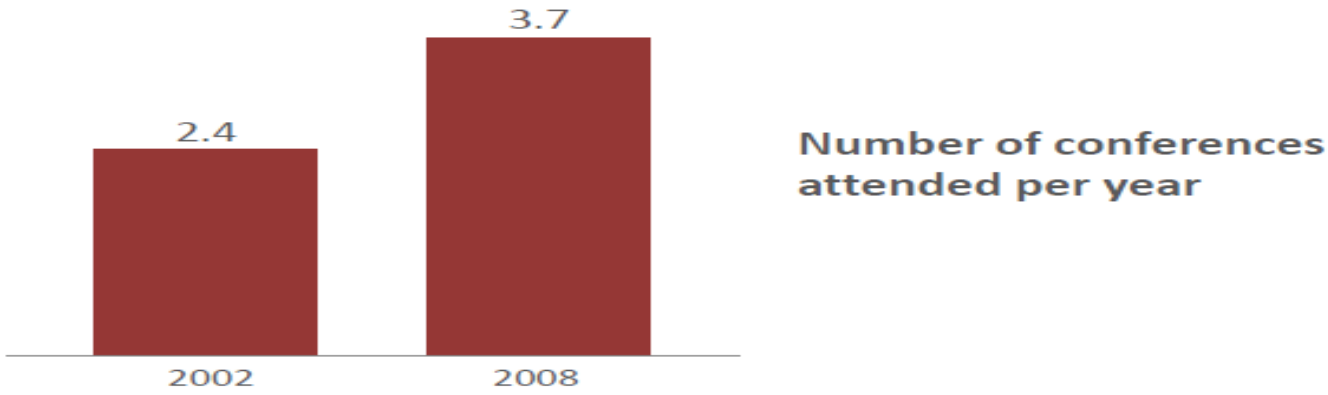
How Attending a Conference Affects Research Collaborations and Citations

Introduction
1. Our Study and findings
2. Analysis of collaborations
3. Analysis of citations
4. Interpretation/Implications

Sen Chai, ESSEC Business School
Richard B. Freeman, Harvard & NBER
Economics of Science Seminar, Dec 4, 2015

1. Conferences, conferences, here and there, everywhere.

- Survey by Science Advisory Board of 1,000 members



Costs: No definitive estimates of numbers (Ioannoidis 2012 estimates 100,000 medical conferences) or costs. Depends on definition of temporary colocation. Could survey scientists; could sample research budgets; university expenditures; could do hotels/convention centers; business sales convention.

Huge variety: big/small; participatory/audience, with little formal assessment or comparison with substitutes Same locale meeting; conference call; virtual conference; But concerns over too much.

"Do medical conferences serve any purpose? In theory these meetings aim to disseminate and advance research, train, educate, and set evidence-based policy? Although these are worthy goals, **there is virtually no evidence supporting the utility of most conferences.**

In the electronic age in which in

formation can be shared around the world instantly, the contribution of such large medical conferences to the dissemination and advancement of science is unclear... For smaller, focused groups of researchers, in-person meetings may be indeed helpful and indispensable.

Eventually, some evidence should be accrued on whether specific types of current conferences offer advantages compared with other means of serving the same purposes."

Ionnadis , Jama, March 28, 2012

Federal Budget Limits Affect Scientific Conferences

By LAURA DATTARO OCT. 23, 2012

After General Services Administration workers were found splurging on hotels, food and catering for a regional conference near Las Vegas two years ago, the Obama administration imposed new guidelines that limit the amount of money that federal agencies can spend on such events. The Office of Management and Budget estimates that the directive saved more than $600 million in the first two quarters of this fiscal year, compared with the same period in 2010.

But a number of science and technology organizations are now arguing that the federal belt-tightening is affecting the ability of the scientific community to share research and collaborate.

Participation in Professional Conferences By Government Scientists and Engineers

Approved by the IEEE-USA
Board of Directors, 3 August 2015

IEEE-USA strongly supports active participation by government and Federally Funded Research and Development Center (FFRDC) scientists and engineers (S&Es) in Science, Technology, Engineering, and Mathematics (STEM) professional meetings. Participation allows S&Es to exchange ideas on novel research, remain current in technical disciplines, and form valuable collaborations. Professional conferences tie together the U.S. science and engineering community, promote technical innovation and commercialization, accommodate peer review of research, provide training opportunities, facilitate recruiting, and help educate graduate students. Participation in overseas conferences additionally provides insights into the more than two-thirds of the world's research that is not performed in the United States.

Individual Decisions

Should you attend X conference? How many conferences should you go to in year? What type to attend? What is best way to spend time at conference?

Decision depends on value -- treat as investment in career, not social pleasure -- but depends on others attending as well. Goal could be to advertise work/self; to learn what others do; to build collaborations. Should be sequential sampling/dating subject to fixed travel budget, "free time" constraint.

Problem in estimating what attending does is endogenous decision with unobservable counterfactual: how would spend time if did opposite. Could look at invited/not invited; planned to attend but prevented due to events. With many conferences, can substitute among them over time.

“The dilemma of attending (or not) scientific conferences”

(adapted from G. Pierce, Editor, Can J of Physiology and Pharmacology (2014)

Scientists spend a lot of money to attend and then visit local tourist sites instead of religiously attending the lectures. Some give lectures on their data to less than optimal audiences. Few come to the poster sessions.

Is it a waste of our resources to hold these meetings? Are we better served by the new electronic technologies for transferring scientific information -- Skype (or similar) at fraction of the cost?

(But) I conversed with scientists with whom I never would have met … established a collaborative, scientific interaction that would never have occurred if I had not attended and met them informally there … relationships that may be scientifically useful in the future, (making) the resources (to) attend justified and productive in the long run. Meetings are critical for networking to advance scientific collaborations (and the) team work necessary to advance the field in novel ways.

These meetings await a creative mind to optimize what we all invest in attending a scientific conference and what we reap from that investment.

Supply of conferences/Funders Decision

Assume purpose of conference is to maximize science/ innovation output: produce new ideas; spread ideas.

Optimal organization once decide to have conference it; small/large; short/long; concentrated talks/many breaks; plenary sessions/multiple sessions; poster shows/exhibits. With budgets, do you spend lots on attracting Professor Super-Big or on others?

Funder: how big travel/conference budget and who goes.

Same problem of endogenous decision with unobservable counterfactual. Do supply decisions produce invisible hand ideal or economies/diseconomies due to spillovers?

1. Our study: Gordon Research conferences

- ~300 annual week-long meetings in chemical, physical and biological sciences begun in 1931
  - Moderate size, 30 to 150 attendees, decentralized set up
  - 80% academic researchers, 11% industry researchers
  - Morning and evening presentations with no parallel sessions; informal afternoon activities
  - Many held in New England prep school/college settings during summer break, but now in HK and other spots

We study **15 biological GRCs from 1991-1995, with** 1265 attendees for an average of ~84 attendees per conference. Data from archives of Philadelphia library.

Analysis

Three outcomes: co-authorship; citations from other attendees and references to other attendees; research "ideas".

Before/after contrasts for attendees vs "synthetic control" matched set of researchers with similar before characteristics

Link by **PubMed Author-ity database** (Smalheiser & Torvik, 2009)

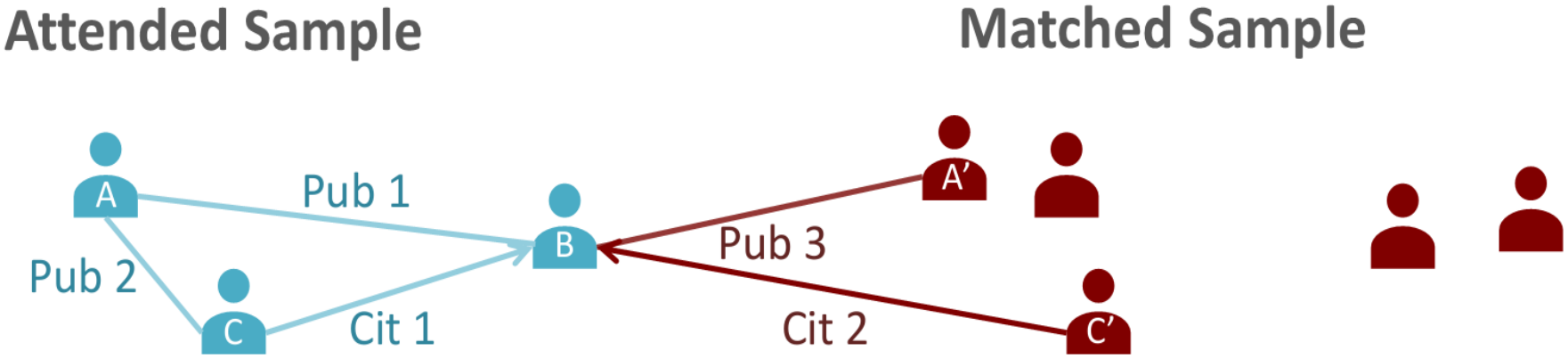
Matched sample to the 1265 attendees

Match of top 3 Medical Subject Headings (MESH) keywords from 5-year prior publications, 514 persons with one exact MESH match; 751 have more than one match.

For the 751 select two matches by nearest neighbor Euclidian distance based on: average 5-year prior years since first publication; # publications; # collaborations; # forward citations --> 1502 matches.

Sample thus has 3281 scientists (= 1265 + 751 + 1502)

Individual-Year Level Variables



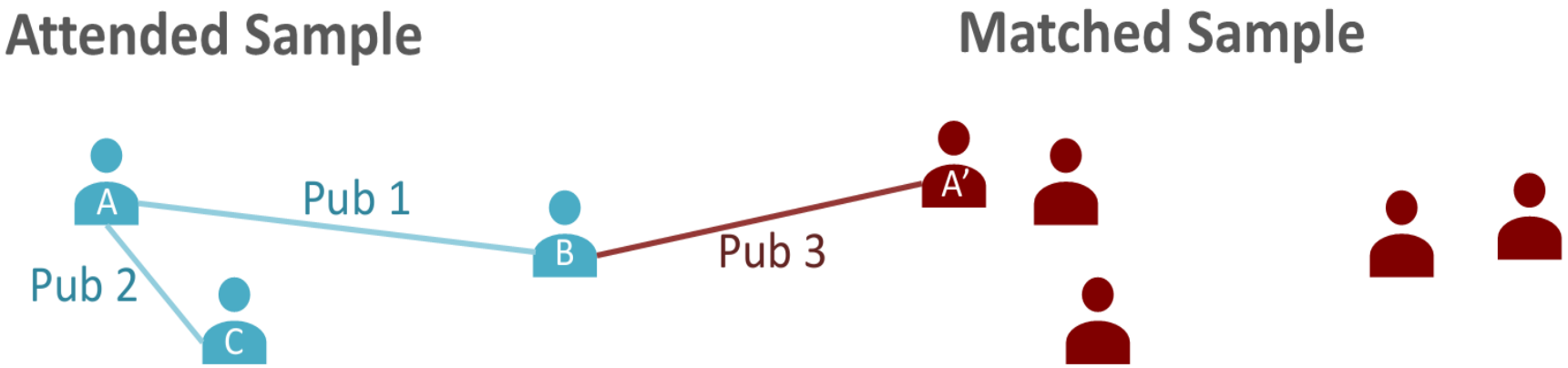
Modeling for individuals:

Outcome Y differences between attendees and non-attendees (ATT); before/after (POST); with covariates (COV)for conference, personal characteristics:

$$Ys,t = a + b\,ATTs + bPOSTt + cATTs \times POSTt + COV$$

Random Effect QML with clustered robust standard errors for count data

Publication Level Variables



Modeling for publications: Citations for papers between attendees and non-attendees (ATT); with covariates (COV)for conference, personal characteristics:

$$Y_{s,t} = a + b\,ATT + COV$$

Three functional forms: QML Poisson with robust standard errors for count; OLS with robust standard errors for percentage; Logistic with robust standard errors for indicator

Findings

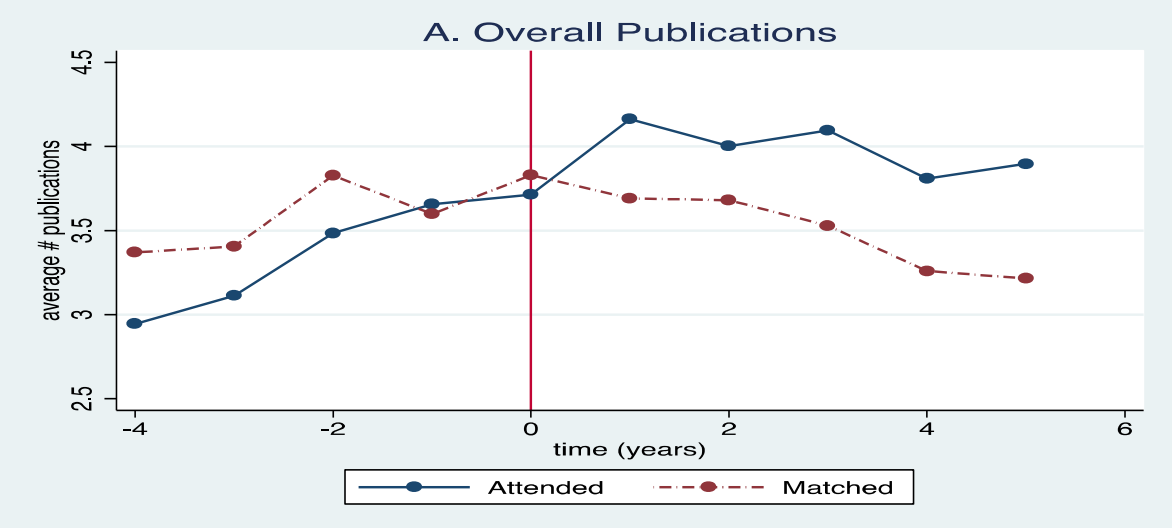
1) Increased collaboration between conference attendees, with main effects for attendees without prior within conference collaborations together

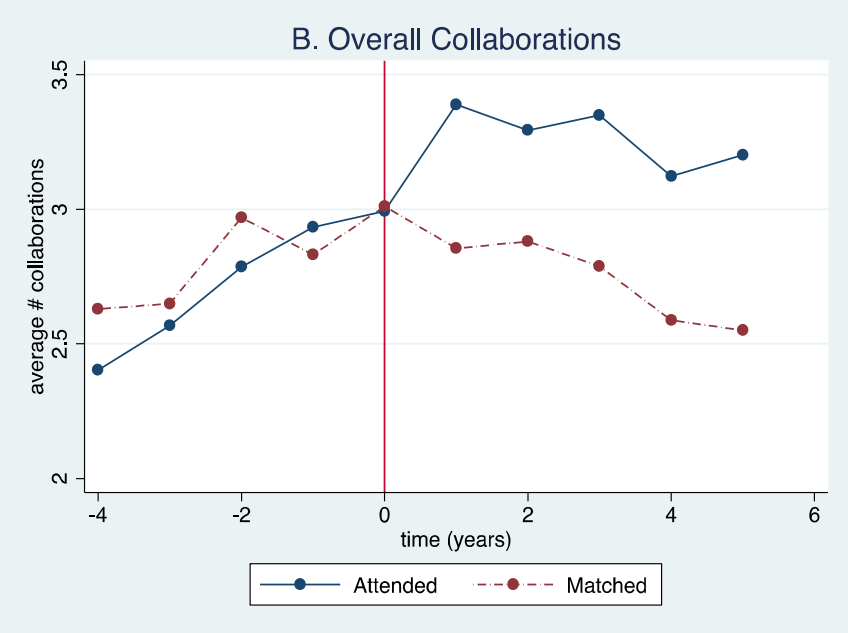
2)Collaborations formed at conferences get more citations than others, suggesting higher quality.

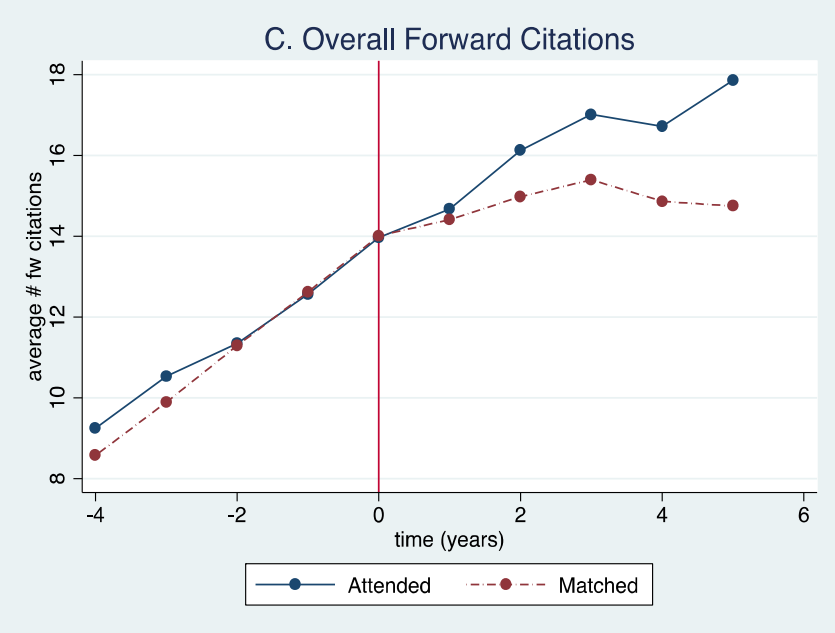
3)Increased citations between conference attendees, with main effects for those without previous citations from attendees.

4) Bigger effects on researchers with less experience, no prior links to conference participants

Before/After Attended/Did not Attend Graphs







2. Results – Collaborations

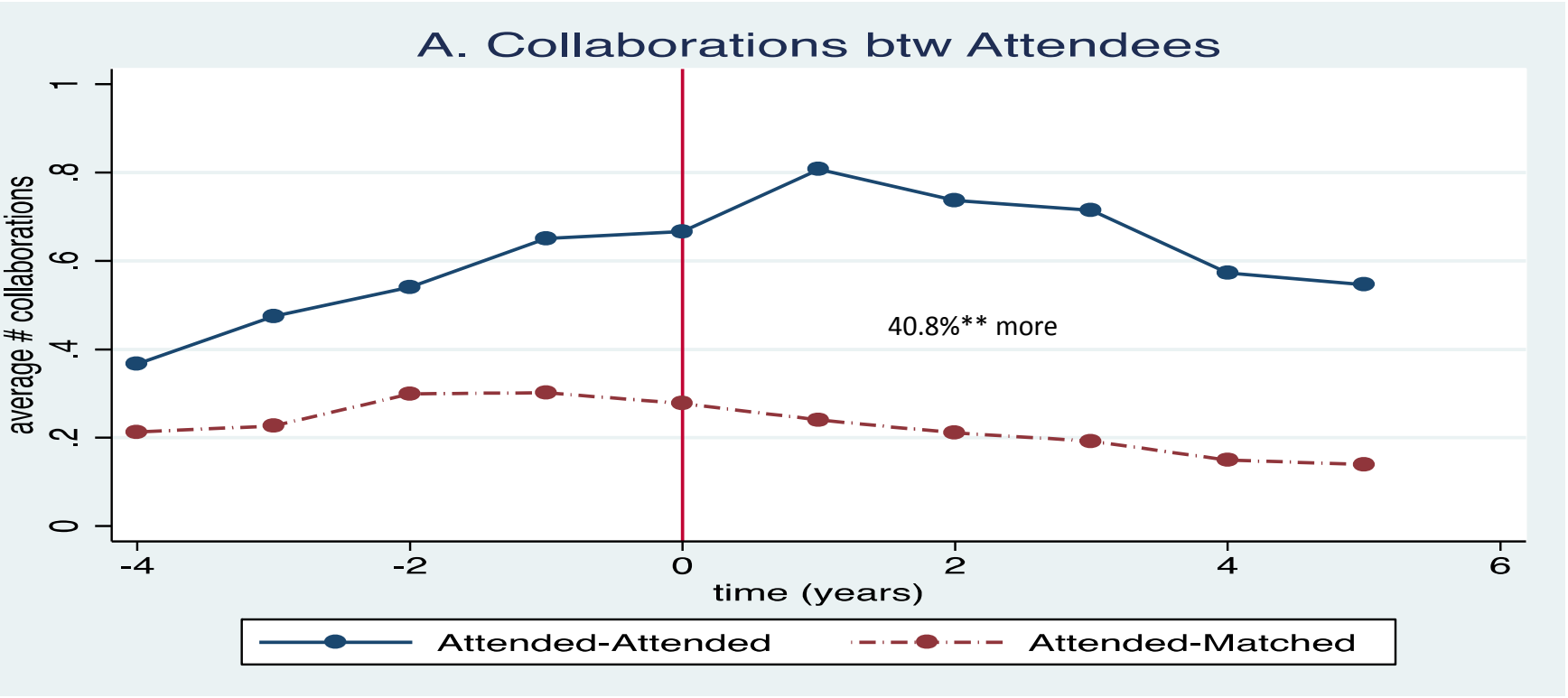
Compared to matched non-attendees, attendees have

3.2% more publications

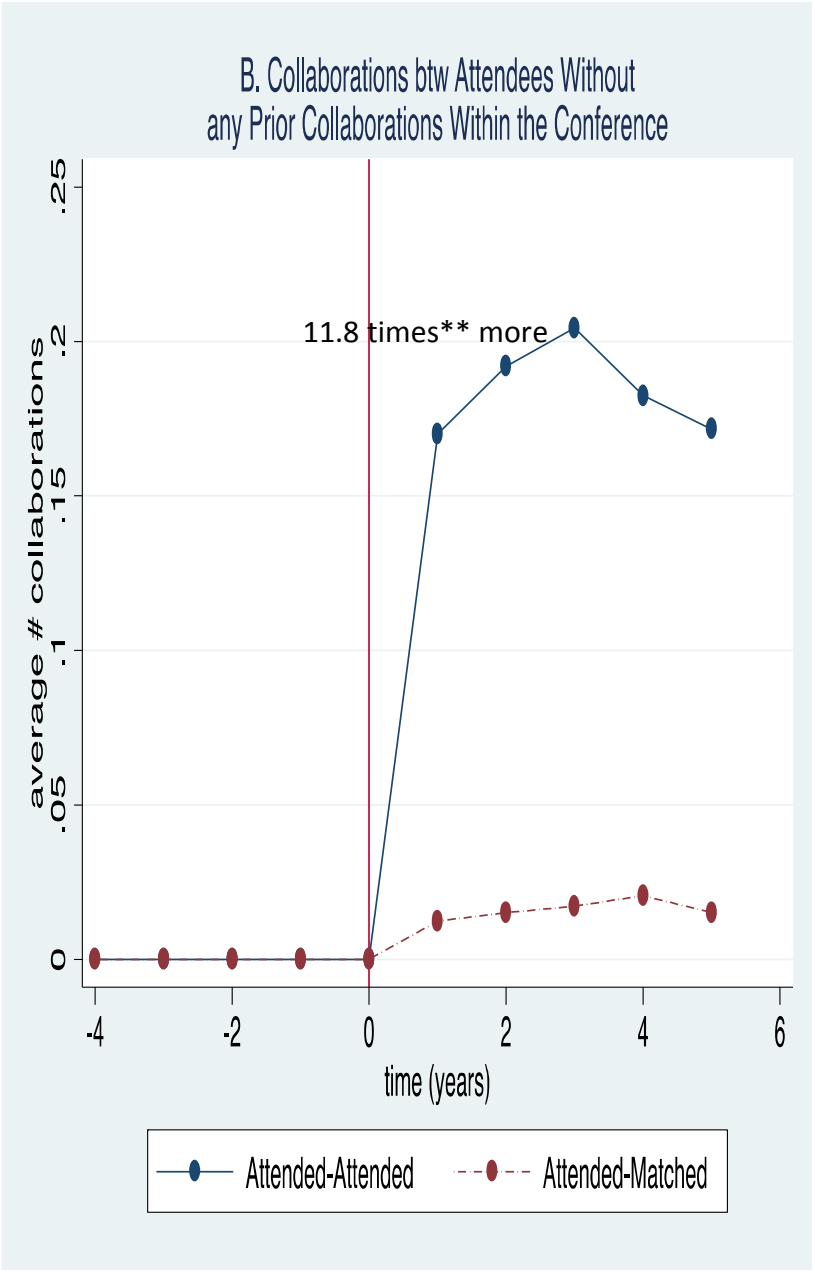
1.3% more collaborations

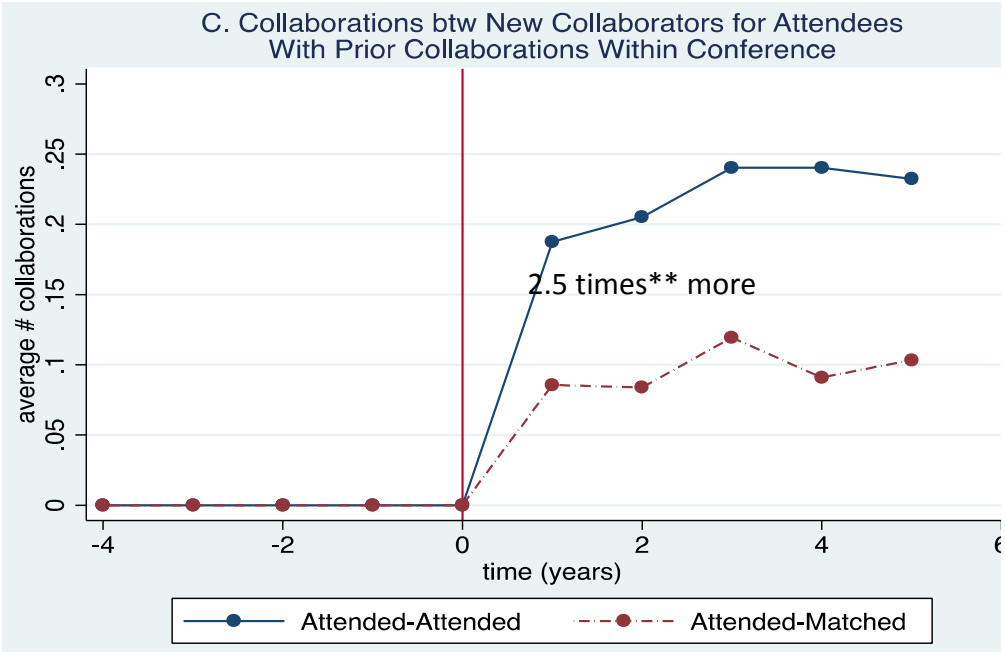
40.8% more between-attendee collaborations

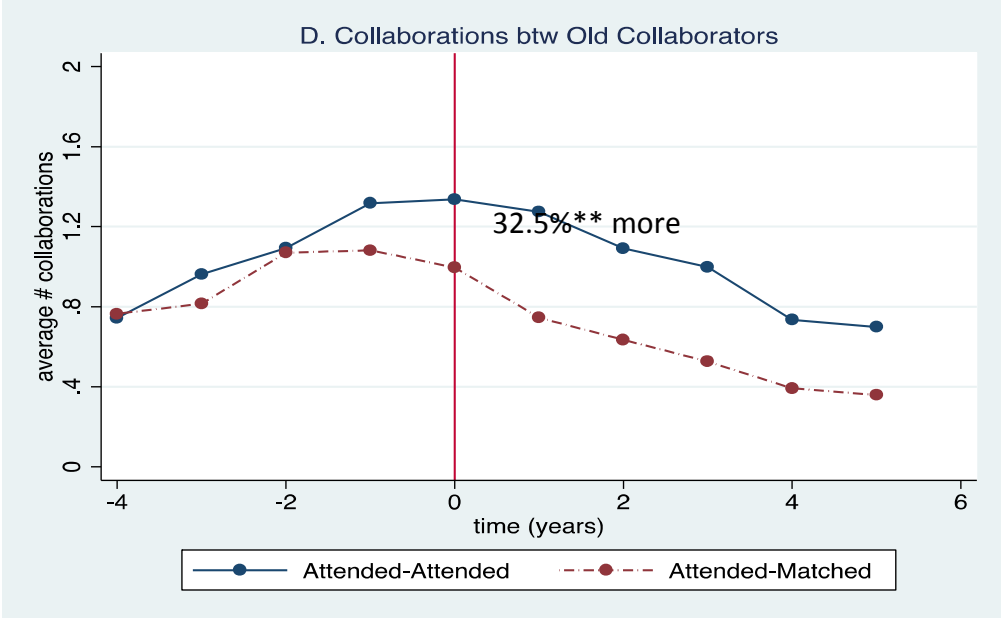
They substitute researchers met at conference for others



Unpacking Collaborations Among Attendees







Full sample	**Model 1** # publications	**Model 2** # collaborations	**Model 3** # collaborations within attendees
post	-0.0244**	-0.0235**	-0.335**
	(0.0087)	(0.0064)	(0.0386)
attended	0.0152	0.0534**	0.774**
	(0.0320)	(0.0110)	(0.0728)
post*attended	0.0307*	0.0132*	0.342**
	(0.0136)	(0.0067)	(0.0516)
ln(experience)	0.181**	0.0427**	-0.327**
	(0.0283)	(0.0085)	(0.0538)
ln(publications)		1.371**	1.525**
		(0.0082)	(0.0223)
ln(citations)	-0.00944	0.00138	-0.0168
	(0.0185)	(0.0063)	(0.0225)
ln(collaborations)	1.368**		
	(0.0267)		
ln(distance to conference)	-0.00969	0.00556	-0.116**
	(0.0070)	(0.0041)	(0.0256)
_cons	-1.251**	-1.313**	-2.016**
	(0.0717)	(0.0453)	(0.3010)
lnalpha			
_cons	-1.863**	-2.284**	1.120**
	(0.1190)	(0.0526)	(0.0407)
conference fe	y	y	y
N	30170	30170	30170
Log lik.	-42592.5	-38306.1	-15010.9

+ p<0.10, * p<0.05, ** p<0.01

Citation of Collaborative papers

Compared to papers between attendees and matched non-attendees collaborative outputs between attendees are

41.2% more cited

46.1% lower odds of receiving no citations

66.2% higher odds of citations being in top 90th percentile of citations

	Model 1 # citations for within-attendee collaborations	Model 2 zero citation indicator	Model 3 top90th citation indicator
attended	0.345*	-0.619**	0.508*
	(0.148)	(0.141)	(0.217)
ln(average experience)	0.0616	0.191	-0.332
	(0.203)	(0.161)	(0.223)
ln(collaborators)	0.505**	-0.752**	0.974**
	(0.194)	(0.144)	(0.205)
_cons	1.197**	-0.194	-2.669**
	(0.450)	(0.623)	(0.860)
conference fe	y	y	y
N	2353	2353	1842
Log lik.	-13159.5	-1179.4	-614.3

+ p<0.10, * p<0.05, ** p<0.01

Inventive Direction of Collaborations

Compared to papers between attendees and matched non-attendees collaborative outputs among attendees are

- 11.2% closer to knowledge space of conference
- Draw 2.6% more from one or the other coauthor
- Draw 1.0% less from both coauthors

This implies that papers influenced by topics of conference; collaborators bring complementary rather than similar knowledge

	Model 1 # MeSH in common with conference	Model 2 MeSH fraction from one or other	Model 3 MeSH fraction from both
attended	0.106**	0.0256**	-0.00995*
	(0.0219)	(0.00553)	(0.00494)
ln(collaborators)	0.0640**		
	(0.0211)		
_cons	2.233**	0.179**	0.183**
	(0.0906)	(0.0117)	(0.00913)
conference fe	y	y	y
N	2353	5294	5294
Log lik.	-5961.8		
R2		0.0740	0.0372

+ p<0.10, * p<0.05, ** p<0.01

3. Citations of Attendees

Attendees receive

- 4.7% more citations (insignificant)
- 15.1% more between-attendee citations (insignificant)

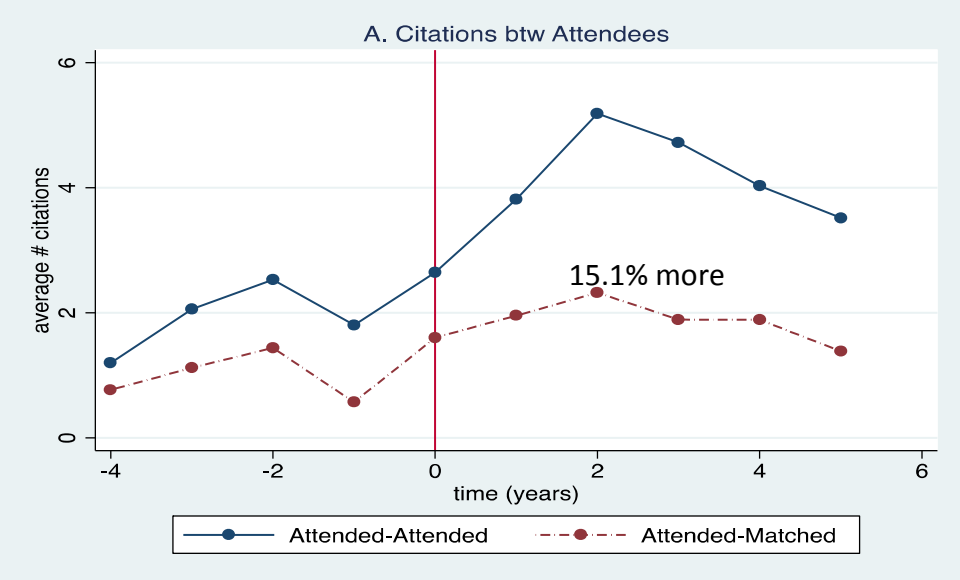
than matched non-attendees

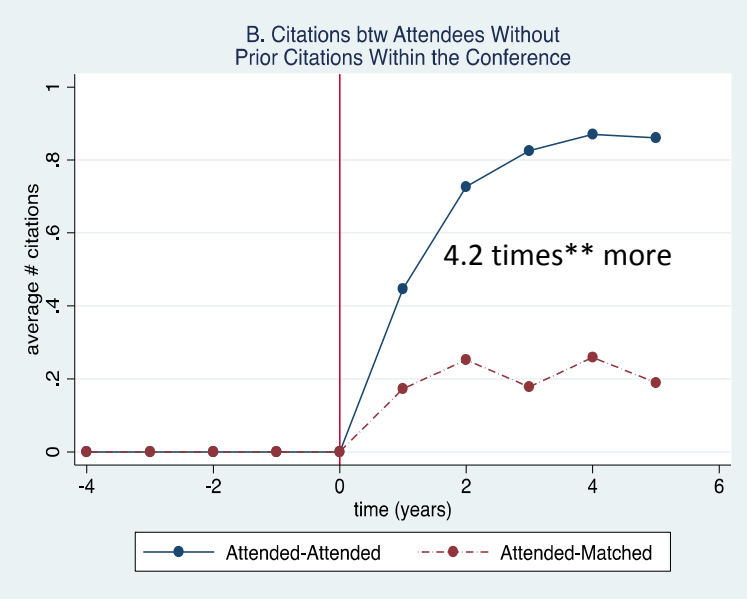
Substitute citing others not in conference with citing attendees from conference

	Model 1	Model 2
Full sample	# citations	# citations within attended
post	0.288**	0.560**
	(0.0231)	(0.0671)
attended	-0.0343	0.707**
	(0.0503)	(0.0914)
post*attended	0.0457	0.141
	(0.0379)	(0.0859)
ln(experience)	0.830**	0.519**
	(0.0300)	(0.0411)
ln(publications)	-0.0220	0.0497
	(0.0757)	(0.0971)
ln(collaborations)	0.216**	0.312**
	(0.0800)	(0.119)
ln(distance to conference)	-0.100**	-0.120**
	(0.0181)	(0.0326)
_cons	1.089**	-1.092**
	(0.191)	(0.271)
lnalpha		
_cons	0.433**	1.396**
	(0.0244)	(0.0251)
conference fe	y	y
N	30170	30170
Log lik.	-98717.3	-48327.4

+ p<0.10, * p<0.05, ** p<0.01

Citations Among Attendees





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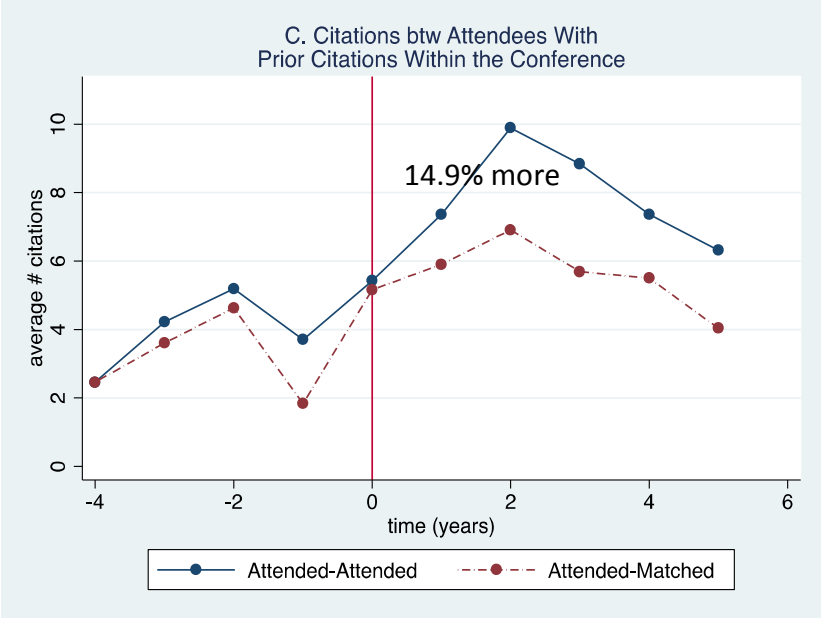

Junior vs. Senior Attendees (based on 10 yrs since first publication) and Presenters vs Non-presenters shows:

bigger boost in collabs/cites to junior attendees

bigger boost in collabs/cites to senior non-presenters

# Collaborations within attendees	Junior	Senior
Presenter	+ 67.4% **	+ 11.0%
Non-presenter	+ 72.8% **	+ 45.9%**

# Citations within attendees	Junior	Senior
Presenter	+ 35.8%	+ 22.6% +
Non-presenter	+ 31.0% *	+ 31.7% +

Sample size	Junior	Senior
Presenter	15%	28%
Non-presenter	33%	24%

4. Conclusion & Implications

1- Conference attendance affects who you work with and knowledge you/other attendees use, some connected to co-authors, others to general topic.

2- Particular conferences produce more substitution of collaborators rather than increased number.

3- Effects are largest for newer researchers.

4- Measure effects of ***transient*** **colocated proximity** suggest value of conferences using bibliometric data to self-evaluate impacts and test alternative designs.

5- Lots more to learn about flow/spread of ideas.

Summary of different statistical models

		Collaborations (within attendees)				**Citations** (within attendees)		
		All collaborations within conference	**No prior collaborations within conference**	**Prior collaborations within conference (new collaborators)**	**Prior collaborations within conference (old collaborators)**	**All citations within conference**	**No prior citations within conference**	**Prior citations within conference**
	Reason for data cut		Address endogeneity of existing collaborators attending the same conference				Address endogeneity of existing citers attending the same conference	
Full sample		+ 40.8%**	+ 11.8 times**	+ 2.5 times**	+ 32.5%**	+ 15.1%	+ 4.2 times**	+ 14.9%
Junior	Understand effect of conference depending on career stage of attendee		+ 17.2 times**	+ 2.9 times**	+ 62.1%**	+ 31.1%**	+ 5.1 times**	+ 24.5%
Senior			+ 8.9 times**	+ 2.3 times**	+ 17.6%*	+ 19.7%*	+ 3.9 times**	+ 20.9%+
Presenter	Understand effect of conference depending on role taken during conference		+ 10.8 times**	+ 2.3 times**	+ 20.9%*	+ 18.3%*	+ 4.5 times**	+ 22.0%*
Non-presenter			+ 12.0 times**	+ 2.7 times**	+ 49.8%**	+ 30.9%*	+ 4.4 times**	+ 20.3%
Dissimilar	Understand effect of conference when attendee is dissimilar or similar to others and address endogeneity of going	+ 22.8%**	+ 14.5 times**	+ 84.0%**	+ 19.0%**	+ 16.8%	+ 7.5 times**	+ 18.3%
Similar		+ 58.4%**	+ 10.0 times**	+ 3.2 times**	+ 45.4%**	+ 22.0%*	+ 3.7 times**	+ 18.7%

Appendix A: Summary Statistics

Variable	# Obs	Mean	Std. Dev.	Min	Max
post	32810	0.500	0.500	0	1
attended	32810	0.386	0.487	0	1
post x attended	32810	0.193	0.394	0	1
junior	32810	0.477	0.499	0	1
presenter	32810	0.432	0.495	0	1
experience	32800	12.887	9.939	0	51
distance to conference	30180	2400.9	2096.4	25.5	11530.5
# publications	32810	3.597	6.384	0	131
# collaborations	32810	2.863	4.688	0	130
# collaborators	32810	9.370	16.300	0	325
# collaborations within attended	32810	0.372	1.119	0	21
# collaborations within attended_m	32810	0.353	1.105	0	21
# collaborators within attended	32810	0.292	0.795	0	10
# collaborators within attended_m	32810	0.261	0.724	0	10
# collaborations within attendees new	32810	0.051	0.323	0	11
# collaborations within attendees old	32810	0.321	1.058	0	21
# citations for within-attendee collaborations	2353	5.173	13.576	0	338
zero citation indicator	2353	0.414	0.493	0	1
top90th citation indicator	2353	0.103	0.304	0	1
# MeSH in common with conference	2353	7.726	3.077	0	17
MeSH fraction from both	5295	0.194	0.129	0	1
MeSH fraction from one or other	5295	0.211	0.159	0	1
average collaborative distance	4675	907.5	1703	0	11862.4
# citations	32810	13.435	27.589	0	661
# citers	32810	50.197	114.598	0	2103
# citations within attended	32810	2.134	8.202	0	247
# citations within attended_m	32810	1.753	7.000	0	247
# citers within attended	32810	0.815	2.159	0	39
# citers within attended_m	32810	0.673	1.853	0	39

Appendix B: Estimated Models: Regressions for Collaborations

Dissimilar sample	Model 1 # publications	Model 2 # collaborations	Model 3 # collaborations within attendees
post	-0.0146	-0.0188*	-0.241**
	-0.0109	-0.00885	-0.0609
attended	0.112*	0.0273	0.869**
	-0.0538	-0.022	-0.125
post*attended	0.0475*	0.00549	0.205**
	-0.0232	-0.0099	-0.0767
ln(experience)	0.302**	0.0403*	-0.389**
	-0.057	-0.0175	-0.0904
ln(publications)		1.280**	1.391**
		-0.013	-0.0421
ln(citations)	-0.0437	0.0322**	0.0651
	-0.036	-0.0113	-0.0431
ln(collaborations)	1.228**		
	-0.0406		
ln(distance to conference)	0.0146	-0.00168	-0.121*
	-0.0114	-0.00701	-0.0511
_cons	-1.384**	-1.176**	-1.856**
	-0.11	-0.0614	-0.533
lnalpha			
_cons	-1.573**	-2.186**	1.268**
	-0.198	-0.087	-0.0613
conference fe	y	y	y
N	10830	10830	10830
Log lik.	-17091.7	-15306.1	-5834.6

+ p<0.10, * p<0.05, ** p<0.01

Similar sample	Model 1 # publications	Model 2 # collaborations	Model 3 # collaborations within attendees
post	-0.0573**	-0.0460**	-0.419**
	(0.00774)	(0.00714)	(0.0546)
attended	-0.0257	0.0725**	0.736**
	(0.0220)	(0.0167)	(0.0877)
post*attended	0.0114	0.0250**	0.460**
	(0.0203)	(0.00811)	(0.0655)
ln(experience)	0.0925**	0.0523**	-0.278**
	(0.0127)	(0.00880)	(0.0504)
ln(publications)		1.455**	1.623**
		(0.0103)	(0.0255)
ln(citations)	0.0367**	-0.0113**	-0.0677**
	(0.00524)	(0.00437)	(0.0193)
ln(collaborations)	1.505**		
	(0.0302)		
ln(distance to conference)	-0.0156*	0.0157**	-0.100**
	(0.00792)	(0.00547)	(0.0315)
_cons	-1.495**	-1.446**	-2.123**
	(0.0947)	(0.0662)	(0.557)
lnalpha			
_cons	-2.200**	-2.430**	1.004**
	(0.105)	(0.0833)	(0.0468)
conference fe	y	y	y
N	19340	19340	19340
Log lik.	-25141.2	-22862.0	-9135.6

+ p<0.10, * p<0.05, ** p<0.01

Collaboration Among Attendees,

	No prior collaborations w/in conference	Prior collaborations w/in conference	
	Model 1	**Model 2**	**Model 3**
Full sample	# collaborations within attendees	# collaborations within attendees (between new collaborators)	# collaborations within attendees (between old collaborators)
post			-0.532**
			(0.0488)
attended	2.465**	0.901**	0.0442
	(0.192)	(0.118)	(0.0516)
post*attended			0.281**
			(0.0673)
ln(experience)	-0.453**	-0.0301	-0.273**
	(0.106)	(0.0805)	(0.0327)
ln(publications)	1.536**	1.298**	1.375**
	(0.0979)	(0.0636)	(0.0253)
ln(citations)	-0.0908	0.111*	-0.0647**
	(0.0752)	(0.0547)	(0.0207)
ln(distance to conference)	-0.126+	0.0278	-0.0246
	(0.0710)	(0.0485)	(0.0223)
_cons	-4.816**	-5.784**	-1.439**
	(0.780)	(0.421)	(0.277)
lnalpha			
_cons	1.005**	0.604**	-0.401**
	(0.164)	(0.124)	(0.0526)
conference fe	y	y	y
N	9330	5755	11510
Log lik.	-1407.7	-2032.4	-11373.8

+ p<0.10, * p<0.05, ** p<0.01

Collaborations for Similar and Dissimilar Researchers

	No prior collaborations w/in conference	Prior collaborations w/in conference	
	Model 1	**Model 2**	**Model 3**
Dissimilar sample	# collaborations within attendees	# collaborations within attendees (between new collaborators)	# collaborations within attendees (between old collaborators)
post			-0.449**
			(0.0677)
attended	2.674**	0.610**	-0.0712
	(0.303)	(0.209)	(0.0989)
post*attended			0.174*
			(0.0828)
ln(experience)	-0.471*	-0.258	-0.344**
	(0.210)	(0.194)	(0.0638)
ln(publications)	1.444**	1.248**	1.255**
	(0.183)	(0.101)	(0.0330)
ln(citations)	-0.108	0.0653	0.0327
	(0.113)	(0.0949)	(0.0426)
ln(distance to conference)	-0.123	0.106	-0.0397
	(0.0819)	(0.0847)	(0.0441)
_cons	-4.403**	-5.252**	-1.101**
	(0.770)	(0.764)	(0.388)
lnalpha			
_cons	1.014**	0.402*	-0.242**
	(0.339)	(0.157)	(0.0821)
conference fe	y	y	y
N	3435	1980	3960
Log lik.	-496.1	-888.4	-4504.4

+ p<0.10, * p<0.05, ** p<0.01

	No prior collaborations w/in conference	Prior collaborations w/in conference	
	Model 1	**Model 2**	**Model 3**
Similar sample	# collaborations within attendees	# collaborations within attendees (between new collaborators)	# collaborations within attendees (between old collaborators)
post			-0.608**
			(0.0558)
attended	2.303**	1.155**	0.102+
	(0.277)	(0.192)	(0.0585)
post*attended			0.371**
			(0.0606)
ln(experience)	-0.380**	0.124	-0.210**
	(0.109)	(0.125)	(0.0403)
ln(publications)	1.665**	1.412**	1.458**
	(0.129)	(0.0745)	(0.0319)
ln(citations)	-0.00358	0.203*	-0.126**
	(0.0882)	(0.0869)	(0.0252)
ln(distance to conference)	-0.138*	0.00252	-0.00438
	(0.0702)	(0.0678)	(0.0289)
_cons	-6.569*	-6.443*	-1.632**
	(2.651)	(2.779)	(0.582)
lnalpha			
_cons	0.809**	0.588**	-0.578**
	(0.227)	(0.182)	(0.0584)
conference fe	y	y	y
N	5895	3775	7550
Log lik.	-897.8	-1125.9	-6819.8

+ p<0.10, * p<0.05, ** p<0.01

Regressions for Citations of Researchers

Dissimilar sample	Model 1 # citations	Model 2 # citations within attended
post	0.234**	0.420**
	(0.0412)	(0.0848)
attended	0.0609	0.865**
	(0.0832)	(0.160)
post*attended	0.0264	0.155
	(0.0593)	(0.106)
ln(experience)	0.931**	0.664**
	(0.0583)	(0.0838)
ln(publications)	-0.0974	0.0839
	(0.148)	(0.180)
ln(collaborations)	0.323*	0.413*
	(0.163)	(0.203)
ln(distance to conference)	-0.121**	-0.108*
	(0.0319)	(0.0519)
_cons	0.782**	-2.042**
	(0.282)	(0.451)
lnalpha		
_cons	0.577**	1.357**
	(0.0465)	(0.0537)
conference fe	y	y
N	10830	10830
Log lik.	-40990.7	-20024.1

+ p<0.10, * p<0.05, ** p<0.01

Similar sample	Model 1 # citations	Model 2 # citations within attended
post	0.354**	0.673**
	(0.0265)	(0.0718)
attended	-0.124*	0.565**
	(0.0547)	(0.114)
post*attended	0.0910	0.199*
	(0.0574)	(0.0828)
ln(experience)	0.657**	0.343**
	(0.0374)	(0.0692)
ln(publications)	0.0597	0.142+
	(0.0425)	(0.0790)
ln(collaborations)	0.0857+	0.0983
	(0.0452)	(0.0923)
ln(distance to conference)	-0.0836**	-0.105**
	(0.0214)	(0.0343)
_cons	1.823**	-0.0736
	(0.225)	(0.391)
lnalpha		
_cons	0.278**	1.383**
	(0.0348)	(0.0377)
conference fe	y	y
N	19340	19340
Log lik.	-57264.5	-28025.6

+ p<0.10, * p<0.05, ** p<0.01

Citations Between Attendees by prior links

Dissimilar sample	Citations btw att w/ no prior citation links w/in conference **Model 1** # citations within attended	Citations btw att w/ prior citation links w/in conference **Model 2** # citations within attended
post		0.363**
		(0.0988)
attended	2.015**	0.303*
	(0.256)	(0.148)
post*attended		0.168
		(0.123)
ln(experience)	-0.333*	0.288**
	(0.153)	(0.0895)
ln(publications)	-0.0124	0.112
	(0.745)	(0.224)
ln(collaborations)	0.701	0.371
	(0.783)	(0.246)
ln(distance to conference)	0.0722	-0.0211
	(0.105)	(0.0410)
_cons	-3.820**	-0.614
	(0.902)	(0.451)
lnalpha		
_cons	1.758**	0.0771
	(0.158)	(0.0538)
conference fe	y	y
N	6090	4740
Log lik.	-2227.9	-17573.7

+ p<0.10, * p<0.05, ** p<0.01

Similar sample	Citations btw att w/ no prior citation links w/in conference **Model 1** # citations within attended	Citations btw att w/ prior citation links w/in conference **Model 2** # citations within attended
post		0.581**
		(0.0716)
attended	1.307**	-0.0343
	(0.127)	(0.0971)
post*attended		0.171
		(0.108)
ln(experience)	0.0396	0.0433
	(0.113)	(0.0697)
ln(publications)	0.157	0.146
	(0.317)	(0.0975)
ln(collaborations)	0.354	0.0889
	(0.362)	(0.112)
ln(distance to conference)	-0.220**	-0.00628
	(0.0626)	(0.0372)
_cons	-3.616	0.873*
	(9.294)	(0.370)
lnalpha		
_cons	1.699**	0.0459
	(0.0765)	(0.0504)
conference fe	y	y
N	11790	7550
Log lik.	-5302.5	-22751.3

+ p<0.10, * p<0.05, ** p<0.01

Collaboration Models by junior and senior status

Junior attendees	No prior collaborations w/in conference	Prior collaborations w/in conference	
	Model 1	**Model 2**	**Model 3**
	# collaborations	# collaborations within attendees (between new collaborators)	# collaborations within attendees (between old collaborators)
post			-0.736**
			(0.0891)
attended	2.847**	1.058**	0.119+
	(0.333)	(0.285)	(0.0619)
post*attended			0.483**
			(0.0983)
ln(experience)	-0.581**	-0.0344	-0.406**
	(0.168)	(0.220)	(0.0526)
ln(publications)	1.947**	1.371**	1.576**
	(0.160)	(0.119)	(0.0374)
ln(citations)	-0.183*	0.122	-0.104**
	(0.0875)	(0.139)	(0.0256)
ln(distance to conference)	-0.105	0.268*	-0.0173
	(0.122)	(0.117)	(0.0328)
_cons	-4.315	-7.048	-1.666**
	(9.050)	(5.222)	(0.540)
lnalpha			
_cons	0.864**	0.828**	-0.742**
	(0.253)	(0.238)	(0.0728)
conference fe	y	y	y
N	4255	2515	5030
Log lik.	-518.5	-585.7	-4231.2

+ p<0.10, * p<0.05, ** p<0.01

Senior attendees	No prior collaborations w/in conference	Prior collaborations w/in conference	
	Model 1	**Model 2**	**Model 3**
	# collaborations	# collaborations within attendees (between new collaborators)	# collaborations within attendees (between old collaborators)
post			-0.426**
			(0.0531)
attended	2.190**	0.834**	-0.00196
	(0.239)	(0.150)	(0.0843)
post*attended			0.162*
			(0.0670)
ln(experience)	-0.894**	-0.367	-0.117
	(0.285)	(0.255)	(0.103)
ln(publications)	1.263**	1.279**	1.237**
	(0.0975)	(0.0779)	(0.0294)
ln(citations)	-0.0104	0.103+	-0.0142
	(0.0937)	(0.0530)	(0.0408)
ln(distance to conference)	-0.131+	-0.0638	-0.0451
	(0.0722)	(0.0758)	(0.0406)
_cons	-3.032**	-4.224**	-1.605**
	(0.990)	(0.980)	(0.345)
lnalpha			
_cons	0.853**	0.473**	-0.273**
	(0.186)	(0.125)	(0.0562)
conference fe	y	y	y
N	5075	3240	6480
Log lik.	-867.7	-1432.0	-7063.2

+ p<0.10, * p<0.05, ** p<0.01

Citation Models by junior and senior status

Junior attendees	Citations btw attendees **Model 1** # citations within attendees	Citations btw att w/ no prior citation links w/in conference **Model 2** # citations within attendees	Citations btw att w/ prior citation links w/in conference **Model 3** # citations within attendees
post	0.891**		0.788**
	(0.0819)		(0.0890)
attended	0.746**	1.621**	0.0260
	(0.151)	(0.222)	(0.151)
post*attended	0.271**		0.219
	(0.105)		(0.134)
ln(experience)	0.879**	0.0411	0.366**
	(0.0880)	(0.123)	(0.0984)
ln(publications)	0.315**	0.00921	0.327**
	(0.102)	(0.329)	(0.110)
ln(collaborations)	-0.0950	0.200	-0.114
	(0.112)	(0.383)	(0.120)
ln(distance to conference)	-0.131*	-0.208*	-0.0150
	(0.0592)	(0.100)	(0.0438)
_cons	-1.946**	-1.212	-0.525
	(0.554)	(4.125)	(0.847)
lnalpha			
_cons	1.558**	1.832**	-0.0671
	(0.0462)	(0.0881)	(0.0741)
conference fe	y	y	y
N	13540	4730	4080
Log lik.	-16350.6	-2681.4	-12606.0

+ p<0.10, * p<0.05, ** p<0.01

Senior attendees	Citations btw attendees **Model 1** # citations within attendees	Citations btw att w/ no prior citation links w/in conference **Model 2** # citations within attendees	Citations btw att w/ prior citation links w/in conference **Model 3** # citations within attendees
post	0.381**		0.322**
	(0.0574)		(0.0605)
attended	0.720**	1.349**	0.196+
	(0.104)	(0.207)	(0.112)
post*attended	0.180*		0.190+
	(0.0763)		(0.101)
ln(experience)	0.624**	0.470	0.442**
	(0.174)	(0.385)	(0.126)
ln(publications)	-0.0152	-0.384	-0.00153
	(0.132)	(0.294)	(0.139)
ln(collaborations)	0.426**	0.620+	0.400*
	(0.146)	(0.335)	(0.158)
ln(distance to conference)	-0.0918**	-0.187*	-0.0149
	(0.0348)	(0.0922)	(0.0313)
_cons	-1.539*	-2.662*	-0.695+
	(0.645)	(1.211)	(0.388)
lnalpha			
_cons	1.265**	1.724**	0.146**
	(0.0388)	(0.103)	(0.0360)
conference fe	y	y	y
N	16630	4210	8210
Log lik.	-31411.8	-2517.4	-27527.1

+ p<0.10, * p<0.05, ** p<0.01

Presenter vs. Non-Presenters: collaborations

Presenters	No prior collaborations w/in conference	Prior collaborations w/in conference	
	Model 1	**Model 2**	**Model 3**
	# collaborations within attendee	# collaborations within attendees (between new collaborators)	# collaborations within attendees (between old collaborators)
post			-0.499**
			(0.0603)
attended	2.375**	0.820**	-0.170*
	(0.231)	(0.147)	(0.0798)
post*attended			0.190*
			(0.0908)
ln(experience)	-0.289	0.0719	-0.243**
	(0.186)	(0.131)	(0.0765)
ln(publications)	1.258**	1.171**	1.230**
	(0.127)	(0.0889)	(0.0340)
ln(citations)	-0.0858	0.0516	-0.0249
	(0.0936)	(0.0620)	(0.0317)
ln(distance to conference)	-0.110	-0.0878	-0.0679
	(0.0785)	(0.0594)	(0.0451)
_cons	-4.699**	-4.865**	-1.005**
	(0.785)	(0.631)	(0.380)
lnalpha			
_cons	0.557	0.274+	-0.271**
	(0.351)	(0.158)	(0.0571)
conference fe	y	y	y
N	4060	2695	5390
Log lik.	-656.4	-1187.6	-5838.9

+ p<0.10, * p<0.05, ** p<0.01

Non-presenters	No prior collaborations w/in conference	Prior collaborations w/in conference	
	Model 1	**Model 2**	**Model 3**
	# collaborations within attendee	# collaborations within attendees (between new collaborators)	# collaborations within attendees (between old collaborators)
post			-0.587**
			(0.0692)
attended	2.484**	0.973**	0.227**
	(0.233)	(0.237)	(0.0653)
post*attended			0.404**
			(0.0843)
ln(experience)	-0.574**	-0.222	-0.249**
	(0.127)	(0.165)	(0.0404)
ln(publications)	1.764**	1.484**	1.525**
	(0.124)	(0.0882)	(0.0355)
ln(citations)	-0.0607	0.196*	-0.0914**
	(0.0880)	(0.0835)	(0.0259)
ln(distance to conference)	-0.155	0.182*	0.00544
	(0.0960)	(0.0893)	(0.0300)
_cons	-5.124	-7.620	-1.642**
	(6.228)	(5.024)	(0.304)
lnalpha			
_cons	1.148**	0.972**	-0.609**
	(0.218)	(0.186)	(0.0655)
conference fe	y	y	y
N	5270	3060	6120
Log lik.	-733.7	-828.5	-5479.9

+ p<0.10, * p<0.05, ** p<0.01

Presenter vs. Non-Presenters:Citations

Presenters	Citations btw attendees **Model 1** # citations within attended	Citations btw att w/ no prior citation links w/in conference **Model 2** # citations within attended	Citations btw att w/ prior citation links w/in conference **Model 3** # citations within attended
post	0.416**		0.350**
	(0.0776)		(0.0747)
attended	0.801**	1.496**	0.230+
	(0.127)	(0.265)	(0.125)
post*attended	0.168*		0.199*
	(0.0816)		(0.0985)
ln(experience)	0.429**	0.0112	0.175*
	(0.0889)	(0.129)	(0.0696)
ln(publications)	0.0351	-0.289	0.0563
	(0.148)	(0.417)	(0.125)
ln(collaborations)	0.400*	0.411	0.376**
	(0.170)	(0.458)	(0.145)
ln(distance to conference)	-0.143**	-0.163+	-0.0311
	(0.0364)	(0.0884)	(0.0309)
_cons	-0.766*	-1.327+	0.0697
	(0.368)	(0.769)	(0.306)
lnalpha			
_cons	1.184**	1.714**	0.0495
	(0.0555)	(0.144)	(0.0508)
conference fe	y	y	y
N	13510	3495	6520
Log lik.	-25888.1	-1916.7	-22899.4

+ p<0.10, * p<0.05, ** p<0.01

Non-Presenters	Citations btw attendees **Model 1** # citations within attended	Citations btw att w/ no prior citation links w/in conference **Model 2** # citations within attended	Citations btw att w/ prior citation links w/in conference **Model 3** # citations within attended
post	0.720**		0.632**
	(0.0894)		(0.0891)
attended	0.425**	1.486**	-0.159
	(0.156)	(0.177)	(0.111)
post*attended	0.269*		0.185
	(0.129)		(0.124)
ln(experience)	0.419**	0.126	0.0194
	(0.0675)	(0.101)	(0.0543)
ln(publications)	0.151	-0.146	0.168
	(0.103)	(0.289)	(0.109)
ln(collaborations)	0.0786	0.409	0.0435
	(0.117)	(0.302)	(0.124)
ln(distance to conference)	-0.0641	-0.189*	0.0178
	(0.0439)	(0.0897)	(0.0376)
_cons	-4.016**	-3.439**	-1.321**
	(0.564)	(1.001)	(0.422)
lnalpha			
_cons	1.521**	1.848**	0.0367
	(0.0445)	(0.0991)	(0.0515)
conference fe	y	y	y
N	16660	5445	5770
Log lik.	-22097.9	-3290.3	-17398.9

+ p<0.10, * p<0.05, ** p<0.01

Appendix C: Robustness checks Collaborations vs. Collaborators

			Collaborations between attendees	
	Model 1	**Model 2**	**Model 3**	**Model 4**
	# collaborations	# collaborators	# collaborations within attendees	# collaborators within attendees
post	-0.0235**	0.147**	-0.335**	-0.275**
	(0.00589)	(0.0121)	(0.0413)	(0.0417)
attended	0.0534**	-0.00799	0.774**	0.820**
	(0.0116)	(0.0194)	(0.0677)	(0.0730)
post*attended	0.0132	0.0461*	0.342**	0.386**
	(0.00885)	(0.0185)	(0.0494)	(0.0546)
ln(experience)	0.0427**	0.0344*	-0.327**	-0.266**
	(0.00931)	(0.0140)	(0.0454)	(0.0440)
ln(publications)	1.371**	1.254**	1.525**	1.212**
	(0.00876)	(0.0108)	(0.0179)	(0.0253)
ln(citations)	0.00138	0.0549**	-0.0168	-0.0459*
	(0.00640)	(0.00916)	(0.0228)	(0.0210)
ln(distance to conference)	0.00556	0.0424**	-0.116**	-0.114**
	(0.00509)	(0.00638)	(0.0288)	(0.0258)
_cons	-1.313**	-0.223**	-2.016**	-2.098**
	(0.0558)	(0.0838)	(0.301)	(0.276)
lnalpha				
_cons	-2.284**	-1.523**	1.120**	0.951**
	(0.0647)	(0.0386)	(0.0404)	(0.0401)
conference fe	y	y	y	y
N	30170	30170	30170	30170
Log lik.	-38306.1	-76066.3	-15010.9	-14493.9

+ p<0.10, * p<0.05, ** p<0.01

Citations vs. Citers

			Citations between attendees	
	Model 1	**Model 2**	**Model 3**	**Model 4**
	# citations	#citers	# citations within attendees	#citers within attendees
post	0.288**	0.624**	0.560**	0.587**
	(0.0255)	(0.0266)	(0.0594)	(0.0290)
attended	-0.0343	-0.0745	0.707**	0.703**
	(0.0590)	(0.0636)	(0.116)	(0.0673)
post*attended	0.0457	0.0570	0.141	0.134**
	(0.0401)	(0.0400)	(0.0865)	(0.0424)
ln(experience)	0.830**	0.758**	0.519**	0.382**
	(0.0378)	(0.0355)	(0.0459)	(0.0358)
ln(publications)	-0.0220	-0.0854	0.0497	0.170*
	(0.0834)	(0.105)	(0.0974)	(0.0806)
ln(collaborations)	0.216*	0.321**	0.312**	0.0782
	(0.0907)	(0.111)	(0.120)	(0.0920)
ln(distance to conference)	-0.100**	-0.0985**	-0.120**	-0.102**
	(0.0189)	(0.0198)	(0.0304)	(0.0241)
_cons	1.089**	2.519**	-1.092**	-1.504**
	(0.220)	(0.190)	(0.316)	(0.262)
lnalpha _cons	0.433**	0.569**	1.396**	1.096**
	(0.0282)	(0.0327)	(0.0332)	(0.0343)
conference fe	y	y	y	y
N	30170	30170	30170	30170
Log lik.	-98717.3	-293033.6	-48327.4	-26523.6

+ p<0.10, * p<0.05, ** p<0.01

Attended-matched vs. Matched-matched

	Collaborations within attendees			
	Model 1	**Model 2**	**Model 3**	**Model 4**
	# collaborations within attendees (w att-mat controls)	# collaborations within attendees (w mat-mat controls)	# collaborators within attendees (w att-mat controls)	# collaborators within attendees (w mat-mat controls)
post	-0.335**	-0.682**	-0.275**	-0.731**
	(0.0408)	(0.0584)	(0.0404)	(0.0431)
attended	0.774**	0.842**	0.820**	0.930**
	(0.0616)	(0.0644)	(0.0610)	(0.0543)
post*attended	0.342**	0.692**	0.386**	0.846**
	(0.0459)	(0.0640)	(0.0449)	(0.0564)
ln(experience)	-0.327**	-0.268**	-0.266**	-0.218**
	(0.0483)	(0.0417)	(0.0471)	(0.0369)
ln(publications)	1.525**	1.495**	1.212**	1.201**
	(0.0259)	(0.0248)	(0.0239)	(0.0267)
ln(citations)	-0.0168	-0.0162	-0.0459*	-0.0519**
	(0.0252)	(0.0269)	(0.0194)	(0.0192)
ln(distance to conference)	-0.116**	0.00439	-0.114**	-0.0379
	(0.0266)	(0.0284)	(0.0258)	(0.0238)
_cons	-2.016**	-3.064**	-2.098**	-3.049**
	(0.358)	(0.325)	(0.343)	(0.249)
lnalpha				
_cons	1.120**	1.022**	0.951**	0.741**
	(0.0379)	(0.0388)	(0.0466)	(0.0426)
conference fe	y	y	y	y
N	30170	30170	30170	30170
Log lik.	-15010.9	-14648.1	-14493.9	-13665.9

+ p<0.10, * p<0.05, ** p<0.01

Attended-matched vs. Matched-matched

	Citations between attendees			
	Model 1	**Model 2**	**Model 3**	**Model 4**
	# citations within attendees (w att-mat controls)	# citations within attendees (w mat-mat controls)	# citers within attendees (w att-mat controls)	# citers within attendees (w mat-mat controls)
post	0.560**	0.112+	0.587**	0.137**
	(0.0642)	(0.0579)	(0.0309)	(0.0368)
attended	0.707**	0.871**	0.703**	0.959**
	(0.0820)	(0.0855)	(0.0688)	(0.0576)
post*attended	0.141+	0.587**	0.134**	0.580**
	(0.0818)	(0.0874)	(0.0425)	(0.0475)
ln(experience)	0.519**	0.528**	0.382**	0.393**
	(0.0464)	(0.0399)	(0.0490)	(0.0420)
ln(publications)	0.0497	0.0899	0.170*	0.216*
	(0.0992)	(0.107)	(0.0729)	(0.0968)
ln(collaborations)	0.312**	0.295*	0.0782	0.0808
	(0.121)	(0.122)	(0.0818)	(0.112)
ln(distance to conference)	-0.120**	-0.0882**	-0.102**	-0.0639**
	(0.0325)	(0.0334)	(0.0272)	(0.0203)
_cons	-1.092**	-1.606**	-1.504**	-2.098**
	(0.284)	(0.328)	(0.251)	(0.278)
lnalpha				
_cons	1.396**	1.288**	1.096**	0.841**
	(0.0303)	(0.0335)	(0.0338)	(0.0343)
conference fe	y	y	y	y
N	30170	30170	30170	30170
Log lik.	-48327.4	-44779.2	-26523.6	-24274.9

+ p<0.10, * p<0.05, ** p<0.01