	0.0237*** (0.0015)
F-test of excluded instruments	25.53	5.17	249.74	13.30	8.40	85.96
B. Supply shock of not draftable inventors (age 46 or above)						
Collaborator (S_{iC}^*)	0.0111* (0.0058)	–	–	0.0103* (0.0058)	0.0036*** (0.0008)	-0.0007 (0.0025)
Geographic (S_{iG}^*)	–	0.0043 (0.0033)	–	-0.0015 (0.0041)	0.0040 (0.0033)	0.0175** (0.0084)
Idea (S_{iF}^*)	–	–	0.0191*** (0.0012)	0.0009 (0.0018)	-0.0004 (0.0003)	0.0191*** (0.0013)
F-test of excluded instruments	3.68	1.70	232.52	2.60	7.97	77.86

Notes: This table reports first-stage regressions for placebo supply shocks measured by unlikely draftable inventors. The sample consists of firms which had at least one patent application prior to the WWI draft. Standard errors are clustered by firms.

Table B.6: CORRELATIONS BETWEEN POSSIBLE SUPPLY SHOCK
AND ACTUAL SUPPLY SHOCK

	Actual supply shock of served inventors		
	Collaborator (1)	Geographic (2)	Idea (3)
A. Supply shock of more likely draftable men in geographic space			
Collaborator	0.2585	0.0110	-0.0156
Geographic	0.0069	0.1787	0.0167
Idea	0.0186	0.0041	0.9499
B. Supply shock of less likely draftable men in geographic space			
Collaborator	0.2585	0.0110	-0.0156
Geographic	-0.0065	-0.1118	0.0016
Idea	0.0186	0.0041	0.9499
C. Supply shock of not draftable men in geographic space			
Collaborator	0.2585	0.0110	-0.0156
Geographic	-0.0035	-0.1459	-0.0259
Idea	0.2585	0.0110	-0.0156

Notes: This table reports correlation between each of possible supply shocks captured by men in 1910 Census and each of actual supply shocks captured by served inventors. The supply shock in geographic space meausred by inventors is replaced with each of possible supply shocks in geographic space measured by men in 1910 Census, while supply shocks in collaboration space and idea space remain the same. The sample consists of firms which had at least one patent application prior to the WWI draft. Standard errors are clustered by firms.

Table B.7: FIRST-STAGE REGRESSIONS, PLACEBO SUPPLY SHOCK IN GEOGRAPHIC SPACE

Instrument	Dependent variable					
	Collaborator (1)	Geographic (2)	Idea (3)	Collaborator (4)	Geographic (5)	Idea (6)
A. Supply shock of more likely draftable men in geographic space from 1910 Census						
Collaborator (S_{iC}^*)	0.1081*** (0.0051)	–	–	0.1093*** (0.0055)	0.0001 (0.0006)	-0.0001 (0.0004)
Geographic (S_{iG}^*)	–	0.0675*** (0.0021)	–	-0.0060** (0.0024)	0.0676*** (0.0021)	-0.0033 (0.0117)
Idea (S_{iF}^*)	–	–	0.6649*** (0.0076)	0.0293*** (0.0090)	-0.0015 (0.0009)	0.6671*** (0.0081)
F-test of excluded instruments	453.85	1,027.98	7,607.89	2,326.87	352.51	132.84
B. Supply shock of less likely draftable men in geographic space from 1910 Census						
Collaborator (S_{iC}^*)	0.1081*** (0.0051)	–	–	0.1093*** (0.0055)	0.0003 (0.0006)	-0.0001 (0.0004)
Geographic (S_{iG}^*)	–	-0.0605*** (0.0034)	–	0.0092*** (0.0035)	-0.0605*** (0.0034)	-0.0005 (0.0167)
Idea (S_{iF}^*)	–	–	0.6649*** (0.0076)	0.0293*** (0.0090)	-0.0007 (0.0009)	0.6671*** (0.0081)
F-test of excluded instruments	453.85	316.49	7,607.89	133.13	106.90	2,314.91
C. Supply shock of not draftable men in geographic space from 1910 Census						
Collaborator (S_{iC}^*)	0.1081*** (0.0051)	–	–	0.1093*** (0.0055)	0.0003 (0.0006)	-0.0001 (0.0004)
Geographic (S_{iG}^*)	–	-0.0801*** (0.0035)	–	0.0031 (0.0029)	-0.0801*** (0.0035)	0.0074 (0.0177)
Idea (S_{iF}^*)	–	–	0.6649*** (0.0076)	0.0293*** (0.0090)	-0.0014 (0.0009)	0.6671*** (0.0081)
F-test of excluded instruments	453.85	526.69	7,607.89	133.14	180.94	2,354.57

Notes: The supply shock in geographic space meausred by inventors is replaced with each of possible supply shocks in geographic space measured by men in 1910 Census, while supply shocks in collaboration space and idea space remain the same. The sample consists of firms which had at least one patent application prior to the WWI draft. Standard errors are clustered by firms.

Table B.8: IMPACT OF SUPPLY SHOCK ON INNOVATION RATES, PLACEBO
SUPPLY SHOCK IN GEOGRAPHIC SPACE

| | Specification | | | |
	(1)	(2)	(3)	(4)
Dependent variable: Patent applications per year				
A. Supply shock of more likely draftable men in geographic space from 1910 Census				
Supply shock in Collaboration space	-0.0217*** (0.0070)	–	–	-0.0204** (0.0080)
Geographic space	–	-0.0425 (0.0360)	–	-0.0431 (0.0359)
Idea space	–	–	0.0832** (0.0326)	0.0886** (0.0361)
B. Supply shock of less likely draftable men in geographic space from 1910 Census				
Supply shock in Collaboration space	-0.0217*** (0.0070)	–	–	-0.0204** (0.0080)
Geographic space	–	0.0748 (0.0487)	–	0.0733 (0.0487)
Idea space	–	–	0.0832** (0.0326)	0.0882** (0.0362)
C. Supply shock of not draftable men in geographic space from 1910 Census				
Supply shock in Collaboration space	-0.0217*** (0.0070)	–	–	-0.0206*** (0.0080)
Geographic space	–	0.0126 (0.0534)	–	0.0153 (0.0533)
Idea space	–	–	0.0832** (0.0326)	0.0881** (0.0361)
Dependent variable mean	0.1664			
Number of observations	265,536			
Number of firms	29,504			
Number of counties	1,361			

Notes: The supply shock in geographic space meausred by inventors is replaced with each of possible supply shocks in geographic space measured by men in 1910 Census, while supply shocks in collaboration space and idea space remain the same. The sample consists of firms which had at least one patent application prior to the WWI draft. The outcome variable is the number of patent applications per year. The number of patent applications is winsorized at 10. Standard errors are clustered by firms.

Table B.9: IMPACT OF SUPPLY SHOCK ON INNOVATION RATES, REDUCED FORM, ALL FIRM

	Specification			
	(1)	(2)	(3)	(4)
Dependent variable: Patent applications per year				
A. All firms				
Supply shock in Collaboration space	-0.0215*** (0.0080)	–	–	-0.0208*** (0.0080)
Geographic space	–	0.0475 (0.0498)	–	0.0481 (0.0497)
Idea space	–	–	0.0927** (0.0362)	0.0915** (0.0362)
Dependent variable mean	0.1664			
Number of observations	226,638			
Number of firms	29,504			
B. More innovative firms (Patents before WWI above the median)				
Supply shock in Collaboration space	-0.0368* (0.0223)	–	–	-0.0332 (0.0223)
Geographic space	–	0.2575 (0.1675)	–	0.2527 (0.1674)
Idea space	–	–	0.2240*** (0.0844)	0.2211*** (0.0844)
Dependent variable mean	0.3572			
Number of observations	78,876			
Number of firms	9,393			
C. Less innovative firms (Patents before WWI below the median)				
Supply shock in Collaboration space	-0.0016 (0.0030)	–	–	-0.0018 (0.0030)
Geographic space	–	-0.0229 (0.0212)	–	-0.0233 (0.0212)
Idea space	–	–	-0.0512*** (0.0125)	-0.0513*** (0.0125)
Dependent variable mean	0.0772			
Number of observations	147,762			
Number of firms	20,111			

Notes: The sample consists of firms which had at least one patent application prior to the WWI draft. More innovative firms had pre-WWI patents above the median and less innovative firms had pre-WWI patents equal to or below the median. The outcome variable is the number of patent applications per year. The number of patent applications is winsorized at 10. Standard errors are clustered by firms. State-year fixed effects are included.

Table B.10: IMPACT OF SUPPLY SHOCK ON INNOVATION RATES,
INTERACTION TERMS FOR MORE OR LESS INNOVATIVE FIRMS

	Specification			
	(1)	(2)	(3)	(4)
Dependent variable: Patent applications per year				
More innovative firms				
Supply shock in Collaboration space	-0.0344 (0.0211)	–	–	-0.0311 (0.0211)
Geographic space	–	0.1370 (0.1517)	–	0.1298 (0.1520)
Idea space	–	–	0.2419*** (0.0834)	0.2389*** (0.0834)
Less innovative firms				
Supply shock in Collaboration space	-0.0016 (0.0019)	–	–	-0.0016 (0.0019)
Geographic space	–	-0.0076 (0.0137)	–	-0.0075 (0.0137)
Idea space	–	–	-0.0159* (0.0085)	-0.0160* (0.0085)
Dependent variable mean	0.1664			
Number of observations	265,536			
Number of firms	29,504			

Notes: The sample consists of firms which had at least one patent application prior to the WWI draft. More innovative firms are those with pre-WWI patents above the median and less innovative firms are those with pre-WWI patents below the median. The outcome variable is the number of patent applications per year. The number of patent applications is winsorized at 10. Standard errors are clustered by firms.

Table B.11: IMPACT OF SUPPLY SHOCK ON INNOVATION RATES, REDUCED FORM (EQUALLY WEIGHTED PRE-WWI PATENTS)

	Specification			
	(1)	(2)	(3)	(4)

Dependent variable: Patent applications per year

A. Firms

Supply shock in Collaboration space	-0.0251*** (0.0083)	–	–	-0.0246*** (0.0083)
Geographic space	–	0.0366 (0.0481)	–	0.0363 (0.0480)
Idea space	–	–	0.0806** (0.0390)	0.0795** (0.0390)
Dependent variable mean	0.1618			
Number of observations	222,795			
Number of firms	29,031			

B. More innovative firms

Supply shock in Collaboration space	-0.0490** (0.0234)	–	–	-0.0455* (0.0234)
Geographic space	–	0.2322 (0.1627)	–	0.2286 (0.1623)
Idea space	–	–	0.1827** (0.0901)	0.1783** (0.0900)
Dependent variable mean	0.3481			
Number of observations	76,338			
Number of firms	9,093			

C. Less innovative firms

Supply shock in Collaboration space	-0.0018 (0.0033)	–	–	-0.0018 (0.0033)
Geographic space	–	-0.0254 (0.0212)	–	-0.0252 (0.0212)
Idea space	–	–	-0.0432*** (0.0144)	-0.0432*** (0.0144)
Dependent variable mean	0.0768			
Number of observations	146,457			
Number of firms	19,938			

Notes: The sample consists of firms which had at least one patent application prior to the WWI draft and had no patent application relevant for the arms industry such as weapons, ammunition, and explosives. More innovative firms are those with pre-WWI patents above the median and less innovative firms are those with pre-WWI patents below the median. The outcome variable is the number of patent applications per year not relevant for the arms industry. The number of patent applications is winsorized at 10. Standard errors are clustered by firms. State-year fixed effects are included.

Table B.12: IMPACT OF SUPPLY SHOCK ON INNOVATION RATES, REDUCED FORM (OUTSIDE THE FIRM)

	Specification			
	(1)	(2)	(3)	(4)
Dependent variable: Patent applications per year				
A. Firms				
Supply shock in Collaboration space	-0.0213*** (0.0077)	–	–	-0.0208*** (0.0077)
Geographic space	–	0.0522 (0.0479)	–	0.0521 (0.0479)
Idea space	–	–	0.0813** (0.0390)	0.0800** (0.0391)
Dependent variable mean	0.1618			
Number of observations	222,795			
Number of firms	29,031			
B. More innovative firms				
Supply shock in Collaboration space	-0.0370* (0.0217)	–	–	-0.0338 (0.0217)
Geographic space	–	0.2840* (0.1688)	–	0.2807* (0.1687)
Idea space	–	–	0.1842** (0.0905)	0.1809** (0.0905)
Dependent variable mean	0.3481			
Number of observations	76,338			
Number of firms	9,093			
C. Less innovative firms				
Supply shock in Collaboration space	-0.0019 (0.0030)	–	–	-0.0021 (0.0030)
Geographic space	–	-0.0254 (0.0212)	–	-0.0252 (0.0212)
Idea space	–	–	-0.0432*** (0.0144)	-0.0433*** (0.0144)
Dependent variable mean	0.0768			
Number of observations	146,457			
Number of firms	19,938			

Notes: The sample consists of firms which had at least one patent application prior to the WWI draft and had no patent application relevant for the arms industry such as weapons, ammunition, and explosives. More innovative firms had pre-WWI patents above the median and less innovative firms had pre-WWI patents equal to or below the median. The outcome variable is the number of patent applications per year not relevant for the arms industry. The number of patent applications is winsorized at 10. Standard errors are clustered by firms. State-year fixed effects are included.

Table B.13: SUMMARY STATISTICS, INDIVIDUAL

	Served inventors	Non-served inventors		
		Total	Registered	Not registered
	(1)	(2)	(3)	(4)
Patent applications per year (SD)				
1910-1916	0.3778 (1.0016)	0.1539 (0.5429)	0.1684 (0.5521)	0.1356 (0.5306)
1917-1918	0.2600 (0.9195)	0.0683 (0.4196)	0.0724 (0.4286)	0.0630 (0.4074)
Median age				
	28	40	33	51
Number of inventors				
	1,783	119,244	67,342	51,902

Notes: The sample consists of inventors who had at least one patent application prior to the WWI draft. The number of patents is winsorized at 10.

Table B.14: IMPACT OF SUPPLY SHOCK ON INNOVATION RATES, OLS COEFFICIENTS, INDIVIDUAL

	Specification			
	(1)	(2)	(3)	(4)

Dependent variable: Number of patent applications per year

A. All inventors who did not serve

	(1)	(2)	(3)	(4)
Supply shock in Collaboration space	-0.0335** (0.0146)	–	–	-0.0337** (0.0145)
Geographic space	–	0.0048 (0.0186)	–	0.0050 (0.0186)
Idea space	–	–	0.0768* (0.0393)	0.0770* (0.0393)
Dependent variable mean	0.1539			
Number of observations	1,055,438			
Number of inventors	119,208			
Number of counties	3,024			

B. Inventors who registered but did not serve

	(1)	(2)	(3)	(4)
Supply shock in Collaboration space	-0.0260 (0.0205)	–	–	-0.0263 (0.0204)
Geographic space	–	0.0039 (0.0267)	–	0.0035 (0.0267)
Idea space	–	–	0.1593*** (0.0568)	0.1594*** (0.0568)
Dependent variable mean	0.1684			
Number of observations	591,054			
Number of inventors	67,342			
Number of counties	2,973			

C. Inventors who neither registered nor serve

	(1)	(2)	(3)	(4)
Supply shock in Collaboration space	-0.0420** (0.0204)	–	–	-0.0419** (0.0204)
Geographic space	–	0.0148 (0.0239)	–	0.0146 (0.0239)
Idea space	–	–	-0.0436 (0.0443)	-0.0430 (0.0444)
Dependent variable mean	0.1356			
Number of observations	464,384			
Number of inventors	51,866			
Number of counties	2,918			

Notes: The sample consists of inventors who had at least one patent application prior to the WWI draft. The number of patents is winsorized at 10. Standard errors are clustered at the individual level.

Table B.15: FIRST-STAGE REGRESSIONS, INDIVIDUAL

Instrument	Collaborator (1)	Geographic (2)	Idea (3)	Collaborator (4)	Geographic (5)	Idea (6)
			Dependent variable			
Collaborator (S_{iC}^*)	0.6042*** (0.0059)	–	–	0.6032*** (0.0059)	0.0006 (0.0007)	0.0021*** (0.0006)
Geographic (S_{iG}^*)	–	0.6223*** (0.0043)	–	0.0001 (0.0007)	0.6222*** (0.0043)	0.0204*** (0.0029)
Idea (S_{iF}^*)	–	–	0.5545*** (0.0056)	0.0011 (0.0022)	0.0004 (0.0007)	0.5544*** (0.0056)
F-test of excluded instruments	10,530.29	20,626.29	9,913.06	3,555.83	6,876.73	3,329.11

Notes: Standard errors are clustered at the individual level.

Table B.16: IMPACT OF SUPPLY SHOCK ON INNOVATION RATES, IV
COEFFICIENTS, INDIVIDUAL

	Specification			
	(1)	(2)	(3)	(4)
Dependent variable: Number of patent applications per year				
A. All inventors who did not serve				
Supply shock in				
Collaboration space	-0.0687***	–	–	-0.0688***
	(0.0189)			(0.0189)
Geographic space	–	0.0087	–	0.0088
		(0.0186)		(0.0187)
Idea space	–	–	0.0406	0.0408
			(0.0331)	(0.0331)
Dependent variable mean	0.1539			
Number of observations	1,055,438			
Number of inventors	119,208			
Number of counties	3,024			
B. Inventors who registered but did not serve				
Supply shock in				
Collaboration space	-0.0359*	–	–	-0.0361*
	(0.0201)			(0.0201)
Geographic space	–	0.0195	–	0.0194
		(0.0256)		(0.0256)
Idea space	–	–	0.1163**	0.1162**
			(0.0460)	(0.0461)
Dependent variable mean	0.1684			
Number of observations	591,054			
Number of inventors	67,342			
Number of counties	2,973			
C. Inventors who neither registered nor served				
Supply shock in				
Collaboration space	-0.1136***	–	–	-0.1133***
	(0.0320)			(0.0320)
Geographic space	–	-0.0074	–	-0.0079
		(0.0269)		(0.0270)
Idea space	–	–	-0.0631	-0.0625
			(0.0422)	(0.0423)
Dependent variable mean	0.1356			
Number of observations	464,384			
Number of inventors	51,866			
Number of counties	2,918			

Notes: The sample consists of inventors who had at least one patent application prior to the WWI draft. The number of patents is winsorized at 10. Standard errors are clustered at the individual level.

Table B.17: IMPACT OF SUPPLY SHOCK ON INNOVATION RATES, REDUCED
FORM, INDIVIDUAL

	Specification			
	(1)	(2)	(3)	(4)

Dependent variable: Number of patent applications per year

A. All inventors who did not serve

	(1)	(2)	(3)	(4)
Supply shock in Collaboration space	-0.0372*** (0.0108)	–	–	-0.0373*** (0.0108)
Geographic space	–	0.0054 (0.0122)	–	0.0055 (0.0122)
Idea space	–	–	0.0224 (0.0194)	0.0225 (0.0194)
Dependent variable mean	0.1539			
Number of observations	1,055,438			
Number of inventors	119,208			
Number of counties	3,024			

B. Inventors who registered but did not serve

	(1)	(2)	(3)	(4)
Supply shock in Collaboration space	-0.0248* (0.0147)	–	–	-0.0248* (0.0147)
Geographic space	–	0.0128 (0.0178)	–	0.0127 (0.0178)
Idea space	–	–	0.0633** (0.0267)	0.0633** (0.0267)
Dependent variable mean	0.1684			
Number of observations	591,054			
Number of inventors	67,342			
Number of counties	2,973			

C. Inventors who neither registered nor serve

	(1)	(2)	(3)	(4)
Supply shock in Collaboration space	-0.0507*** (0.0150)	–	–	-0.0506*** (0.0150)
Geographic space	–	-0.0043 (0.0164)	–	-0.0044 (0.0164)
Idea space	–	–	-0.0355 (0.0251)	-0.0351 (0.0252)
Dependent variable mean	0.1356			
Number of observations	464,384			
Number of inventors	51,866			
Number of counties	2,918			

Notes: The sample consists of inventors who had at least one patent application prior to the WWI draft. The number of patents is winsorized at 10. Standard errors are clustered at the individual level.

Table B.18: IMPACT OF SUPPLY SHOCK ON INNOVATION RATES,
INTERACTION TERMS FOR PERCENTILE IN PRE-WWI PATENTS

	Specification			
	(1)	(2)	(3)	(4)
Dependent variable: Patent applications per year				
Firms at the bottom percentile in pre-WWI patents				
Supply shock in Collaboration space	0.0334*** (0.0090)	–	–	0.0198** (0.0094)
Geographic space	–	0.4314*** (0.0652)	–	0.3955*** (0.0690)
Idea space	–	–	-0.1090*** (0.0347)	-0.1391*** (0.0362)
Interacted with the percentile in pre-WWI patents				
Supply shock in Collaboration space	-0.0040*** (0.0011)	–	–	-0.0026** (0.0012)
Geographic space	–	-0.0431*** (0.0084)	–	-0.0385*** (0.0092)
Idea space	–	–	0.0118*** (0.0038)	0.0155*** (0.0040)
Dependent variable mean	0.1618			
Number of observations	261,279			
Number of firms	29,031			

Notes: The sample consists of firms which had at least one patent application prior to the WWI draft and had no patent application relevant for the arms industry such as weapons, ammunition, and explosives. The outcome variable is the number of patent applications per year not relevant for the arms industry. The number of patent applications is winsorized at 10. Standard errors are clustered by firms.

Table B.19: IMPACT OF SUPPLY SHOCK ON ORIGINAL PATENT
APPLICATIONS, HIGHLY INNOVATIVE FIRM

	Specification			
	(1)	(2)	(3)	(4)
Dependent variable: Original patent applications per year				
A. Firms in the top 5 percentile of invention				
Supply shock in Collaboration space	-0.1047 (0.0797)	–	–	-0.0967 (0.0802)
Geographic space	–	1.0874* (0.5728)	–	1.0201* (0.5689)
Idea space	–	–	0.2074** (0.0825)	0.1854** (0.0836)
Dependent variable mean	0.2510			
Number of observations	12,447			
Number of firms	1,383			
B. Firms in the top 10 percentile of invention				
Supply shock in Collaboration space	-0.0481 (0.0443)	–	–	-0.0451 (0.0444)
Geographic space	–	0.5004* (0.2707)	–	0.4903* (0.2670)
Idea space	–	–	0.1358** (0.0580)	0.1286** (0.0582)
Dependent variable mean	0.1648			
Number of observations	26,397			
Number of firms	2,933			
C. Firms in the top 25 percentile of invention				
Supply shock in Collaboration space	-0.0199 (0.0170)	–	–	-0.0176 (0.0171)
Geographic space	–	0.1920** (0.0902)	–	0.1830** (0.0897)
Idea space	–	–	0.1153*** (0.0351)	0.1126*** (0.0352)
Dependent variable mean	0.0818			
Number of observations	73,314			
Number of firms	8,146			

Notes: The sample consists of firms which had at least one patent application prior to the WWI draft and had no patent application relevant for the arms industry such as weapons, ammunition, and explosives. The outcome variable is the number of original patent applications per year defined as those with new one/two/three word phrases in title that did not exist in patent applications in previous years. The number of patent applications is winsorized at 10. Standard errors are clustered by firms.

Table B.20: IMPACT OF SUPPLY SHOCK ON PATENT CITATIONS, HIGHLY INNOVATIVE FIRM

	Specification			
	(1)	(2)	(3)	(4)
Dependent variable: Patent citations per year				
A. Firms in the top 5 percentile of invention				
Supply shock in Collaboration space	-0.9958*** (0.3704)	–	–	-0.8994** (0.3703)
Geographic space	–	1.8670 (3.8225)	–	1.0469 (3.7989)
Idea space	–	–	2.3937*** (0.5956)	2.2689*** (0.5942)
Dependent variable mean	2.8476			
Number of observations	12,447			
Number of firms	1,383			
B. Firms in the top 10 percentile of invention				
Supply shock in Collaboration space	-0.6047*** (0.2088)	–	–	-0.5485*** (0.2082)
Geographic space	–	0.9828 (1.8921)	–	0.8056 (1.8716)
Idea space	–	–	2.0608*** (0.4282)	1.9975*** (0.4275)
Dependent variable mean	1.9534			
Number of observations	26,397			
Number of firms	2,933			
C. Firms in the top 25 percentile of invention				
Supply shock in Collaboration space	-0.2747*** (0.0848)	–	–	-0.2461*** (0.0847)
Geographic space	–	0.4368 (0.6362)	–	0.3122 (0.6315)
Idea space	–	–	1.5880*** (0.2755)	1.5611*** (0.2749)
Dependent variable mean	1.0267			
Number of observations	73,314			
Number of firms	8,146			

Notes: The sample consists of firms which had at least one patent application prior to the WWI draft and had no patent application relevant for the arms industry such as weapons, ammunition, and explosives. The outcome variable is the number of patent citations. The number of patent citations is winsorized at 20. Standard errors are clustered by firms.

Table B.21: QUALITY OF INVENTORS AND IMPACT OF SUPPLY SHOCK ON INNOVATION RATES, MORE INNOVATIVE FIRM

	Specification			
	(1)	(2)	(3)	(4)
Dependent variable: Patent applications per year				
A. Supply shock of very high-quality inventors				
Supply shock in Collaboration space	-0.0895*** (0.0324)	–	–	-0.0823** (0.0325)
Geographic space	–	-0.0872*** (0.0333)	–	-0.0818** (0.0332)
Idea space	–	–	0.1557* (0.0891)	0.1551* (0.0894)
B. Supply shock of high-quality inventors				
Supply shock in Collaboration space	-0.0799*** (0.0253)	–	–	-0.0745*** (0.0253)
Geographic space	–	-0.0741** (0.0337)	–	-0.0680** (0.0336)
Idea space	–	–	0.1381* (0.0799)	0.1365* (0.0800)
C. Supply shock of low-quality inventors				
Supply shock in Collaboration space	0.0111 (0.0459)	–	–	0.0093 (0.0470)
Geographic space	–	0.0617 (0.0920)	–	0.0664 (0.0942)
Idea space	–	–	0.0938* (0.0548)	0.0944* (0.0548)
Dependent variable mean	0.3481			
Number of observations	81,837			
Number of firms	9,093			

Notes: The sample consists of firms which had at least one patent application prior to the WWI draft and had no patent application relevant for the arms industry such as weapons, ammunition, and explosives. Very high-quality inventors are those with pre-WWI patents in the top 10 percentile of invention. High-quality inventors are those with pre-WWI patents above the median and low-quality inventors are those with pre-WWI patents below the median. The outcome variable is the number of patent applications per year not relevant for the arms industry. The number of patent applications is winsorized at 10. Standard errors are clustered by firms. State-year fixed effects are included.

Table B.22: QUALITY OF INVENTORS AND IMPACT OF SUPPLY SHOCK ON INNOVATION RATES, LESS INNOVATIVE FIRM

	Specification			
	(1)	(2)	(3)	(4)
Dependent variable: Patent applications per year				
A. Supply shock of very high-quality inventors				
Supply shock in Collaboration space	-0.0050 (0.0043)	–	–	-0.0048 (0.0043)
Geographic space	–	-0.0048 (0.0043)	–	-0.0041 (0.0043)
Idea space	–	–	-0.0446*** (0.0135)	-0.0445*** (0.0135)
B. Supply shock of high-quality inventors				
Supply shock in Collaboration space	-0.0069* (0.0037)	–	–	-0.0068* (0.0037)
Geographic space	–	-0.0067 (0.0042)	–	-0.0058 (0.0042)
Idea space	–	–	-0.0387*** (0.0120)	-0.0387*** (0.0120)
C. Supply shock of low-quality inventors				
Supply shock in Collaboration space	0.0013 (0.0052)	–	–	-0.0001 (0.0052)
Geographic space	–	0.0278** (0.0112)	–	0.0268** (0.0113)
Idea space	–	–	-0.0267*** (0.0082)	-0.0264*** (0.0082)
Dependent variable mean	0.0768			
Number of observations	179,442			
Number of firms	19,938			

Notes: The sample consists of firms which had at least one patent application prior to the WWI draft and had no patent application relevant for the arms industry such as weapons, ammunition, and explosives. Very high-quality inventors are those with pre-WWI patents in the top 10 percentile of invention. High-quality inventors are those with pre-WWI patents above the median and low-quality inventors are those with pre-WWI patents below the median. The outcome variable is the number of patent applications per year not relevant for the arms industry. The number of patent applications is winsorized at 10. Standard errors are clustered by firms. State-year fixed effects are included.

Table B.23: QUALITY OF INVENTORS AND IMPACT OF SUPPLY SHOCK ON
INNOVATION RATES, HIGHLY INNOVATIVE FIRM

	Specification			
	(1)	(2)	(3)	(4)
Dependent variable: Patent applications per year				
A. Supply shock of very high-quality inventors				
Supply shock in Collaboration space	-1.0218*** (0.1486)	–	–	-0.9361*** (0.1468)
Geographic space	–	-0.3464* (0.1925)	–	-0.3197* (0.1891)
Idea space	–	–	2.6969*** (0.2887)	2.6461*** (0.2905)
B. Supply shock of high-quality inventors				
Supply shock in Collaboration space	-0.8577*** (0.1304)	–	–	-0.7824*** (0.1283)
Geographic space	–	-0.2801 (0.2028)	–	-0.2840 (0.1976)
Idea space	–	–	2.4511*** (0.2566)	2.4102*** (0.2569)
C. Supply shock of low-quality inventors				
Supply shock in Collaboration space	0.2825 (0.2510)	–	–	0.2936 (0.2570)
Geographic space	–	0.6749 (0.5901)	–	1.2053** (0.5910)
Idea space	–	–	1.7340*** (0.1758)	1.7517*** (0.1761)
Dependent variable mean	1.2970			
Number of observations	58,660			
Number of firms	2,933			

Notes: The sample consists of firms which had at least one patent application prior to the WWI draft and had no patent application relevant for the arms industry such as weapons, ammunition, and explosives. Highly innovative firms are those with pre-WWI patents in the top 10 percentile. Very high-quality inventors are those with pre-WWI patents in the top 10 percentile of invention. High-quality inventors are those with pre-WWI patents above the median and low-quality inventors are those with pre-WWI patents below the median. The outcome variable is the number of patent applications per year not relevant for the arms industry. The number of patent applications is winsorized at 10. Standard errors are clustered by firms. State-year fixed effects are included.