Online Appendix

"Isolating personal knowledge spillovers: co-inventor deaths and spatial citation differentials."

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A17 – Knowledge flow reductions within 20 miles over time: full analysis sample

A18 - Knowledge flow reductions across distance and time: full analysis sample without top 1% most cited patents

A19 - Knowledge flow reductions across distance and time estimated with Linear Probability Model: full analysis sample

A20 - Knowledge flow reductions across distance and time estimated with OLS regression of log(Y+1): full analysis sample

A21 - Knowledge flow reductions across distance and time: full analysis sample including self-citations

A22 - Knowledge flow reductions across distance and time: only examiner added citations sample

A23 - Knowledge flow reductions across distance and time estimated with observations reweighted to (1/number of inventors): full analysis sample

A24 - Knowledge flow reductions across distance and time: at least one co-inventor lives closer than 500 miles from the deceased inventor sample

A25 - Knowledge flow reductions across distance and time: Coarsened Exact Matching (CEM) sample

A26 - Test of Coarsened Exact Matching (CEM) sample balancing

Appendix references

Alcácer, Juan, and Michelle Gittelman. 2006**.** "Patent Citations as a Measure of Knowledge Flows: The Influence of Examiner Citations." *Review of Economics and Statistics* 88 (4): 774-779.

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Iacus, Stefano M., Gary King, and Giuseppe Porro. 2012. "Causal Inference Without Balance Checking: Coarsened Exact Matching." *Political Analysis* 20 (1): 1–24.

Kaltenberg, Mary, Adam Jaffe, and Margie E. Lachman. 2021. "Matched Inventor Ages from Patents, Based on Web Scraped Sources." Harvard Dataverse https://doi.org/10.7910/DVN/YRLSKU (accessed July 20, 2021)

A1 - Example of data source that identifies differing home towns of deceased and still living co-inventors

United States Patent [19]

Schwartz et al.

[11] **4,344,822**

[45] **Aug. 17, 1982**

[54] **ONE-SPOT CAR COKE QUENCHING METHOD**

[75] Inventors: **S. Robert Schwartz**, Valparaiso; **William E. Swan, Jr.**; **Robert C. Fetterman**, both of Chesterton, all of Ind.; **Victor A. Neubaum**, **deceased**, late of Coopersburg, Pa., by Doris W. Neubaum, administratrix

[73] Assignee: **Bethlehem Steel Corporation**, Bethlehem, Pa.

[21] Appl. No.: **89,847**

[22] Filed: **Oct. 31, 1979**

[51] **Int. Cl.**[3] **C10B 39/08**; C10B 39/14

[52] **U.S. Cl.** **201/39**; 202/227

[58] **Field of Search** 201/39, 41; 202/227, 202/253

[56] **References Cited**

U.S. PATENT DOCUMENTS

1,677,973	7/1928	Marquard .	
3,806,425	8/1971	Ekholm et al. .	
3,862,015	1/1975	Ouwerkerk .	
3,876,143	4/1975	Rossow et al. .	
4,025,395	5/1977	Ekholm et al.	201/39
4,104,130	8/1978	Calderon	202/227
4,196,054	4/1980	Becker et al.	202/227

Primary Examiner—Bradley Garris

Attorney, Agent, or Firm—Joseph J. O'Keefe; Michael J. Delaney; Anson W. Biggs

[57] **ABSTRACT**

A process for quenching hot coke in a one-spot coke quench car. The process utilizes a unique arrangement of pipes and spray nozzles to quench the hot coke in a substantially watertight coke quench car having a sloping bottom. A plurality of pipes are directed downwardly from a header mounted on the bench side of the quench car to provide solid streams of water onto the shallow coke bed portion at the top of the sloped bottom for a portion of the quench period. After an initial period a flow of water from a plurality of spray nozzles mounted on additional headers is directed onto the substantially horizontal deep coke bed portion for the remainder of the quenching period. The unvaporized quench liquid is retained in the watertight car until the completion of the quench cycle when it is rapidly drained away.

5 Claims, 3 Drawing Figures

Notes: Original patent front page for U.S. patent 4,344,822, indicating that Victor Neubaum, of Coopersburg, Pennsylvania, died after the application for the patent but before the patent's grant. All of his still-living co-inventors resided in Indiana.

A2 - Distribution of number of inventors per patent: full analysis sample

No. of inventors per patent	Frequency	Percent	Cumulative percent
2	678	41.83	41.83
3	414	25.54	67.37
4	229	14.13	81.49
5	115	7.09	88.59
6	79	4.87	93.46
7	44	2.71	96.18
8	17	1.05	97.22
9	17	1.05	98.27
10	10	0.62	98.89
11	4	0.25	99.14
12	8	0.49	99.63
13	1	0.06	99.69
14	2	0.12	99.81
15	1	0.06	99.88
17	1	0.06	99.94
18	1	0.06	100.00
Total	1,621	100.00	

Notes: All 1,621 patents in analysis sample. Application dates fall between January 1, 1976 and December 31, 2005.

A3 - Distribution of distances between deceased and living co-inventors: full analysis sample

Distance from deceased to alive co-inventors	
Distance (in miles)	Percent
≤ 10	21.42
≤ 50	64.16
≤ 100	67.39
≤ 300	74.68
≤ 500	79.59
≤ 1000	86.05
≤ 3262	100.00

Notes: Distribution of distances between deceased and living co-inventors. N=5491 from a total of 1,621 patents with exactly one deceased inventor and 3,870 living co-inventors. Application dates fall between January 1, 1976 and December 31, 2005. Distance is defined as the minimal distance between the city centers of the deceased and still living inventor, measured in miles.

A4 - Distribution of application years of patents: full analysis sample

Application year	Frequency	Percent	Cumulative percent
1976	50	3.08	3.08
1977	56	3.45	6.54
1978	29	1.79	8.33
1979	28	1.73	10.06
1980	38	2.34	12.40
1981	40	2.47	14.87
1982	43	2.65	17.52
1983	27	1.67	19.19
1984	46	2.84	22.02
1985	47	2.90	24.92
1986	39	2.41	27.33
1987	43	2.65	29.98
1988	33	2.04	32.02
1989	40	2.47	34.48
1990	53	3.27	37.75
1991	52	3.21	40.96
1992	59	3.64	44.60
1993	64	3.95	48.55
1994	49	3.02	51.57
1995	100	6.17	57.74
1996	82	5.06	62.80
1997	89	5.49	68.29
1998	94	5.80	74.09
1999	79	4.87	78.96
2000	83	5.12	84.08
2001	70	4.32	88.40
2002	74	4.57	92.97
2003	49	3.02	95.99
2004	43	2.65	98.64
2005	22	1.36	100.00
Total	1,621	100.00	

Notes: All 1,621 patents in analysis sample.

A5 - Distribution of grant years of patents: full analysis sample

Granting year	Frequency	Percent	Cumulative percent
1976	1	0.06	0.06
1977	15	0.93	0.99
1978	42	2.59	3.58
1979	43	2.65	6.23
1980	34	2.10	8.33
1981	22	1.36	9.69
1982	47	2.90	12.58
1983	30	1.85	14.44
1984	34	2.10	16.53
1985	38	2.34	18.88
1986	53	3.27	22.15
1987	38	2.34	24.49
1988	50	3.08	27.58
1989	36	2.22	29.80
1990	40	2.47	32.26
1991	49	3.02	35.29
1992	49	3.02	38.31
1993	53	3.27	41.58
1994	53	3.27	44.85
1995	50	3.08	47.93
1996	69	4.26	52.19
1997	67	4.13	56.32
1998	73	4.50	60.83
1999	79	4.87	65.70
2000	87	5.37	71.07
2001	91	5.61	76.68
2002	81	5.00	81.68
2003	74	4.57	86.24
2004	53	3.27	89.51
2005	14	0.86	90.38
2006	80	4.94	95.31
2007	71	4.38	99.69
2008	5	0.31	100.00
Total	1,621	100.00	

Notes: All 1,621 patents in analysis sample.

A6 - Distributions of time to and distance of citation, for cited patent to citing patent: full analysis sample

Time (in years)	Cumulative percent
5	30.56
10	59.02
15	79.80
all	100

Notes: Percentage of citations that occur within given timespan calculated as difference between grant date of cited patent to application date of citing patent. 1,621 patents with exactly one deceased inventor. Application dates fall between January 1, 1976 and December 31, 2005. All citations from US patents granted thru 2020.

Radius	Cumulative percent
10	14.16
20	17.99
30	19.77
40	20.50
50	21.04
60	21.54
70	22.14
80	22.64
90	23.40
100	23.84
110	24.23
120	24.56
130	25.26
140	25.60
150	26.13

Notes: Percentage of citations that occur within given distance from the location of the nearest inventor. 1,621 patents with exactly one deceased inventor. Application dates fall between January 1, 1976 and December 31, 2005. Distance is defined as the minimal distance between the city center of the deceased/still living inventor of the cited patent and the city center of the closest inventor of the citing patent, measured in miles. All citations from US patents granted thru 2020.

A7 -Descriptive stats of dependent variables over different time windows: full analysis sample

Cites within 15 years

Variable	Obs	Median	Mean	SD	Min	Max	Share of 0	Share of patents with 0 cites
No. cites within 10 miles	5491	0	1.83	8.54	0	178	74.18	65.21
No. cites within 20 miles	5491	0	2.87	12.78	0	238	65.53	58.98
No. cites within 30 miles	5491	0	3.36	14.06	0	257	61.14	55.77
No. cites within 40 miles	5491	0	3.62	15.10	0	265	58.86	54.29
No. cites within 50 miles	5491	0	3.73	15.33	0	265	57.48	53.12
No. cites within 60 miles	5491	0	3.81	15.42	0	265	56.26	51.94
No. cites within 70 miles	5491	0	3.88	15.47	0	265	54.85	50.65
No. cites within 80 miles	5491	0	3.96	15.52	0	265	53.67	49.35
No. cites within 90 miles	5491	0	4.03	15.60	0	265	52.90	48.98
No. cites within 100 miles	5491	0	4.13	15.72	0	265	51.68	47.93
No. cites within 110 miles	5491	0	4.23	15.87	0	265	50.57	46.82
No. cites within 120 miles	5491	1	4.28	15.90	0	265	49.79	46.14
No. cites within 130 miles	5491	1	4.40	16.04	0	265	49.04	45.47
No. cites within 140 miles	5491	1	4.46	16.09	0	265	48.32	44.85
No. cites within 150 miles	5491	1	4.52	16.17	0	265	47.70	44.05

Cites within 10 years

Variable	Obs	Median	Mean	SD	Min	Max	Share of 0	Share of patents with 0 cites
No. cites within 10 miles	5491	0	1.43	6.29	0	121	77.09	68.78
No. cites within 20 miles	5491	0	2.25	9.81	0	178	69.02	63.11
No. cites within 30 miles	5491	0	2.63	10.69	0	188	65.16	60.46
No. cites within 40 miles	5491	0	2.82	11.32	0	190	63.34	59.10
No. cites within 50 miles	5491	0	2.89	11.44	0	190	62.10	57.93
No. cites within 60 miles	5491	0	2.95	11.51	0	190	60.86	56.76
No. cites within 70 miles	5491	0	3.00	11.55	0	190	59.68	55.52
No. cites within 80 miles	5491	0	3.05	11.60	0	190	58.57	54.10
No. cites within 90 miles	5491	0	3.11	11.67	0	190	57.79	53.61
No. cites within 100 miles	5491	0	3.18	11.76	0	190	56.64	52.87
No. cites within 110 miles	5491	0	3.24	11.84	0	190	55.62	51.82
No. cites within 120 miles	5491	0	3.28	11.88	0	190	54.98	51.33
No. cites within 130 miles	5491	0	3.34	11.92	0	190	54.25	50.59
No. cites within 140 miles	5491	0	3.37	11.93	0	190	53.62	50.09
No. cites within 150 miles	5491	0	3.40	11.95	0	190	53.03	49.29

Cites within 5 years

Variable	Obs	Median	Mean	SD	Min	Max	Share of 0	Share of patents with 0 cites
No. cites within 10 miles	5491	0	0.69	3.05	0	47	82.43	75.57
No. cites within 20 miles	5491	0	1.06	4.28	0	59	75.56	70.94
No. cites within 30 miles	5491	0	1.24	4.79	0	60	72.41	69.22
No. cites within 40 miles	5491	0	1.32	5.04	0	60	71.01	68.48
No. cites within 50 miles	5491	0	1.36	5.07	0	61	70.11	67.55
No. cites within 60 miles	5491	0	1.38	5.10	0	61	69.40	66.75
No. cites within 70 miles	5491	0	1.40	5.12	0	61	68.77	66.13
No. cites within 80 miles	5491	0	1.42	5.15	0	62	68.18	65.21
No. cites within 90 miles	5491	0	1.44	5.16	0	62	67.67	64.47
No. cites within 100 miles	5491	0	1.46	5.18	0	62	66.96	63.85
No. cites within 110 miles	5491	0	1.49	5.20	0	62	66.11	63.05
No. cites within 120 miles	5491	0	1.51	5.21	0	62	65.54	62.43
No. cites within 130 miles	5491	0	1.53	5.22	0	62	64.89	62.00
No. cites within 140 miles	5491	0	1.55	5.23	0	62	64.41	61.63
No. cites within 150 miles	5491	0	1.56	5.24	0	64	64.01	61.20

Notes: Unit of observation is an inventor-patent pair. N=5491 from a total of 1,621 patents with exactly one deceased inventor and 3,870 living co-inventors. Application dates fall between January 1, 1976 and December 31, 2005. Distance is defined as the minimal distance between the city center of the deceased/still living inventor of the cited patent and the city center of the closest inventor of the citing patent, measured in miles. All citations from US patents granted thru 2020.

A8 - Comparison of deceased and living co-inventors: full analysis and premature death samples

The following table compares inventor age and prior patenting activity per inventor (for whom age data is available) for deceased versus living co-inventors in the analysis sample and premature death sample (inventors who died before the age 60).

Variable	Obs	Median	Mean	SD	Min	Max
Age (analysis sample)						
All	4,126	46	46.63	13.42	10	107
Deceased inventors	1,205	54	51.80	15.59	10	93
Co-Inventors	2,921	44	44.50	11.78	10	107
Age (premature death)						
All	2,247	44	43.93	11.88	10	107
Deceased inventors	722	46	43.72	12.34	10	60
Co-Inventors	1,525	43	44.03	11.65	10	107
No. of prior patents within 5 years (analysis sample)						
All	5,491	2	4.62	8.98	0	152
Deceased inventors	1,621	1	4.50	8.71	0	92
Co-Inventors	3,870	2	4.66	9.10	0	152
No. of prior patents within 5 years (premature death)						
All	2.247	1	3.13	5.58	0	77
Deceased inventors	722	1	3.28	5.32	0	44
Co-Inventors	1,525	1	3.07	5.70	0	77

Notes: Comparison of deceased and living co-inventors for analysis sample inventors with available birth dates from Kaltenberg et al. 2021 and premature death sample inventors (deceased at or before age of 60). Age is defined as the time in years between birth date and application date of the patent in the analysis sample. Prior patents is the number of patents an inventor applied for during the last 5 years before application of the analysis sample patent.

A9 - Prediction of death based on inventor age and prior patenting activity: full analysis and premature death samples

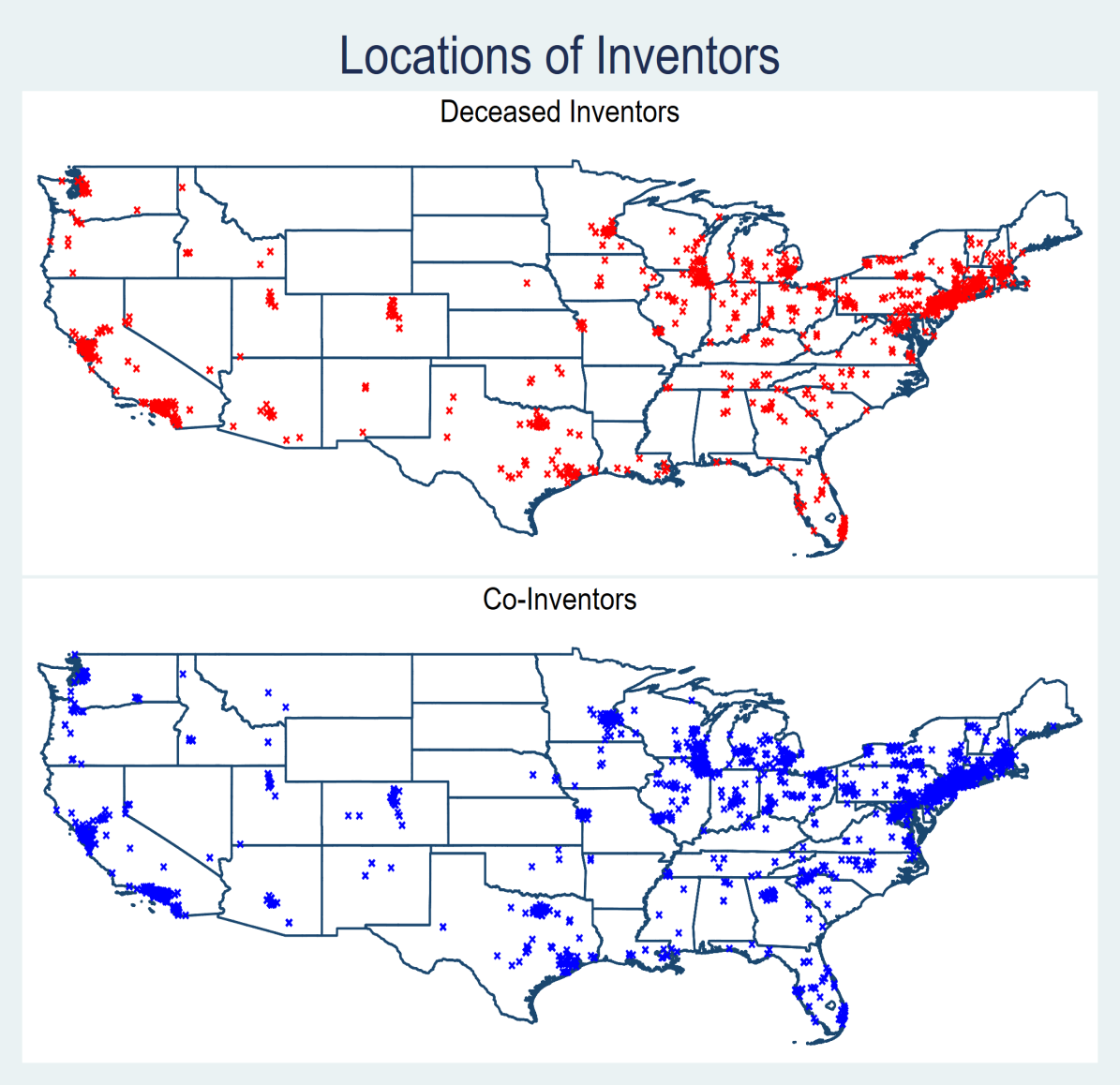
The following table shows how inventor age is not a significant predictor of inventor death in the premature death sample.

	Inventor on patent is the deceased (0|1)	
	Full age sample	Premature death sample
Age	0.024	-0.001
	(0.002)	(0.002)
Prior patents	0.000	0.004
	(0.002)	(0.004)
N	4,126	2,247

Notes: This table presents results of Probit models where the dependent variable is a dummy variable indicating the deceased inventor of a multi-author patent. Inventor age is measured in years between birth year and year of application of the analysis sample patent. Prior patents is the number patents an inventor applied for during the last 5 years before application of the patent on which the deceased inventor is reported. Standard errors clustered at the patent level appear in parentheses.

A10 - Locations (maps) of deceased and still living inventors: full analysis sample

The following shows that deceased and still living inventors live in similar places (the geographic centroid of the two groups only differs by 18 miles).



Notes: Deceased inventors in top panel are in red and still-living inventors are in blue in bottom panel. The geographic centroids of deceased and living co-inventors are 18 miles apart (latitude 38.9 (deceased) versus 39.2 (living) and the longitude -91.6 (deceased) versus -90.9 (living)).

A11 - Knowledge flow reductions across distance and time: full analysis sample

The following table shows full baseline results for the analysis sample with varying citation windows of all available, 15, 10, and 5 years.

Panel A: Analysis sample

	Cites from within X miles:														
	10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**	**140**	**150**
Panel A1: All cites															
$Deceased_{ip}$	-0.246	-0.299	-0.190	-0.101	-0.072	-0.070	-0.058	-0.045	-0.032	-0.016	-0.020	-0.023	-0.023	-0.031	-0.031
	(0.080)	(0.065)	(0.045)	(0.031)	(0.030)	(0.031)	(0.030)	(0.028)	(0.029)	(0.028)	(0.026)	(0.026)	(0.025)	(0.025)	(0.025)
Pseudo R²	0.711	0.772	0.796	0.807	0.813	0.813	0.811	0.811	0.808	0.809	0.814	0.814	0.814	0.816	0.816
Panel A2: Cites within 15 years															
$Deceased_{ip}$	-0.249	-0.311	-0.207	-0.111	-0.088	-0.084	-0.073	-0.059	-0.039	-0.024	-0.031	-0.034	-0.041	-0.046	-0.045
	(0.086)	(0.071)	(0.048)	(0.033)	(0.032)	(0.032)	(0.031)	(0.029)	(0.031)	(0.029)	(0.027)	(0.027)	(0.026)	(0.026)	(0.026)
Pseudo R²	0.699	0.766	0.793	0.805	0.810	0.810	0.808	0.808	0.805	0.806	0.811	0.811	0.811	0.813	0.813
Panel A3: Cites within 10 years															
$Deceased_{ip}$	-0.304	-0.346	-0.211	-0.122	-0.103	-0.100	-0.098	-0.083	-0.069	-0.055	-0.059	-0.062	-0.075	-0.075	-0.075
	(0.087)	(0.074)	(0.044)	(0.035)	(0.033)	(0.033)	(0.032)	(0.030)	(0.031)	(0.029)	(0.028)	(0.028)	(0.028)	(0.028)	(0.027)
Pseudo R²	0.660	0.741	0.770	0.781	0.785	0.785	0.784	0.784	0.781	0.782	0.785	0.785	0.785	0.785	0.784
Panel A4: Cites within 5 years															
$Deceased_{ip}$	-0.389	-0.434	-0.215	-0.127	-0.112	-0.110	-0.105	-0.091	-0.086	-0.071	-0.066	-0.070	-0.081	-0.084	-0.085
	(0.100)	(0.085)	(0.043)	(0.041)	(0.038)	(0.038)	(0.037)	(0.035)	(0.035)	(0.033)	(0.033)	(0.033)	(0.032)	(0.032)	(0.032)
Pseudo R²	0.570	0.644	0.678	0.686	0.686	0.686	0.685	0.684	0.681	0.679	0.678	0.678	0.676	0.675	0.673
N	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491
Patent FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents results of Poisson models, where the dependent variable is the number of cites that occur within a radius *r* of the location of inventor *i* for the same multi-author patent *p* within a time window of *t* since grant of *p*. Unit of observation is an inventor-patent pair. N includes patents with zero future cites as reported in Table 1. $Deceased_{ip}$ indicates the inventor who died after application but before the grant of patent *p*. Standard errors clustered at patent p reported in parentheses.

A12 - Knowledge flow reductions across distance and time: premature death sample (age of deceased ≤ 60)

The following table shows full baseline results for the premature death sample (age of deceased ≤ 60) with varying citation windows of all available, 15, 10, and 5 years.

Panel B: Premature death sample

	Cites from within X miles:														
	10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**	**140**	**150**
Panel B1: All cites															
$Deceased_{ip}$	-0.298	-0.295	-0.262	-0.120	-0.084	-0.084	-0.083	-0.064	-0.046	-0.045	-0.060	-0.061	-0.064	-0.070	-0.074
	(0.150)	(0.109)	(0.091)	(0.062)	(0.050)	(0.048)	(0.048)	(0.045)	(0.046)	(0.045)	(0.042)	(0.042)	(0.041)	(0.040)	(0.039)
Pseudo R²	0.760	0.818	0.833	0.844	0.852	0.854	0.852	0.852	0.848	0.847	0.849	0.847	0.845	0.848	0.849
Panel B2: Cites within 15 years															
$Deceased_{ip}$	-0.312	-0.307	-0.280	-0.136	-0.106	-0.104	-0.100	-0.086	-0.065	-0.060	-0.080	-0.078	-0.086	-0.092	-0.097
	(0.155)	(0.117)	(0.098)	(0.069)	(0.058)	(0.057)	(0.056)	(0.053)	(0.054)	(0.053)	(0.049)	(0.049)	(0.048)	(0.046)	(0.046)
Pseudo R²	0.752	0.815	0.831	0.843	0.850	0.850	0.848	0.848	0.845	0.843	0.846	0.845	0.843	0.846	0.848
Panel B3: Cites within 10 years															
$Deceased_{ip}$	-0.360	-0.319	-0.278	-0.165	-0.133	-0.136	-0.131	-0.114	-0.096	-0.089	-0.107	-0.105	-0.126	-0.124	-0.130
	(0.145)	(0.112)	(0.091)	(0.072)	(0.064)	(0.063)	(0.061)	(0.057)	(0.057)	(0.056)	(0.054)	(0.053)	(0.053)	(0.053)	(0.052)
Pseudo R²	0.707	0.790	0.803	0.812	0.818	0.818	0.815	0.815	0.812	0.811	0.813	0.812	0.810	0.809	0.810
Panel B4: Cites within 5 years															
$Deceased_{ip}$	-0.457	-0.392	-0.323	-0.241	-0.208	-0.211	-0.206	-0.184	-0.177	-0.169	-0.175	-0.176	-0.199	-0.194	-0.192
	(0.147)	(0.122)	(0.107)	(0.102)	(0.093)	(0.091)	(0.090)	(0.086)	(0.085)	(0.083)	(0.082)	(0.081)	(0.079)	(0.078)	(0.077)
Pseudo R²	0.612	0.666	0.666	0.667	0.668	0.669	0.666	0.665	0.664	0.660	0.657	0.656	0.654	0.650	0.649
N	2,247	2,247	2,247	2,247	2,247	2,247	2,247	2,247	2,247	2,247	2,247	2,247	2,247	2,247	2,247
Patent FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents results of Poisson models, where the dependent variable is the number of cites that occur within a radius *r* of the location of inventor *i* for the same multi-author patent *p* within a time window of *t* since grant of *p*. Unit of observation is an inventor-patent pair. N includes patents with zero future cites as reported in Table 1. $Deceased_{ip}$ indicates the inventor who died after application but before the grant of patent *p*. Standard errors clustered at patent p reported in parentheses.

A13 - Knowledge flow reductions across distance and time: all co-inventors live at least 500 miles from the deceased inventor sample

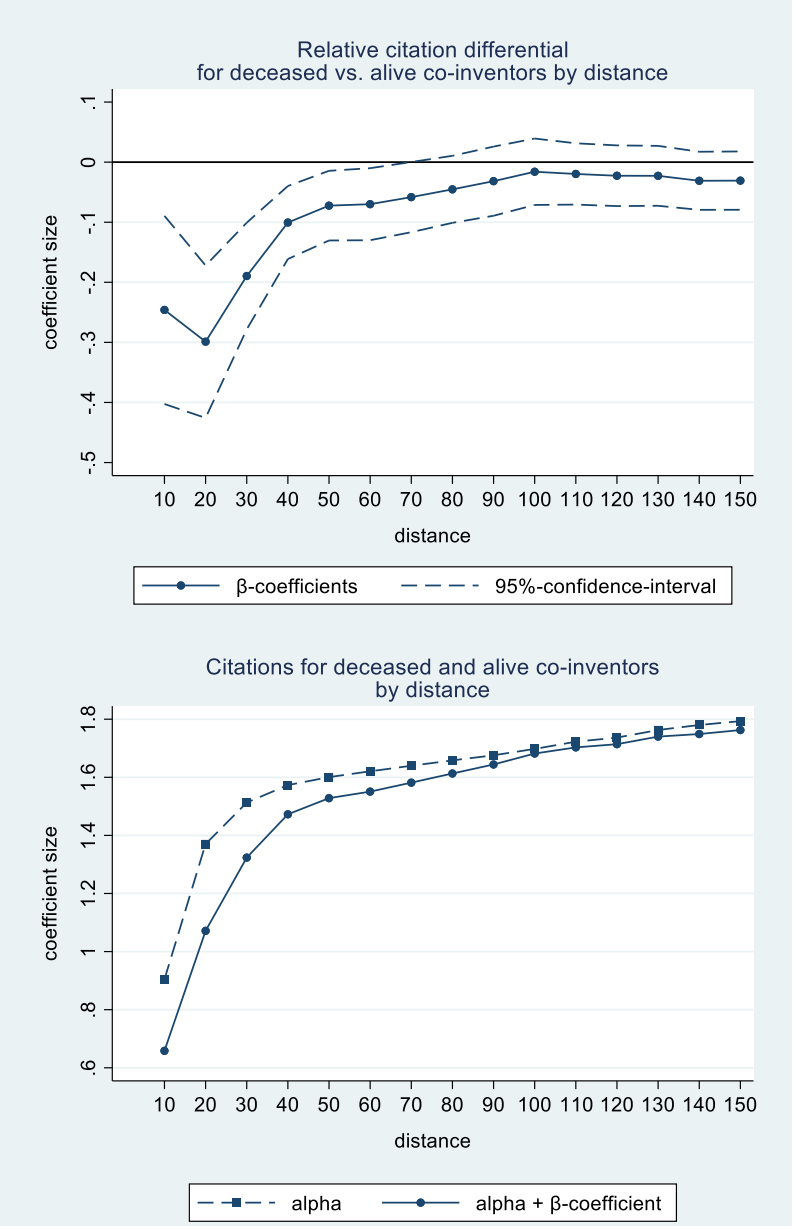
The following table shows full results for a sample where all co-inventors live at least 500 miles from the deceased inventor sample with varying citation windows of all available, 15, 10, and 5 years.

Panel C: Large distance sample

	Cites from within X miles:														
	10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**	**140**	**150**
Panel C1: All cites															
$Deceased_{ip}$	-1.391	-1.225	-0.997	-0.954	-0.804	-0.791	-0.793	-0.742	-0.688	-0.604	-0.596	-0.601	-0.626	-0.606	-0.512
	(0.287)	(0.257)	(0.234)	(0.234)	(0.218)	(0.212)	(0.208)	(0.196)	(0.195)	(0.210)	(0.206)	(0.208)	(0.206)	(0.203)	(0.208)
Pseudo R²	0.458	0.545	0.543	0.539	0.536	0.534	0.537	0.532	0.524	0.507	0.510	0.510	0.506	0.507	0.507
Panel C2: Cites within 15 years															
$Deceased_{ip}$	-1.783	-1.370	-1.120	-1.008	-1.025	-0.986	-0.999	-0.947	-0.889	-0.784	-0.766	-0.770	-0.798	-0.779	-0.665
	(0.300)	(0.291)	(0.263)	(0.251)	(0.248)	(0.242)	(0.238)	(0.221)	(0.224)	(0.250)	(0.243)	(0.243)	(0.240)	(0.234)	(0.241)
Pseudo R²	0.470	0.542	0.535	0.530	0.526	0.519	0.525	0.524	0.511	0.494	0.496	0.497	0.493	0.497	0.496
Panel C3: Cites within 10 years															
$Deceased_{ip}$	-1.870	-1.560	-1.315	-1.264	-1.272	-1.210	-1.241	-1.185	-1.105	-1.073	-1.062	-1.056	-1.076	-1.048	-0.966
	(0.318)	(0.297)	(0.265)	(0.257)	(0.253)	(0.247)	(0.245)	(0.224)	(0.233)	(0.238)	(0.234)	(0.233)	(0.230)	(0.224)	(0.230)
Pseudo R²	0.484	0.570	0.561	0.566	0.562	0.557	0.564	0.564	0.549	0.544	0.547	0.546	0.541	0.540	0.538
Panel C4: Cites within 5 years															
$Deceased_{ip}$	-1.720	-1.592	-1.368	-1.270	-1.253	-1.149	-1.148	-1.090	-1.037	-1.016	-1.011	-1.005	-1.024	-0.992	-0.994
	(0.336)	(0.301)	(0.276)	(0.268)	(0.262)	(0.256)	(0.247)	(0.228)	(0.235)	(0.237)	(0.233)	(0.236)	(0.232)	(0.227)	(0.227)
Pseudo R²	0.524	0.602	0.599	0.593	0.589	0.585	0.582	0.580	0.567	0.564	0.564	0.562	0.554	0.551	0.551
N	749	749	749	749	749	749	749	749	749	749	749	749	749	749	749
Patent FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

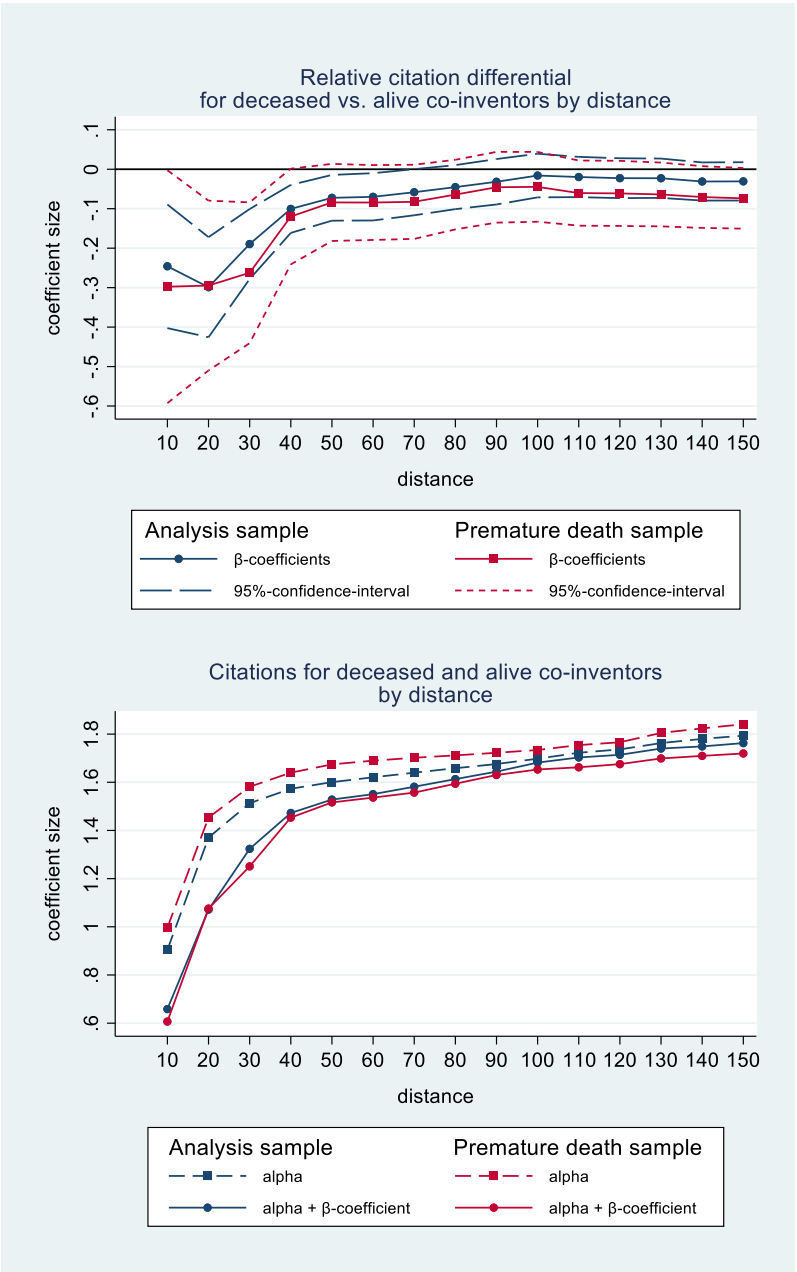
Notes: This table presents results of Poisson models, where the dependent variable is the number of cites that occur within a radius *r* of the location of inventor *i* for the same multi-author patent *p* within a time window of *t* since grant of *p*. Unit of observation is an inventor-patent pair. N includes patents with zero future cites as reported in Table 1. $Deceased_{ip}$ indicates the inventor who died after application but before the grant of patent *p*. Standard errors clustered at patent p reported in parentheses.

A14 - Figure 1, Panel A, plus additional plot of estimated number of cites for deceased versus living co-inventors by distance



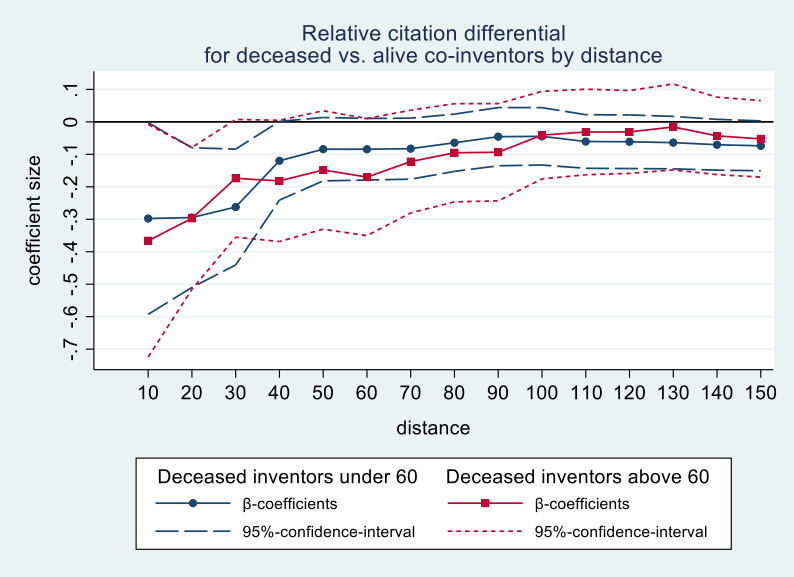
Notes: Coefficient estimates of β_1 from Equation 1 (Panel A) for separate and assumedly independent Poisson models, where the dependent variables are the number of cites that occur within the stated distance of a given inventor, measured in miles. Confidence bands are computed based on standard errors clustered at the patent level and assume independence of regressions. Lower graph plots alpha coefficients for each regression, representing the log-transformed average number of cites that occur within given distance for the alive co-inventors (dashed line in lower graph, connected by squares). Solid line connected by dots in lower graph plots estimated alpha minus beta1 from equation 1, representing the log-transformed average number of cites that occur within given distance for the deceased inventors. Note that we take alpha from equation 1 estimated without patent fixed effects to have alpha showing the log-transformed average number of cites of the alive inventors in the sample and not the average log-transformed cites of the alive inventors of the one patent that serves as the baseline category for all patent fixed effects in the Poisson model.

A15 - Figure 1, Panel B, plus additional plot of estimated number of cites for deceased versus living co-inventors by distance



Notes: Coefficient estimates of β_1 from Equation 1 (Panels A, analysis sample [blue] and Panel B, premature death sample [red]) for separate and assumedly independent Poisson models, where the dependent variables are the number of cites that occur within the stated distance of a given inventor, measured in miles. Confidence bands are computed based on standard errors clustered at the patent level and assume independence of regressions. Lower graph plots alpha coefficients for each regression, representing the log-transformed average number of cites that occur within given distance for the alive co-inventors (dashed line in lower graph, connected by squares). Solid line connected by dots in lower graph plots estimated alpha minus beta1 from equation 1, representing the log-transformed average number of cites that occur within given distance for the deceased inventors. Note that we take alpha from equation 1 estimated without patent fixed effects to have alpha showing the log-transformed average number of cites of the alive inventors in the sample and not the average log-transformed cites of the alive inventors of the one patent that serves as the baseline category for all patent fixed effects in the Poisson model.

A16 - Figure illustrating baseline estimates for premature death sample and complementary sample of deaths at age 61 or higher



Notes: Coefficient estimates of β_1 from Equation 1 (premature sample [blue] and complementary sample of inventors deceased at age 61 or higher [red]) for separate and assumedly independent Poisson models, where the dependent variables are the number of cites that occur within the stated distance of a given inventor, measured in miles. Confidence bands are computed based on standard errors clustered at the patent level and assume independence of regressions.

A17 – Knowledge flow reductions within 20 miles over time: full analysis sample

	Estimates in years 1 to 10 since grant:									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Deceased$_{ip}$	-0.383	-0.252	-0.575	-0.526	-0.364	-0.343	-0.287	-0.211	-0.215	-0.255
	(0.120)	(0.088)	(0.151)	(0.138)	(0.101)	(0.092)	(0.079)	(0.081)	(0.105)	(0.138)
Pseudo R²	0.384	0.320	0.492	0.483	0.471	0.470	0.387	0.488	0.575	0.629
N	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491
Patent FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table reports results (β_1) of separate Poisson models as specified in equation (1) where the dependent variable is the number of cites to a patent *p* that occur within a radius of 20 miles of inventor *i* in year X after grant of *p* for the same multi-author patent *p*. All models are estimated with patent fixed effects. Distance is defined as the minimal distance between the city center of the deceased/still living inventor of the cited patent and the city center of the closest inventor of the citing patent, measured in miles, considering all citations form US patents granted thru 2020. N=5,491 from 3,870 living and 1,621 deceased inventors. Confidence bands are computed based on standard errors clustered at the patent level and assume independence of regressions.

A18 - Knowledge flow reductions across distance and time: full analysis sample without top 1% most cited patents

The following table shows full results for the baseline sample excluding the top 1% most cited patents with varying citation windows of all available, 15, 10, and 5 years.

	Cites from within X miles:														
	10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**	**140**	**150**
All cites															
Deceased$_{ip}$	-0.210	-0.256	-0.145	-0.114	-0.094	-0.096	-0.089	-0.076	-0.057	-0.043	-0.050	-0.052	-0.048	-0.057	-0.057
	(0.070)	(0.054)	(0.034)	(0.032)	(0.030)	(0.029)	(0.031)	(0.029)	(0.032)	(0.031)	(0.028)	(0.028)	(0.028)	(0.027)	(0.027)
Pseudo R²	0.658	0.716	0.736	0.738	0.740	0.741	0.736	0.736	0.732	0.732	0.737	0.737	0.737	0.742	0.742
Cites within 15 years															
Deceased$_{ip}$	-0.224	-0.278	-0.172	-0.135	-0.119	-0.117	-0.111	-0.092	-0.069	-0.053	-0.067	-0.068	-0.073	-0.078	-0.077
	(0.077)	(0.059)	(0.036)	(0.034)	(0.031)	(0.031)	(0.032)	(0.031)	(0.034)	(0.033)	(0.029)	(0.029)	(0.029)	(0.028)	(0.028)
Pseudo R²	0.631	0.697	0.725	0.729	0.729	0.729	0.724	0.725	0.721	0.720	0.727	0.727	0.727	0.731	0.733
Cites within 10 years															
Deceased$_{ip}$	-0.299	-0.336	-0.196	-0.152	-0.134	-0.131	-0.133	-0.113	-0.096	-0.082	-0.091	-0.092	-0.105	-0.103	-0.104
	(0.085)	(0.069)	(0.038)	(0.036)	(0.034)	(0.034)	(0.034)	(0.032)	(0.034)	(0.032)	(0.030)	(0.030)	(0.030)	(0.030)	(0.029)
Pseudo R²	0.602	0.670	0.705	0.710	0.710	0.711	0.709	0.709	0.706	0.705	0.709	0.709	0.708	0.707	0.707
Cites within 5 years															
Deceased$_{ip}$	-0.416	-0.430	-0.214	-0.147	-0.128	-0.125	-0.124	-0.107	-0.101	-0.085	-0.083	-0.087	-0.097	-0.100	-0.101
	(0.104)	(0.087)	(0.044)	(0.044)	(0.041)	(0.041)	(0.040)	(0.038)	(0.038)	(0.036)	(0.036)	(0.036)	(0.035)	(0.035)	(0.035)
Pseudo R²	0.539	0.602	0.637	0.640	0.638	0.639	0.638	0.637	0.634	0.631	0.630	0.630	0.627	0.625	0.624
N	5,410	5,410	5,410	5,410	5,410	5,410	5,410	5,410	5,410	5,410	5,410	5,410	5,410	5,410	5,410
Patent FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents results of Poisson models, where the dependent variable is the number of cites that occur within a radius *r* of the location of inventor *i* for the same multi-author patent *p* within a time window of *t* since grant of *p*. Unit of observation is an inventor-patent pair. N includes patents with zero future cites as reported in Table 1. $Deceased_{ip}$ indicates the inventor who died after application but before the grant of patent *p*. Standard errors clustered at patent p reported in parentheses.

A19 - Knowledge flow reductions across distance and time estimated with Linear Probability Model: full analysis sample

The following table shows full results for the baseline sample estimated as a linear probability model with varying citation windows of all available, 15, 10, and 5 years.

	Cites from within X miles:														
	10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**	**140**	**150**
All cites															
$Deceased_{ip}$	-0.055	-0.058	-0.048	-0.050	-0.042	-0.044	-0.039	-0.032	-0.029	-0.025	-0.029	-0.025	-0.022	-0.024	-0.019
	(0.010)	(0.009)	(0.009)	(0.009)	(0.009)	(0.008)	(0.008)	(0.009)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
R^2	0.667	0.760	0.798	0.817	0.824	0.825	0.826	0.824	0.828	0.835	0.839	0.841	0.845	0.848	0.848
Cites within 15 years															
$Deceased_{ip}$	-0.051	-0.057	-0.050	-0.048	-0.041	-0.043	-0.040	-0.034	-0.034	-0.030	-0.033	-0.030	-0.028	-0.028	-0.025
	(0.009)	(0.009)	(0.009)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
R^2	0.673	0.769	0.808	0.830	0.837	0.838	0.839	0.836	0.839	0.847	0.851	0.853	0.856	0.861	0.859
Cites within 10 years															
$Deceased_{ip}$	-0.048	-0.052	-0.041	-0.039	-0.033	-0.038	-0.035	-0.030	-0.031	-0.025	-0.028	-0.029	-0.027	-0.027	-0.024
	(0.009)	(0.009)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
R^2	0.675	0.775	0.815	0.836	0.841	0.844	0.845	0.840	0.842	0.851	0.854	0.857	0.861	0.866	0.866
Cites within 5 years															
$Deceased_{ip}$	-0.029	-0.032	-0.032	-0.029	-0.024	-0.028	-0.027	-0.021	-0.018	-0.010	-0.014	-0.017	-0.017	-0.020	-0.017
	(0.008)	(0.008)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
R^2	0.674	0.776	0.823	0.847	0.855	0.857	0.861	0.856	0.854	0.859	0.863	0.862	0.867	0.869	0.870
N	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491
Patent FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents results of OLS regressions, where the dependent variable is a dummy indicating a positive number of of cites that come from within a radius r of the location of inventor i for the same multi-author patent p within a time window of t since grant of p. $Deceased_{ip}$ indicates the inventor who died after application but before the grant of patent p. Standard errors clustered at the patent level appear in parentheses.

A20 - Knowledge flow reductions across distance and time estimated with OLS regression of log(Y+1): full analysis sample

The following table shows full results for the baseline sample estimated as regular OLS regression of log(Y+1) with varying citation windows of all available, 15, 10, and 5 years.

	Cites from within X miles:														
	10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**	**140**	**150**
All cites															
$Deceased_{ip}$	-0.090	-0.111	-0.086	-0.081	-0.070	-0.075	-0.069	-0.056	-0.051	-0.039	-0.044	-0.043	-0.042	-0.046	-0.044
	(0.015)	(0.015)	(0.015)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
R^2	0.761	0.840	0.868	0.875	0.882	0.883	0.883	0.884	0.883	0.886	0.889	0.891	0.892	0.895	0.896
Cites within 15 years															
$Deceased_{ip}$	-0.080	-0.102	-0.090	-0.081	-0.073	-0.077	-0.071	-0.059	-0.056	-0.045	-0.048	-0.047	-0.049	-0.052	-0.051
	(0.014)	(0.014)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
R^2	0.757	0.841	0.873	0.883	0.889	0.889	0.889	0.890	0.888	0.892	0.897	0.899	0.899	0.903	0.903
Cites within 10 years															
$Deceased_{ip}$	-0.076	-0.092	-0.075	-0.067	-0.060	-0.064	-0.061	-0.052	-0.049	-0.038	-0.043	-0.044	-0.047	-0.048	-0.048
	(0.013)	(0.013)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
R^2	0.749	0.840	0.875	0.886	0.891	0.892	0.893	0.892	0.891	0.895	0.899	0.901	0.903	0.904	0.905
Cites within 5 years															
$Deceased_{ip}$	-0.046	-0.059	-0.049	-0.041	-0.037	-0.040	-0.038	-0.030	-0.027	-0.019	-0.021	-0.024	-0.027	-0.030	-0.029
	(0.010)	(0.010)	(0.010)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
R^2	0.754	0.834	0.875	0.886	0.892	0.894	0.897	0.895	0.894	0.896	0.897	0.898	0.901	0.902	0.902
N	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491
Patent FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents results of OLS regressions, where the dependent variable is the log of one plus the number of cites that come from within a radius *r* of the location of inventor *i* for the same multi-author patent *p* within a time window of *t* since grant of *p*. $Deceased_{ip}$ indicates the inventor who died after application but before the grant of patent *p*. Standard errors clustered at the patent level appear in parentheses.

A21 - Knowledge flow reductions across distance and time: full analysis sample including self-citations

The following table shows full results for the baseline sample including self-citations with varying citation windows of all available, 15, 10, and 5 years.

	Cites from within X miles:														
	10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**	**140**	**150**
All cites															
Deceased$_{ip}$	-0.287	-0.315	-0.211	-0.137	-0.110	-0.108	-0.097	-0.085	-0.074	-0.060	-0.062	-0.064	-0.062	-0.068	-0.068
	(0.065)	(0.054)	(0.039)	(0.029)	(0.028)	(0.029)	(0.028)	(0.027)	(0.028)	(0.027)	(0.025)	(0.025)	(0.025)	(0.024)	(0.024)
Pseudo R²	0.708	0.773	0.796	0.805	0.810	0.811	0.809	0.809	0.807	0.809	0.813	0.814	0.814	0.815	0.815
Cites within 15 years															
Deceased$_{ip}$	-0.299	-0.336	-0.235	-0.155	-0.131	-0.127	-0.117	-0.104	-0.087	-0.074	-0.079	-0.080	-0.084	-0.088	-0.087
	(0.072)	(0.060)	(0.043)	(0.033)	(0.032)	(0.032)	(0.031)	(0.030)	(0.031)	(0.029)	(0.028)	(0.027)	(0.027)	(0.027)	(0.026)
Pseudo R²	0.699	0.767	0.793	0.803	0.807	0.808	0.806	0.806	0.804	0.806	0.810	0.810	0.810	0.812	0.812
Cites within 10 years															
Deceased$_{ip}$	-0.343	-0.364	-0.240	-0.168	-0.148	-0.145	-0.141	-0.128	-0.116	-0.105	-0.106	-0.108	-0.116	-0.116	-0.115
	(0.071)	(0.062)	(0.040)	(0.035)	(0.033)	(0.033)	(0.032)	(0.031)	(0.031)	(0.030)	(0.029)	(0.029)	(0.029)	(0.029)	(0.028)
Pseudo R²	0.669	0.746	0.772	0.781	0.784	0.785	0.784	0.784	0.783	0.783	0.786	0.786	0.786	0.786	0.785
Cites within 5 years															
Deceased$_{ip}$	-0.391	-0.415	-0.245	-0.179	-0.160	-0.157	-0.152	-0.140	-0.136	-0.125	-0.118	-0.121	-0.125	-0.128	-0.128
	(0.071)	(0.065)	(0.043)	(0.042)	(0.040)	(0.040)	(0.039)	(0.038)	(0.037)	(0.036)	(0.036)	(0.036)	(0.035)	(0.035)	(0.035)
Pseudo R²	0.590	0.658	0.685	0.689	0.690	0.691	0.690	0.689	0.688	0.686	0.686	0.686	0.685	0.684	0.683
N	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491
Patent FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents results of Poisson models, where the dependent variable is the number of cites that occur within a radius *r* of the location of inventor *i* for the same multi-author patent *p* within a time window of *t* since grant of *p*. Unit of observation is an inventor-patent pair. N includes patents with zero future cites as reported in Table 1. $Deceased_{ip}$ indicates the inventor who died after application but before the grant of patent *p*. Standard errors clustered at patent p reported in parentheses.

A22 - Knowledge flow reductions across distance and time: only examiner added citations sample and 15, 10, and 5 years

One potential concern is the possibility that local inventors change their citing behavior in response to the local inventor's death. For example, surviving inventors might feel that they should cite their deceased colleague more, out of deference or social promotion (Azoulay, Wahlen, and Zuckerman Sivan 2019), or less, because they need not credit the deceased. If inventors that work in close proximity to the deceased did not cite the dead inventor's patent simply for social reasons, then we might falsely attribute a negative spatial difference in citations to lower knowledge spillovers. As illustrated below, citations from patent examiners only (Alcacer and Gittleman 2006) illustrate that the baseline effect remains, even though examiners rarely work or live close to the deceased inventor and are also unlikely to have any social ties that may change their citation behavior in response to an inventor death. In other words, an examiner citation should be independent of any social biases or awareness of the inventors' geographies. Alcacer and Gittelman (2006) also found a strong similarity in the geographic localization of cites, whether made by examiners or inventors. Note this model does not estimate the distance from Washington D.C., rather, as with all analyses, it measures the distances from the citing inventors to the deceased and still living inventors.

	Examiner cites from within X miles:														
	10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**	**140**	**150**
All cites															
$Deceased_{ip}$	-0.373	-0.295	-0.181	-0.142	-0.124	-0.121	-0.103	-0.096	-0.093	-0.088	-0.079	-0.074	-0.077	-0.075	-0.074
	(0.074)	(0.055)	(0.044)	(0.041)	(0.042)	(0.041)	(0.039)	(0.038)	(0.037)	(0.036)	(0.036)	(0.036)	(0.035)	(0.034)	(0.033)
Pseudo R²	0.283	0.315	0.331	0.336	0.341	0.345	0.350	0.351	0.348	0.349	0.346	0.345	0.344	0.344	0.347
Cites within 15 years															
$Deceased_{ip}$	-0.376	-0.327	-0.199	-0.148	-0.139	-0.136	-0.126	-0.115	-0.109	-0.100	-0.080	-0.072	-0.083	-0.087	-0.088
	(0.095)	(0.071)	(0.055)	(0.051)	(0.049)	(0.048)	(0.046)	(0.045)	(0.043)	(0.042)	(0.041)	(0.041)	(0.040)	(0.040)	(0.039)
Pseudo R²	0.267	0.286	0.299	0.300	0.306	0.312	0.317	0.318	0.315	0.314	0.317	0.316	0.314	0.313	0.315
Cites within 10 years															
$Deceased_{ip}$	-0.425	-0.348	-0.190	-0.139	-0.134	-0.130	-0.127	-0.120	-0.114	-0.099	-0.094	-0.079	-0.089	-0.095	-0.093
	(0.098)	(0.075)	(0.057)	(0.053)	(0.051)	(0.049)	(0.048)	(0.047)	(0.045)	(0.044)	(0.043)	(0.043)	(0.042)	(0.042)	(0.041)
Pseudo R²	0.233	0.253	0.263	0.267	0.272	0.280	0.286	0.287	0.283	0.278	0.278	0.278	0.274	0.273	0.274
Cites within 5 years															
$Deceased_{ip}$	-0.298	-0.247	-0.131	-0.076	-0.093	-0.088	-0.097	-0.090	-0.072	-0.052	-0.048	-0.031	-0.035	-0.037	-0.031
	(0.099)	(0.075)	(0.057)	(0.051)	(0.050)	(0.048)	(0.047)	(0.047)	(0.047)	(0.045)	(0.044)	(0.045)	(0.045)	(0.045)	(0.044)
Pseudo R²	0.197	0.213	0.202	0.205	0.216	0.228	0.231	0.229	0.230	0.227	0.227	0.228	0.223	0.219	0.222
N	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491
Patent FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents results of Poisson models, where the dependent variable is the number of cites that occur within a radius *r* of the location of inventor *i* for the same multi-author patent *p* within a time window of *t* since grant of *p*. Unit of observation is an inventor-patent pair. N includes patents with zero future cites as reported in Table 1. $Deceased_{ip}$ indicates the inventor who died after application but before the grant of patent *p*. Standard errors clustered at patent p reported in parentheses.

A23 - Knowledge flow reductions across distance and time estimated with observations reweighted to (1/number of inventors): full analysis sample

The following table shows full results for the baseline sample estimated with observations reweighted to (1/number of inventors) with varying citation windows of all available, 15, 10, and 5 years.

	Cites from within X miles:														
	10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**	**140**	**150**
All cites															
$Deceased_{ip}$	-0.216	-0.302	-0.199	-0.101	-0.080	-0.077	-0.057	-0.047	-0.033	-0.006	-0.008	-0.010	-0.012	-0.019	-0.019
	(0.089)	(0.093)	(0.064)	(0.044)	(0.041)	(0.041)	(0.035)	(0.033)	(0.033)	(0.036)	(0.035)	(0.036)	(0.035)	(0.035)	(0.035)
Pseudo R²	0.734	0.793	0.817	0.827	0.834	0.834	0.833	0.833	0.831	0.830	0.834	0.834	0.834	0.835	0.835
Cites within 15 years															
$Deceased_{ip}$	-0.202	-0.302	-0.209	-0.112	-0.094	-0.090	-0.071	-0.058	-0.039	-0.014	-0.017	-0.020	-0.026	-0.031	-0.031
	(0.096)	(0.104)	(0.072)	(0.050)	(0.047)	(0.046)	(0.040)	(0.037)	(0.037)	(0.040)	(0.039)	(0.039)	(0.039)	(0.038)	(0.038)
Pseudo R²	0.733	0.795	0.820	0.831	0.837	0.836	0.835	0.835	0.832	0.831	0.835	0.835	0.835	0.837	0.837
Cites within 10 years															
$Deceased_{ip}$	-0.269	-0.334	-0.214	-0.126	-0.109	-0.106	-0.098	-0.084	-0.067	-0.053	-0.053	-0.056	-0.068	-0.067	-0.068
	(0.100)	(0.108)	(0.068)	(0.051)	(0.048)	(0.047)	(0.044)	(0.041)	(0.041)	(0.040)	(0.039)	(0.040)	(0.040)	(0.040)	(0.040)
Pseudo R²	0.692	0.772	0.798	0.807	0.812	0.812	0.812	0.811	0.808	0.808	0.811	0.811	0.811	0.811	0.811
Cites within 5 years															
$Deceased_{ip}$	-0.365	-0.437	-0.243	-0.143	-0.131	-0.129	-0.121	-0.107	-0.094	-0.081	-0.076	-0.080	-0.086	-0.087	-0.089
	(0.123)	(0.107)	(0.065)	(0.058)	(0.055)	(0.054)	(0.051)	(0.049)	(0.050)	(0.049)	(0.048)	(0.049)	(0.048)	(0.048)	(0.047)
Pseudo R²	0.605	0.672	0.698	0.706	0.709	0.708	0.708	0.707	0.702	0.699	0.699	0.699	0.697	0.695	0.693
N	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491	5,491
Patent FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents results of Poisson models, where the dependent variable is the number of cites that occur within a radius *r* of the location of inventor *i* for the same multi-author patent *p* within a time window of *t* since grant of *p*. Unit of observation is an inventor-patent pair. N includes patents with zero future cites as reported in Table 1. $Deceased_{ip}$ indicates the inventor who died after application but before the grant of patent *p*. Standard errors clustered at patent p reported in parentheses.

A24 - Knowledge flow reductions across distance and time: at least one co-inventor lives closer than 500 miles from the deceased inventor sample

The following table shows full results for the baseline sample restricted to cases where at least one co-inventor lives closer than 500 miles from the deceased inventor with varying citation windows of all available, 15, 10, and 5 years.

	Cites from within X miles:														
	10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**	**140**	**150**
All cites															
Deceased$_{ip}$	-0.181	-0.243	-0.136	-0.041	-0.017	-0.015	-0.002	0.008	0.019	0.030	0.025	0.022	0.024	0.014	0.009
	(0.080)	(0.065)	(0.044)	(0.025)	(0.024)	(0.025)	(0.024)	(0.023)	(0.025)	(0.024)	(0.021)	(0.020)	(0.020)	(0.019)	(0.019)
Pseudo R²	0.730	0.788	0.813	0.826	0.832	0.833	0.830	0.830	0.828	0.830	0.834	0.834	0.834	0.836	0.836
Cites within 15 years															
Deceased$_{ip}$	-0.172	-0.249	-0.148	-0.051	-0.026	-0.023	-0.009	0.003	0.019	0.029	0.020	0.018	0.012	0.006	0.002
	(0.085)	(0.070)	(0.046)	(0.027)	(0.025)	(0.025)	(0.023)	(0.022)	(0.025)	(0.023)	(0.020)	(0.020)	(0.019)	(0.019)	(0.019)
Pseudo R²	0.719	0.783	0.812	0.825	0.830	0.830	0.829	0.828	0.826	0.827	0.832	0.832	0.832	0.834	0.834
Cites within 10 years															
Deceased$_{ip}$	-0.215	-0.272	-0.137	-0.046	-0.025	-0.024	-0.018	-0.005	0.004	0.016	0.011	0.008	-0.005	-0.005	-0.009
	(0.086)	(0.073)	(0.039)	(0.026)	(0.023)	(0.023)	(0.021)	(0.021)	(0.022)	(0.021)	(0.019)	(0.019)	(0.019)	(0.018)	(0.018)
Pseudo R²	0.681	0.758	0.790	0.802	0.806	0.807	0.806	0.805	0.803	0.803	0.806	0.806	0.807	0.807	0.806
Cites within 5 years															
Deceased$_{ip}$	-0.280	-0.338	-0.118	-0.032	-0.018	-0.020	-0.014	-0.003	-0.002	0.012	0.017	0.011	0.001	-0.003	-0.005
	(0.101)	(0.086)	(0.031)	(0.026)	(0.022)	(0.022)	(0.020)	(0.021)	(0.020)	(0.019)	(0.019)	(0.019)	(0.018)	(0.018)	(0.018)
Pseudo R²	0.584	0.655	0.695	0.704	0.705	0.705	0.704	0.703	0.701	0.699	0.698	0.698	0.697	0.695	0.693
N	4,742	4,742	4,742	4,742	4,742	4,742	4,742	4,742	4,742	4,742	4,742	4,742	4,742	4,742	4,742
Patent FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents results of Poisson models, where the dependent variable is the number of cites that occur within a radius *r* of the location of inventor *i* for the same multi-author patent *p* within a time window of *t* since grant of *p*. Unit of observation is an inventor-patent pair. N includes patents with zero future cites as reported in Table 1. $Deceased_{ip}$ indicates the inventor who died after application but before the grant of patent *p*. Standard errors clustered at patent p reported in parentheses.

A25 - Knowledge flow reductions across distance and time: Coarsened Exact Matching (CEM) sample

Here we use Coarsened Exact Matching (CEM) to achieve a balanced sample of deceased and living co-inventors with respect to inventor age. CEM temporarily coarsens the data, generates exact matches based on these coarsened data, to derive a balanced sample of the original, not coarsened, data (see Iacus, King and Porro 2012). The resulting sample contains only patents where co-inventors have similar characteristics as the deceased.

	Cites from within X miles:														
	10	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**	**110**	**120**	**130**	**140**	**150**
All cites															
$Deceased_{ip}$	-0.264	-0.286	-0.268	-0.159	-0.098	-0.089	-0.086	-0.065	-0.061	-0.040	-0.044	-0.048	-0.059	-0.066	-0.072
	(0.167)	(0.127)	(0.107)	(0.075)	(0.066)	(0.064)	(0.065)	(0.062)	(0.060)	(0.058)	(0.057)	(0.057)	(0.056)	(0.056)	(0.057)
Pseudo R²	0.756	0.808	0.815	0.829	0.832	0.832	0.830	0.829	0.827	0.827	0.825	0.824	0.826	0.824	0.824
Cites within 15 years															
$Deceased_{ip}$	-0.293	-0.302	-0.289	-0.176	-0.111	-0.106	-0.107	-0.094	-0.090	-0.065	-0.070	-0.073	-0.087	-0.089	-0.091
	(0.172)	(0.133)	(0.115)	(0.085)	(0.075)	(0.074)	(0.075)	(0.072)	(0.071)	(0.067)	(0.067)	(0.066)	(0.065)	(0.064)	(0.065)
Pseudo R²	0.744	0.800	0.804	0.819	0.821	0.821	0.818	0.817	0.817	0.817	0.817	0.815	0.818	0.817	0.818
Cites within 10 years															
$Deceased_{ip}$	-0.359	-0.315	-0.293	-0.205	-0.148	-0.148	-0.149	-0.135	-0.131	-0.100	-0.105	-0.113	-0.135	-0.132	-0.140
	(0.174)	(0.133)	(0.112)	(0.095)	(0.088)	(0.087)	(0.089)	(0.085)	(0.083)	(0.079)	(0.078)	(0.078)	(0.078)	(0.077)	(0.078)
Pseudo R²	0.692	0.767	0.770	0.781	0.781	0.780	0.777	0.777	0.777	0.775	0.776	0.775	0.775	0.774	0.775
Cites within 5 years															
$Deceased_{ip}$	-0.430	-0.409	-0.348	-0.259	-0.207	-0.205	-0.203	-0.179	-0.175	-0.140	-0.144	-0.162	-0.184	-0.174	-0.181
	(0.191)	(0.163)	(0.142)	(0.135)	(0.122)	(0.119)	(0.117)	(0.113)	(0.111)	(0.107)	(0.105)	(0.104)	(0.103)	(0.101)	(0.100)
Pseudo R²	0.578	0.603	0.600	0.604	0.600	0.598	0.595	0.598	0.598	0.590	0.588	0.589	0.588	0.585	0.584
N	2,016	2,016	2,016	2,016	2,016	2,016	2,016	2,016	2,016	2,016	2,016	2,016	2,016	2,016	2,016
Patent FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents results of Poisson models, where the dependent variable is the number of cites that occur within a radius *r* of the location of inventor *i* for the same multi-author patent *p* within a time window of *t* since grant of *p*. Unit of observation is an inventor-patent pair. N includes patents with zero future cites as reported in Table 1. $Deceased_{ip}$ indicates the inventor who died after application but before the grant of patent *p*. Standard errors clustered at patent p reported in parentheses.

A26 - Test of Coarsened Exact Matching (CEM) sample balancing

The following table shows how inventor age no longer predicts inventor death in the Coarsened Exact Matched sample.

	Inventor on patent is the deceased (0|1)	
	Full age sample	After CEM matching
Age	0.024	0.001
	(0.002)	(0.002)
N	4,126	2,016

Notes: This table presents results of Probit models where the dependent variable is a dummy variable indicating the deceased inventor of a multi-author patent. Inventor age is measured in years between birth year and year of application of the analysis sample patent. Standard errors clustered at the patent level appear in parentheses.