Does Mentoring Increase the Collaboration Networks Of Female Economists? An Evaluation of the CeMENT Randomized Trial

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Abstract:
Many researchers argue that lower research productivity by female economists contributes to the underrepresentation of women in academic economics. The Committee on the Status of Women in the Economics Profession (CSWEP) of the American Economics Association (AEA) established the CeMENT mentoring workshop to support women in research careers. CeMENT is a randomized controlled trial that also may contribute to an exogenous change in professional networks. We examine whether the CeMENT workshop affected the number of publications and coauthors of treated women. Our results show that treated women publish more papers and add three additional coauthors. Once we control for coauthors, the treatment effect is reduced but remains significant. Our research suggest that the CeMENT workshop provided knowledge and advice that led to larger collaboration networks, additional papers, and more citations.

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Women in the economics field are less likely to get tenure (Ginther and Kahn 2004, Ginther and Kahn 2014, Ginther and Kahn, 2021) when compared to their male colleagues. Many studies have investigated the reasons for women's underrepresentation in the economic profession. Research productivity is cited as one of the major reasons for the gender difference in economic careers in academia (Conley, Önder and Torgler 2016, Conley and Önder 2014). Studies have shown that collaborations among economists are positively related to the overall productivity of both men and women (Cainelli et al 2015). In this study, we investigate the impact of the CeMENT mentoring randomized controlled trial on coauthorship networks. Our results show that the CeMENT workshop expanded coauthorship networks among treated women, but these additional coauthors do not fully explain the positive impact of the mentoring workshop.

The American Economic Association (AEA) Committee on the Status of Women in the Economics Profession (CSWEP) has monitored the representation of female economists since the 1990s (Levenstein 2020). With the support of the National Science Foundation (NSF) and the AEA, CSWEP established the CeMENT mentoring program to support junior female economists.[1] The National Workshop (now the Workshop for Faculty in Doctoral Programs) focuses on junior female economists employed at institutions where research accomplishments weigh heavily in the promotion decision. It was originally designed as a randomized controlled trial, and was held every other year from 2004-2014. Based on an interim evaluation (Blau et al

[1] CSWEP runs two mentoring workshops. The CeMENT Workshop for Faculty in Doctoral Programs https://www.aeaweb.org/about-aea/committees/cswep/programs/CEMENT-mentoring-workshops#doctoral was originally a randomized controlled trial and is the source of data for this paper. The workshop is held immediately following the ASSA meetings. The CeMENT Workshop for Faculty in Non-Doctoral programs https://www.aeaweb.org/about-aea/committees/cswep/programs/CEMENT-mentoring-workshops#nondoctoral is held in conjunction with a regional economic association meeting (in 2020 with the Western Economic Association Meetings). The Non-Doctoral workshop was not designed as a randomized controlled trial and does not emphasize the same professional development topics as the Doctoral Workshop.

2010), the AEA funded the workshop every year starting in 2015. Previous studies have shown that the CeMENT program increased the number of publications, publications in top journals, and the number of federal grants for treated cohorts and increased the likelihood that women remained in academia as well as promotion to tenure in top-ranked economics departments (Blau et al 2010; Ginther et al 2020). However, neither evaluation has fully investigated the mechanism contributing to the improvement in publication outcomes.

I. The Importance of Collaboration in Research Productivity

Lower research productivity is often cited as a primary reason for women's disadvantage in academic careers. Conley, Önder and Torgler (2016) found that research productivity is positively related with the availability of academic jobs for both genders. Women's responsibility in childbearing and caregiving negatively affect their research productivity (Joecks, Pull and Backes-Gellner 2014, Krapf et al 2014). At work, women devote more time in teaching and other non-research obligations (Bellas and Toutkoushian 1999, Harter, Becker and Watts 2011, Manchester and Barbezat 2013). Moreover, Taylor, Fender and Burke (2006) have shown the importance of collaboration and research networks to women's research productivity.

Coauthorship is increasingly important for research productivity in economics Hamermesh (2012). Several researchers have examined coauthorship and its impact on academic research productivity (Laband and Tollison 2000, Hamermesh 2012). Ductor (2015) shows that for journals listed in *EconLit,* the proportion of more-than-one-authored papers increased from 24.7% in 1970s to 62.7% in 2011. Cainelli et al (2012, 2015) studied a group of Italian economists and their research outcomes, and found that one's research productivity was correlated with the "propensity to collaborate, his/her 'international' connections and the stability of his/her collaborative behavior." Although many researchers have shown a positive

association between coauthorship and research productivity, establishing the causal effect of coauthorship is difficult due to the endogeneity of collaboration networks. Lee and Bozeman (2005) instrumented coauthorship using a scale for the location of co-authors. Common research interest between coauthors has also been used as instrument to handle the endogeneity of coauthorship networks (Ductor 2015).

A limited number of papers have studied women's collaboration networks. McDowell, Singell and Stater (2006) showed that female economists were less likely to coauthor than their male colleagues, indicating that lacking professional research networks might explain women's lower research productivity. However, women's smaller coauthorship networks may be a rational choice because Sarsons (2017) found that women were given less credit for coauthored work than men. In addition, Hengel (2017) and Card et al (2020) found that women economists may be held to a higher standard for publications than men. Although women publish fewer research papers, the average number of citations to those papers is the same as men's (Ceci et al 2014, Ginther and Kahn 2004, Kahn and Ginther 2018).

Given the importance of collaboration to research productivity, we hypothesize that the CeMENT workshop provides a positive shock to collaboration networks. Since the CeMENT workshop is a randomized controlled trial, it may result in an exogenous change to professional networks for those who are treated, giving us an opportunity to examine the coauthorship networks of CeMENT participants compared to the control group.

II. The CeMENT Randomized Controlled Trial

The CeMENT Mentoring Workshop for Faculty in Doctoral Programs was designed to provide role models (senior female economists) and peers in one's research field. The workshop

is held immediately after the ASSA meetings and lasts two days. Between 40-50 junior faculty attend and are divided into groups of 4-5 women in the same field. Two senior female economists in the same field are assigned to mentor each group.

Prior to the conference, each woman circulates a research paper that will be read and discussed by the group. During small group sessions, each paper is given an hour where all group members provide comments and feedback on the work. In between group sessions, plenary sessions made up of a panel of senior mentors are held. These panel discussions focused on the topics of research and publishing, getting grants, networking strategies, teaching, the tenure process, and work-life balance. Thus, the CeMENT intervention focused on strategies for publishing research as well as providing comments on a specific paper. In addition, the networking strategy session focused on how to increase professional exposure which would also be associated with increasing one's network.

Approximately 80 people applied to each workshop. Applications were screened by completeness and research intensity of an applicant's current institution (those at teaching-focused universities were re-directed to the Non-Doctoral Workshop). Applicants were assigned to groups based on research field (e.g. Labor, Macroeconomics, Health, Development, etc.). Within each field, applicants were randomly assigned to treatment or control groups, and more applicants were treated than not (e.g. if there were eight applicants in a field, five were selected as treatments). All applicants were told that there were more applications than slots available in the workshop, and several women reapplied for the workshop.

III. Data on Publications and Methods

We collected the Curriculum Vitae (CVs) and Web of Science publications of the applicants to the CeMENT workshop. Our Web of Science queries for publications were based on five years prior to the doctorate through the third quarter of 2018. We collected data on the first eight CeMENT cohorts from 2004—2016. We did not include the most-recent cohorts because it will take time for potential new collaborations to result in additional publications. In total, there are 512 people in the data.[2] We rank the quality of the doctoral department and first job using the world rankings of institutions in economics from Kalaitzidakis, Stengos, and Mamuneas (2003).

Our WOS publication data contain information on year of publication, journal, affiliations, coauthor names, and citations. We ranked journals based on quality. Top tier journals are the *American Economic Review*, the *Journal of Political Economy,* the *Quarterly Journal of Economics*, *Econometrica,* and the *Review of Economic Studies.* Top field journals are in our second category, and Other Refereed publications are all journals indexed in WOS that are not categorized as Top Tier or Top Field. Since we are interested in the mechanisms associated with the CeMENT workshop we focus on pre-tenure publications as in Ginther et al (2020). We identified 3,161 pre-tenure publications of which 163 were Top Tier, 1,023 were Top Field and 2,002 were Other Refereed.

We identified the cumulative number of unique coauthors by publication years and used that data to identify the number of coauthors prior to receiving the mentoring treatment and the number of additional coauthors after treatment but pre-tenure. In addition, we identified only 20 publications that resulted from the CeMENT workshop. Two women collaborated on multiple

[2] Our sample includes more cohorts of data compared to Ginther et al (2020) that restricted the sample to people who had sufficient time for promotion to tenure.

publications with women in their same cohort (8 publications); 10 women collaborated on one publication with another member of their cohort (5 publications); 3 women collaborated with a CeMENT mentor (3 publications); and 2 women collaborated on 2 publications each with a CeMENT mentor (4 publications).

Table 1 lists the cohort year and number of treatment and control groups. Appendix 1 provides more details about our data collection methods. As mentioned earlier, 83 out of the 512 women in our sample reapplied for the workshop and 60 of those women eventually received the mentoring treatment. We follow Ginther et al (2020) in using an intent-to-treat framework where the initial assignment to the treatment or control group is used as an instrument for whether a person was eventually treated.

Table 2 compares the characteristics of the sample prior to the CeMENT workshop. There are few significant differences between the treatment and control groups. Between 86 – 90% of the applicants had an academic first job. Over half of the sample (53 – 56%) obtained their PhD at Top 10 or 20 ranked institutions. Women in the treatment and control groups had on average 1.3 to 1.6 pretreatment coauthors. We found two significant differences in pre-CEMENT characteristics. First, the treated group received their doctorates on average one year earlier than the control group. Second, the control group includes more women whose first job was at an unranked (201+) academic institution. These differences are likely the result of changes in CeMENT policies after 2014 that gave women who previously applied to the workshop the opportunity to participate in subsequent workshops. In all estimates we control for years since PhD as well as the initial CeMENT cohort. In addition, we split the sample by first job at a top 200 ranked institution (Ranked) and 201+ ranked as well as nonacademic institutions

(Unranked). All models include controls for pre-treatment coauthors in order to adjust for the CeMENT applicant's initial collaboration network.

IV. Results

Table 3, panel A reports our main results on the effect of the CeMENT treatment on pre-tenure publications, coauthors and total citations as of 2018 using the full sample. All models use initial treatment assignment as an instrument for the probability of ever receiving treatment. Women who participated in the CeMENT workshop published 1.6 more papers (representing a 26% increase at the mean), .21 additional Top Tier papers (representing a 78% increase), and .96 additional Other Refereed papers (representing a 16% increase) all statistically significant at $p<.05$. As found in the previous literature, there is a significant relationship between the number of coauthors and publications. Each additional pretreatment coauthor contributed .79 in additional publications. However, the number of coauthors have no impact on Top Tier publications.

In addition, the CeMENT workshop significantly expanded a woman's pre-tenure collaborations, adding 3 additional coauthors relative to the treatment group (a 51% increase). However, these additional collaborations were not directly the result of collaborations formed at the CeMENT workshop. After adjusting for CeMENT papers, the treated group still had an average of 3 more coauthors than the control group. Finally, the treatment group had 43 more citations to pre-tenure publications than the control group (a 45% increase).

Panel B of Table 3 reports the same results for the subsample of women whose first job was at a top 200 ranked academic institution. We see similar results for total publications (1.3 more), but no significant difference from the control group for other publication measures. However, women whose first job was at a ranked institution who received the mentoring

treatment have 3.4 additional coauthors (a 52% increase over the mean). Citations are not significantly different between the treatment and control groups. Panel C repeats the analysis for women whose first job was at an unranked academic or a nonacademic institution. The women in the treatment group have more total publications than those at ranked institutions 1.6 compared to 1.3. Most of this increase is made up of Other Refereed publications. Women in the treatment group have 1.3 more Other Refereed publications than the control group, an increase of 33% at the mean. Also women in the treatment group have an additional 61 citations, representing an 84% increase. However, treated women whose first job was at unranked or nonacademic institutions who received the mentoring treatment have one less coauthor (2.3 compared to 3.4) than women at ranked institutions. In fact the average number of coauthors in the two groups differs by 1.7.

The final panel of Table 3 re-estimates the models for the full sample including controls for coauthors added after the CeMENT workshop as well as pre-treatment coauthors. After controlling for all pre-tenure coauthors, women who received the mentoring treatment had an additional .57 publication (a 9% increase). Although much of the publication effect for treated women is explained by controlling for coauthors, the mentoring treatment still has a marginally significant ($p<.10$) effect. We also find that coauthors explain none of the highly significant effect of the mentoring treatment on Top Tier publications. Finally, we find that mentoring treatment contributes to 31 additional citations ($p<.07$) after controlling for all pre-tenure collaborators, a 32% increase.

V. Conclusions

Researchers have found that women publish fewer papers than men (Ceci et al 2014, Ginther and Kahn 2004, Kahn and Ginther 2020), have more difficulty publishing their work

(Hengel 2017 and Card et al 2020), and are given less credit for coauthored work (Sarsons 2017). The CeMENT randomized controlled mentoring trial has shown that mentoring increases the number and quality of publications (Blau et al 2010, Ginther et al 2020). This paper examines whether the increase in publications is the result of expanded coauthoring networks.

We found that the mentoring treatment increases publications, Top Tier publications, Other Refereed publications, and total citations. In addition, the treatment increased the number of pretreatment coauthors by three relative to the control group. We were expecting that this increase in networks would be the result of new collaborations formed at the CeMENT workshop but found that was not the case. Networks also grew larger at ranked academic institutions relative to unranked institutions.

Once we control for the number of pre-tenure coauthors, the estimated impact of the mentoring treatment on publications is significantly reduced, but not eliminated. In fact, none of the increase in Top Tier publications by treated women is explained by the coauthor variables, suggesting that the knowledge transmitted in the mentoring workshop contributed to this publication success.

Taken together, these results suggest that the CeMENT workshop provided information and advice that contributed to the expansion of collaboration networks and the career success of treated women. Although women at unranked academic and nonacademic institutions had smaller increases in their number of coauthors, the mentoring treatment increased their publications and citations as well. Thus, it remains a troubling puzzle that these women were less successful in achieving tenure than women at the top ranked institutions (Ginther et al 2020). Unfortunately, Ginther and Kahn (2021) also found that women at less research-intensive

universities were less likely to be promoted than men after controlling for publications and citations, suggesting that unobservable factors including bias may be playing a role.

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Table 1: CeMENT Cohort Data

Cohort	Year	Treatment	Control	Reapplied	Eventually Treated
1	2004	45	34	5	1
2	2006	36	27	10	6
3	2008	41	20	4	3
4	2010	28	19	5	4
5	2012	37	51	13	10
6	2014	31	40	24	16
7	2015	28	26	12	11
8	2016	27	22	10	9
	Total	273	239	83	60

Notes: The Reapplied column indicates those who were from a previous cohort and reapplied to participate in the workshop. The Eventually Treated column are those who reapplied and were eventually treated. One person in cohort 3 died and was removed from the sample. Seven people could not be located and were assumed to have nonacademic jobs.

Table 2: Balance Between Treatment and Control Groups Based on Initial Assignment

	Treated	Control	p-value
Top 10 PhD Institution	0.319	0.297	0.598
Top 20 (11-20) PhD Institution	0.245	0.238	0.856
Top 40 (21-40) PhD Institution	0.187	0.205	0.605
PhD non-US	0.081	0.100	0.435
Academic First Job	0.890	0.858	0.270
First Job Top 10 Rank	0.121	0.105	0.563
First Job Top 11-20 Rank	0.088	0.071	0.486
First Job Top 21-40 Rank	0.092	0.067	0.307
First Job Top 41-100 Rank	0.165	0.138	0.402
First Job 201+ Rank	0.333	0.427	0.030
Pre-Treatment Coauthors	1.293	1.552	0.280
PhD Year	2006.32	2007.6	0.002

Table 3: IV Estimates of Intention to Treat Effects on Publication Outcomes

VARIABLES	Total Publications	Top Tier Publications	Top Field Publications	Other Refereed Publications	Coauthors	Coauthors x CeMENT	Pre-Tenure Citations
Full Sample							
CeMENT Treatment	1.550***	0.213**	0.376	0.961**	3.025***	2.995***	43.356**
	[0.459]	[0.084]	[0.236]	[0.398]	[0.942]	[0.940]	[17.326]
Pretreatment Coauthors	0.789***	-0.002	0.140***	0.651***	0.721***	0.717***	16.810***
	[0.067]	[0.012]	[0.035]	[0.058]	[0.138]	[0.138]	[2.541]
R-squared	0.393	0.052	0.160	0.315	0.126	0.126	0.251
Mean	6.174	0.266	1.998	3.910	5.914	5.885	96.99
Ranked Academic							
CeMENT Treatment	1.326**	0.210	0.231	0.885	3.433**	3.413**	16.317
	[0.655]	[0.134]	[0.326]	[0.577]	[1.516]	[1.515]	[25.722]
Pretreatment Coauthors	0.787***	-0.009	0.126***	0.671***	0.699***	0.696***	16.455***
	[0.086]	[0.017]	[0.043]	[0.075]	[0.198]	[0.198]	[3.359]
R-squared	0.411	0.068	0.210	0.327	0.131	0.131	0.251
Mean	6.590	0.362	2.349	3.878	6.583	6.551	112.6
Unranked & Non Academic							
CeMENT Treatment	1.627**	0.117	0.254	1.256**	2.282**	2.229**	61.317***
	[0.637]	[0.078]	[0.325]	[0.543]	[0.912]	[0.903]	[21.693]
Pretreatment Coauthors	0.817***	0.025*	0.184***	0.607***	0.742***	0.738***	19.988***
	[0.116]	[0.014]	[0.059]	[0.099]	[0.166]	[0.164]	[3.942]
R-squared	0.418	0.112	0.184	0.367	0.210	0.210	0.343
Mean	5.525	0.115	1.450	3.960	4.870	4.845	72.69
Full Sample							
CeMENT Treatment	0.572*	0.217***	0.284	0.071			30.955*
	[0.346]	[0.084]	[0.236]	[0.289]			[17.021]
Pretreatment Coauthors	0.556***	-0.001	0.118***	0.439***			13.856***
	[0.052]	[0.013]	[0.035]	[0.043]			[2.541]
Add Pre-tenure Coauthors	0.323***	-0.001	0.030***	0.294***			4.099***
	[0.016]	[0.004]	[0.011]	[0.014]			[0.796]
R-squared	0.660	0.052	0.173	0.644			0.289
Mean	6.174	0.266	1.998	3.910			96.99

Notes: There are 512 observations in the full sample, 312 in the ranked sample and 200 in the unranked sample. Standard errors in brackets. All regressions include dummy variables for each cohort and for years 4 to 16+ since PhD. F-statistic for the first stage regressors is 40.34 for the full sample, 23.13 for the ranked sample, and 17.6 for the unranked sample. * p<.10, ** p<.05, *** p<.01.

Appendix 1: Data Collection Methods and Web of Science Search Process

Note: This data appendix originally appeared in Ginther, Donna K., Currie, Janet M., Blau, Francine D., Croson, Rachel T.A. (2020). "Can Mentoring Help Female Assistant Professors in Economics? An Evaluation by Randomized Trial." NBER Working Paper 26864.

We collected data from several sources in order to create the analysis data on women in the CEMENT treatment and control groups. We conducted web searches for women in the CEMENT treatment and control groups in order to find their current employment status. University websites and LinkedIn allowed us to locate most in the sample. For those that we could not locate, we reached out to colleagues at their last known institution to find their current whereabouts. Whenever possible, we downloaded the most recent CVs and recorded employment history, publications and grants in an Access Database. Some individuals did not have a recent CV, and we used sources such as LinkedIn to fill in employment records.

Given that some CVs were out-of-date or missing, we used public sources to find publications and grants. Publications, journals, and publication dates come from *Web of Science*. We searched for each woman by name using Python code to query the *Web of Science* interface and downloaded all publications associated with the name. We used publications listed on CVs, affiliations listed on publications, and the field of the journal to identify publications associated with the women in our sample. Grants include all National Science Foundation (NSF) and National Institutes of Health (NIH) grants where the person is listed as the principal investigator (or co-PI). Grant awards were downloaded from NSF and NIH award websites and matched by name, affiliation, and field of study to those in the CeMENT sample. We used the matchit routine in STATA to create fuzzy name matches, and then reviewed and verified low-quality matches. The use of these public sources enabled us to obtain consistent information on publications and grants for virtually the full sample. We note that we do not have information on

articles that were forthcoming at the time tenure decisions were made nor on grants from sources other than NSF and NIH.

In order to verify tenure status, we searched online curriculum vitae and university web sites with faculty listings. In some cases women reported the date of receiving tenure on their CVs. In other cases, we used data from the CSWEP survey of economics departments to impute tenure status for many universities. If an institution reported no untenured associate professors, we assumed that anyone reporting an associate professor rank at that institution was tenured. If a person reported that they were a full professor, we assumed that they were tenured. In cases where tenure status could not be determined in this way, we contacted individuals to ask if they had tenure and when they received it. The tenure variable can be considered current as of September 2018.

Web of Science Search Process

We started by creating a list of search queries for everyone in the CeMENT data. Each search query includes names, publication year intervals and affiliations. For names, we use both full names and name initials, because publications indexed in WOS prior to 2008 included only last names and initials for first and middle name. We limit the publication year intervals to be from 5 years prior to PhD year to 2018. The affiliations are the job institutions or affiliations of each person. Such information could be found on the job information collected in in the CVs. Institution names must be changed according to the Web of Science organization enhanced index.

For example, we have a female in the data named Katherine R. McDonald, who graduated in the 2008 from University of Kansas, and she worked in the University of Chicago

from 2009 to 2013 and switched to Federal Reserve Bank of Boston after 2013. Then the search query for her would be:

> (AU = "McDonald, Katherine" or AU = McDonald, KR or AU = "McDonald, K") and (PY = (2003-2018)) and (OG = "University of Kansas" or OG = "University of Chicago" or OG = "Federal Reserve Bank – Boston")

The search with the name "McDonald, KR" would results in all the records with the full name "McDonald, Katherine R." For people without a middle name (or middle name is not found), the search using last name and first name initials would result in records with same last name but not same first name. For example, paper published by McDonald, Kathy or McDonald, Kevin are likely to be found. Economics papers published before 2006 and Health economics paper published in health journals are more likely to be published in name initials.

After searching and downloading the result files from WOS for each person, we put the data together and hand-validated publications using information from the CVs. We use author's full names, field, institutions and journals to find the false records.

There are several potential limitations to our data. First, the data collection is based on online searches. Second, because of the query limitations in WOS, we cannot simply use the WOS search results only. The search queries vary by each person. Some searches returned zero records, and required updating. The screening process may have introduced coding errors. Most of the CV searches were done in 2017, however publications were found in WOS through the third quarter of 2018.