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# LOST IN THE STORM: THE ACADEMIC COLLABORATIONS THAT WENT MISSING IN HURRICANE ISSAC*

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By exploiting the cancellation of the 2012 American Political Science Association Annual Meeting, we investigate the role of conferences in facilitating academic collaboration. We assembled data sets comprising 17,467 academics, and in difference-in-differences analysis we find that the conference cancellation led to a decrease in individuals' likelihood of co-authoring an article with another attendant by 16%. Moreover, collaborations formed among attendants of (occurring) conferences are associated with more successful co-publications: an effect which is sharpest for teams that are new or non-collocated. Conferences seem to de-cluster the co-authorship network. Altogether, our findings demonstrate the importance of conferences in scientific production.

A phenomenon observed across all scientific disciplines – as noted for example by Wuchty *et al.* (2007) – is the increasing prevalence of collaborative endeavour. An existing literature (Jones, 2009; Gans and Murray, 2014; Agrawal *et al.*, 2016) has attributed this trend to the increasing challenges associated with pushing further outwards at the existing frontiers of knowledge, and of producing work generally at the standards required for success in an increasingly competitive academic environment. Co-authors bring, to a project, a wider pool of ideas and of specialist expertise, and scientific productivity therefore depends on co-authors becoming efficiently matched. And yet, there is also strong evidence, provided in Freeman and Huang (2015), that some of the most productive scientific collaborations arise the least readily.

In this article, we measure the extent to which academic conferences facilitate collaborations generally, and productive collaborations particularly. By exploiting a 'natural experiment' – the last-minute cancellation, due to 'Hurricane Isaac', of the 2012 American Political Science Association (APSA) Annual Meeting – we are able to estimate the number and character of the collaborations that 'went missing'. From these estimates, we draw inferences about the specific role of conferences in the formation of new scientific work, and also, more generally, about the role of network constraints in causing inefficient biases in co-author matchings.

The APSA meeting gathers around 3,000 presenters every year, and by the time of its cancellation in 2012 the conference programme had been arranged and published. Our main hypothesis is that the cancellation decreased individuals' chances of collaborating with another conference participant. We run standard difference-in-

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difference regressions, examining the likelihood of collaboration among participants in the APSA conference in the 2009–12 editions and using as a 'control' the chance of collaboration among participants attending a comparator conference (the Midwest Political Science Association Annual Meeting). To conduct this analysis, we assembled new data sets including 17,467 academics (attendants of the relevant meetings) and around 86 million dyads of participants. This sample is representative of research active academics in the field of political science, accounting for 22% of published authors during the period. We matched these data sets to co-authored working papers and published articles to infer the occurrence of a collaboration.

We find that the 2012 APSA meeting cancellation led to a 16% decrease in individuals' likelihood of co-authoring an output with another conference participant, and moreover that it was specifically the likelihood of collaborating with an academic affiliated to a different institution that fell. In our regressions, we include controls for individual fixed effects and several covariates to control for individuals' time-varying productivity and propensity to collaborate. Our findings are robust to several econometric specifications and sample classifications. (Moreover, in online Appendix A, we provide evidence that there were no systematic changes in attendants' characteristics across 'treatment' and 'control' conferences in the year of the cancellation.)

We also find that collaborations forged between the attendants of occurring conferences lead to better publication outcomes. Of collaborations manifested as journal publications, those that were among academics scheduled to attend the cancelled meeting appeared, on average, in journals ranked five places lower than those that were among academics that attended a conference that actually took place. Pairs of collaborators that are not collocated are the ones that benefit most from conferences, in terms of improving their ranking of publication. In principle, this premium may be driven either by academics finding more suitable co-authors in academic meetings, or by already nascent collaborations benefiting from the face-to-face interaction afforded by the conference. Our evidence points to the first of these explanations. In particular, we observe that occurring conferences reduce 'clustering' (the tendency for one's direct contacts to also be direct contacts of each other) within the relevant co-authorship networks. Altogether, it seems that conferences help academics to find and sustain productive collaborations that are otherwise difficult to find and sustain: collaborations outside their existing institution or clique.

To our knowledge, this is the first article that quantifies effects of conferences in the formation of academic collaborations, using quasi-experimental evidence.[1] Chai and Freeman (2017) also infer positive conference effects, but by a different approach: comparing patterns of collaboration among attendees of the Gordon Research Conferences with patterns among a matched group of non-conference attendees. Outside of a typical conference setting, Boudreau *et al.* (2017) implemented a field experiment at Harvard Medical School to understand how search costs (within one institution) affect the

[1] Previous papers have however used experimental data to understand other forms of conference effect. Leon and McQuillin (2016) used the same data and setting as the current article to look at conference effects on the academic impact (as measured by citations) of presented papers. Blau *et al.* (2010) investigated the success of CeMENT – a mentoring workshop, arguably similar to a small conference, for female assistant professors – in increasing participants' publications and successful grant publications, based on randomised controlled trial data.

formation of collaborations. Within a grant opportunity informational event, individuals were randomly assigned to small brainstorm sessions, and participants were subsequently 75% more likely to write a grant application with an academic assigned to the same brainstorm room than with someone assigned to a different room.

Our results also contribute to a broader and growing literature on the determinants of the formation of academic collaborations.[2] A strand within this literature seeks to understand the role of communication costs and network constraints in determining patterns of academic collaborations.[3] Agrawal and Goldfarb (2008) and Ding *et al.* (2010) show that the introduction of Bitnet (an early version of the Internet) led to substantial increases in the rates of multi-institutional collaborations. Concomitantly, as shown in Kim *et al.* (2009), the research productivity effects of being placed in a top university diminished, as academics' dependency on colleagues, as possible co-authors, declined. Even so, it seems that opportunities for face-to-face interaction remain important: Boudreau *et al.* (2017) evidence this, and Catalini *et al.* (2016) show that decreasing air travel costs have also facilitated collaboration. A survey conducted by Freeman *et al.* (2015) suggests that, still, most academic collaborations are among (presently or previously) collocated authors and, therefore, that network constraints remain significant in affecting collaborations. Our results suggest that even a single conference relaxes these constraints with discernible effect.

We develop the remainder of the article as follows. In Section 1, we explain the data and describe the natural experiment. In Section 2, we present the estimates of conference effects. We conclude, in Section 3, with some interpretative discussion.

## 1. Data

### 1.1. *Background*

The APSA is a professional association of political science in the United States, and it publishes one of the preeminent journals in its field: *The American Political Science Review*. Its Annual Meeting is held immediately preceding Labor Day (in September) and gathers authors (from more than 700 institutions) of close to 3,000 working papers to be presented in 52 main themes, encompassing a very broad spectrum of approaches and research topics across the field of political science.

The 2012 APSA meeting was due to take place in New Orleans and was scheduled to start on August 30. However, it was cancelled at less than 48 hours' notice due to the approach of 'Hurricane Isaac'. By the time of this cancellation, and indeed well before any genesis of tropical cyclone Isaac itself, the conference programme was finalised and publicly available.[4] The cancellation generated a group of participants who did not experience the network benefits of the meeting. Our main hypothesis is that the individuals within this group (named in the 2012 APSA Meeting Programme) became

[2] See Furman and Gaule (2013) and Freeman *et al.* (2015), for useful surveys.

[3] Another part of the literature – see Fafchamps *et al.* (2010) and Freeman and Huang (2015) – examines the role of academics' preferences in determining collaborations.

[4] The synoptic history for Hurricane Isaac is provided in Berg (2013). An atmospheric trough that started developing west of Africa on 16–17 August, manifested to a 'tropical storm' by 21 August. A state of emergency was declared for Louisiana on 26 August.

less likely to form subsequent in-group collaborations than individuals in the groups that attended occurring conferences.

To quantify conference impacts, we conduct difference-in-differences regressions using data on conference participants from the 2009–12 editions. This strategy is similar to the one we use in Leon and McQuillin (2016). We use, as a baseline group, collaborations formed among participants at a comparator conference: the Midwest Political Science Association (MPSA) Annual Meeting. The MPSA is also a professional association of political science scholars in the United States, and it publishes another leading journal within the discipline: *The American Journal of Political Science*. The APSA and the MPSA meetings are the largest conferences in the field of political science. They are similar in profile and almost identical in format. Each is a four-day event consisting of panels, posters, workshops, evening sessions, roundtables and panel sessions, including four presenting papers, discussants and a chair. Moreover, because the MPSA meeting (held in April) precedes the APSA meeting, the 2012 MPSA attendance would not have been impacted by the APSA cancellation.

A difference between the meetings is that the APSA is also an important job-market event. The job-market aspect of the meeting occurs in parallel to the conference presentations and was also cancelled in 2012 due to Hurricane Isaac. In subsection 2.1, we discuss in detail how job-market effects from this cancellation could have interacted with the impacts investigated in this article.

### 1.2. *Data Sources and Sample*

We collected information on APSA and MPSA conference participants, from the meeting programmes available on the respective associations' websites.[5] The programmes describe, for each session within the conference, the names and affiliations of the session chair(s) and discussants(s), and for each presenting paper within the session the names and affiliations of all of the authors. Also recorded is the theme with which the session is associated, and title (sub-theme) of the session.[6]

For presenting papers with more than one author, the conference programmes do not distinguish the presenting author, and therefore in our main analyses we will have included some 'conference participants' who, as non-presenting co-authors, did not actually attend. (Note that for a paper to be listed in the programme, at least one of the authors must pay the registration fee.) Our main sample includes all individuals named in panel sessions, as an author, a chair or a discussant. We also present the results for the subset of 'sure participants': the 69% of conference participants who appear within the programme as a sole-author, chair or discussant.[7] For ease of

[5] In addition, the MPSA provided us with programme information in a cleaner electronic format.

[6] The APSA meeting has 52 main theme panels (that contain 90% of the articles) and 70 remaining themes that vary per year. In Table A1 in online Appendix A, we describe the Top 30 and Top 10 most populated themes in terms of papers for the two meeting series. There are close similarities, between the series, in the themes that concentrate most papers.

[7] Within the two conferences, panel sessions concentrate most of the presenting authors. 70.8% of presenting papers are single-authored. By including individuals named in co-authored papers in our analysis, we may underestimate the conference effect, because we are likely to include authors who did not attend the conference. However, by excluding these papers, we also underestimate the conference effect because we thereby exclude individuals that have a higher intrinsic likelihood to work in teams.

exposition, we refer to all individuals listed in the APSA/MPSA Annual Meeting Programmes from 2009–12 (i.e. including those in the cancelled conference) as 'participants' in the respective conference.

The assembled data set comprises 39,586 conference-authors and 17,467 individuals. (Individuals often attend many conferences. An individual who attended three conferences appears, in our data set, as one individual – 'Adam Adams' – and as three conference-authors: 'APSA2009-Adam Adams', 'MPSA2011-Adam Adams' and 'APSA2012-Adam Adams'.) In our analysis, we examine the data at two levels:

(*i*) at the conference-author level in which the outcome is an indicator for whether the individual comes to collaborate with someone in the same conference; and
(*ii*) at the conference-author pair (dyad) level, where the outcome is whether the pair collaborates after the conference (and also whether the pair generates an output with specific characteristics).

The number of observations is described in Table 1. For example, the 2009 APSA Meeting entailed a total of 4,007 participants (column (1)) and, therefore, $4{,}007 \times 4{,}006/2 = 8{,}026{,}021$ potential collaboration dyads (column (2)). However, we ignored collaborations formed among co-authors in a paper presented in the attending conference. This was to avoid the risk of misinterpreting a conference effect on the publication outcome of the presented paper as an impact on the formation of new work (the phenomenon of interest in this article).[8] Hence, when analysing the data at the dyad level, we disregarded these pairs (12,313 dyads across eight conferences),

Table 1
*Number of Observations*

| | Conference-authors | Conference-author dyads | |
|---|---|---|---|
| | All | All | Prospective collaborations |
| Level: | (1) | (2) | (3) |
| APSA2009 | 4,007 | 8,026,021 | 8,024,911 |
| APSA2010 | 4,248 | 9,020,628 | 9,019,366 |
| APSA2011 | 4,356 | 9,485,190 | 9,483,754 |
| APSA2012 | 4,203 | 8,830,503 | 8,829,026 |
| MPSA2009 | 4,925 | 12,125,350 | 12,123,789 |
| MPSA2010 | 5,175 | 13,387,725 | 13,385,997 |
| MPSA2011 | 5,024 | 12,617,776 | 12,615,967 |
| MPSA2012 | 5,018 | 12,587,653 | 12,585,723 |
| Total | 36,956 | 86,080,846 | 86,068,533 |

*Note.* The number of prospective collaborations (in column (3)) is given by the number of conference-author dyads that have not collaborated in a paper presented in the conference.

[8] In Leon and McQuillin (2016), we document other effects of the 2012 APSA cancellation: articles became less likely to be cited.

and focused on the remaining number, shown in column (3). This exclusion comes at the expense of shutting down another possible channel of conference effect: on ongoing collaborations that might get reinforced, and turned into new research projects, because of feedback and suggestions offered during the conference.

To look for collaborations, we assembled a data set of working papers and published papers in political science, using the Social Science Research Network (SSRN) and the Web of Science (WoS). The set of working papers comprises all papers posted in the SSRN Political Science Network from January 1996 to September 2015. The set of published papers comprises all articles published in the 155 WoS political science journals and in the top 20 WoS journals in economics, sociology, law, history and international relations from 2004 to 2016.[9] The list of journals is detailed in online Appendix A. The sets include 113,895 working papers and 199,692 published papers, respectively.

### 1.3. *Linking Data Sets*

We linked the SSRN and WoS data to conference participants using individuals' first and last name. A complication, in using this rule, is that some names are not unique among published authors or among conference participants, potentially leading to misattributions of collaborations (based on co-publications). There are, within our set of conference participants, 493 first-name/last-name combinations that appear with more than one associated middle initial across the set of all conference participants and WoS authors. (For example, we may have both a Jenny A Jones and a Jenny B Jones among the conference participants, or – more frequently – a Jenny Jones among the conference participants and both a Jenny A Jones and a Jenny B Jones among the WoS published authors.) We categorised these names as ' ambiguous' and checked by hand all co-publications involving someone with an ambiguous name. In addition, in online Appendix A we replicate all results excluding individuals with common surnames, and the estimates are largely unchanged.[10]

### 1.4. *Measures of Collaboration and Explanatory Variables*

Our main dependent variable and measure of collaboration is the existence of a co-authored paper after the conference, in a form of a SSRN working paper or a WoS published paper. A key decision was the time frame within which to look for such collaborations. Our main interest is in collaborative outputs that may have been in some sense generated by a conference, and we judged that papers appearing very soon after a conference (less than one year for a working paper, or less than approximately two and a half years for a published paper) were likely to reflect work that had been substantially completed by the time of the conference itself. We consider, for each

[9] The additional WoS categories were chosen because they were the most frequent, aside from Political Science, among the publications of a random sample of conference attendants.

[10] In Table A2 in online Appendix A, we provide the list of 'common surnames'. To determine these names, we used the SSRN data set, within which authors have a unique identifier. We classified as a 'common surname', a surname shared by more than 30 SSRN authors, and using this threshold authors with 'common surnames' accounted for 6% of total authors in SSRN. We tested other thresholds, but in all cases obtained, within our analyses, similar coefficients and p-values.

conference, working papers appearing in a two-year window commencing one year after the conference, so to control as much as possible for the time difference across the conferences. However, to ensure that we include, for each conference, the same number of issues from each journal, we based our observation window for published papers on calendar years, and we therefore consider published papers appearing in the two complete calendar years commencing between two and three years after the conference. These time frames are described in Table 2.

In terms of explanatory variables, from the WoS data, we recover conference-author characteristics, as observed in a five-year window prior to their attendance in the conference. These are as follows: the number of previous publications weighted by journal impact factor, the number of previous collaborators and the number of previous collaborators attending the same conference. From the conference programmes, we recovered each conference-author's affiliation and we associated geographic coordinates,[11] an affiliation ranking and affiliation 'size'. Affiliation rankings, coded 1–200 and 'below top 200', were taken from Hix (2004). The 'size' was based on the number of individuals (with a given affiliation) within the eight conferences (APSA2009–12 and MPSA 2009–12). For each conference-author pair, we additionally calculated the spatial distance between affiliation coordinates (using the 'geodist' command in Stata).

### 1.5. *Summary Statistics*

In Table 3, we present summary statistics describing the set of conference-authors. Most of the authors are affiliated to an institution in the US (81%), and they are roughly equally divided (30.9%, 30.3% and 38.5%) between institutions ranked, respectively, in the top 50, 51–200 and outside the top 200. Less than a third have co-authored an article (31.8%) and the average number of previous publications in the sample is 1.32. The median participant has not published, or co-authored, a paper before the conference. However, the meetings also gather experienced authors. The

Table 2

*Timeframe for Collaboration Outcome*

| Conference | SSRN working paper | Publication |
|---|---|---|
| APSA 2009 | September 2010–August 2012 | January 2012–December 2013 |
| APSA 2010 | September 2011–August 2013 | January 2013–December 2014 |
| APSA 2011 | September 2012–August 2014 | January 2014–December 2015 |
| APSA 2012 | September 2013–August 2015 | January 2015–December 2016 |
| MPSA 2009 | April 2010–March 2012 | January 2012–December 2013 |
| MPSA 2010 | April 2011–March 2013 | January 2013–December 2014 |
| MPSA 2011 | April 2012–March 2014 | January 2014–December 2015 |
| MPSA 2012 | April 2013–March 2015 | January 2015–December 2016 |

*Note.* The realisation of a collaboration was assumed if a co-authored paper was found in date-windows described in Table 2.

[11] We obtained a location address from a geographic online database (OpenStreetMap.org) and extracted the coordinates of these locations using Nominatim (nominatim.openstreetmap.org/).

Table 3

*Descriptives of Conference-authors' Characteristics*

| | All ($n$ = 36,956) | | | | | | APSA ($n$ = 16,814) | MPSA ($n$ = 20,142) |
|---|---|---|---|---|---|---|---|---|
| | | | Centiles | | | | | |
| Sample: | Mean | SD | 50th | 75th | 90th | 95th | Mean | |
| Affiliation rank: | | | | | | | | |
| 1–50 | 30.9% | 0.46 | 0.0 | 1.0 | 1.0 | 1.0 | 32.7% | 29.5% |
| 51–100 | 15.6% | 0.36 | 0.0 | 0.0 | 1.0 | 1.0 | 15.7% | 15.5% |
| 101–150 | 10.5% | 0.31 | 0.0 | 0.0 | 1.0 | 1.0 | 11.0% | 10.0% |
| 151–200 | 4.2% | 0.20 | 0.0 | 0.0 | 0.0 | 1.0 | 3.9% | 4.4% |
| >200 | 38.5% | 0.49 | 0.0 | 1.0 | 1.0 | 1.0 | 36.0% | 40.5% |
| At least one previous co-author (dummy) | 31.8% | 0.47 | 0.0 | 1.0 | 1.0 | 1.0 | 37.1% | 27.4% |
| No. previous co-authors | 1.52 | 3.46 | 0.0 | 2.0 | 5.0 | 8.0 | 1.74 | 1.34 |
| Co-author in the conference (dummy) | 28.3% | 0.45 | 0.0 | 1.0 | 1.0 | 1.0 | 33.0% | 24.3% |
| No. previous co-authors in the conference | 0.75 | 1.69 | 0.0 | 1.0 | 3.0 | 4.0 | 0.85 | 0.66 |
| No. publications | 1.32 | 2.55 | 0.0 | 2.0 | 4.0 | 6.0 | 1.66 | 1.03 |
| No. publications weighted by impact factor | 1.93 | 4.28 | 0.0 | 2.2 | 6.3 | 9.8 | 2.45 | 1.49 |
| Impact factor of best publication | 1.90 | 1.10 | 1.7 | 2.6 | 3.3 | 3.8 | 1.94 | 1.85 |
| Based in the US (dummy) | 80.9% | 0.39 | 1.0 | 1.0 | 1.0 | 1.0 | 78.2% | 83.1% |
| *Outcome*: | | | | | | | | |
| Collaborate with another author in the conference (dummy) | 15.6% | 0.36 | 0.0 | 0.0 | 1.0 | 1.0 | 17.0% | 14.5% |

*Notes*. The statistics shown for the impact factor of best publication are based only on conference-authors with a previous publication (14,779 conference-authors, 8,206 in the APSA and 6,573 in the MPSA). The outcome excludes subsequent collaborations with co-author(s) in a paper presented in the conference.

academic in the 90th centile (95th centile) has published four papers (six papers) in the five years preceding the conference, and has three (four) previous co-authors also attending the conference. In terms of outcomes, 15% of conference-authors subsequently co-author a paper with another participant in the conference.[12] In Table A3 in online Appendix A, we provide a picture of types of participants that come to collaborate. Conference collaborations are more likely to occur among academics that have closer research (are assigned to the same session and that have papers in the same theme), that work in the same institution and have collaborated before.

In the last two columns in Table 3, we present separate means for participants in the APSA (treatment) and MPSA (control) meetings. The MPSA meeting has a larger number of participants (and presenting papers) than the APSA: 5,035 *versus* 4,200

[12] Recall that this proportion excludes collaborations subsequently formed among co-authors in the paper presented in the conference and it is based on a two-year window (Table 2), that is narrower than the five-year window used for control variables, such as the number of previous co-authors.

participants, on average. This difference reflects in participants' profiles: MPSA participants have fewer previous publications on average (1.03 *versus* 1.66) and fewer co-authors (1.34 *versus* 1.74). The diff-in-diff approach that we are using controls for systematic differences across conferences, such as different standards for article (and author) acceptance. In our main regressions, we control for individual fixed effects, but it is also appropriate to check that the peer environments in neither the treated (APSA) nor control (MPSA) meeting series changed in any systematic way in 2012.[13] We test for whether participants' pre-determined characteristics evolved in parallel over conference-years by running standard diff-in-diff regressions on these characteristics. We use, as dependent variables, several author characteristics predictive of collaborative behaviour (including previous collaborations and publication record). The results are reported in Table A4 in online Appendix A. For most variables, we find no statistically significant effect and the p-values associated to the 2012 APSA coefficient are large. The parallel conference series trends are also noticeable visually in Figures A1 in online Appendix A.

## 2. Results

This Section is organised as follows: in subsection 2.1, we provide a descriptive visualisation of the conference impacts, and we examine impacts at the conference-author level, to further illustrate the magnitudes of the effects for individual academics. We investigate conference effects on the likelihood of the formation of academic collaborations and we examine related broader impacts on academics' publication portfolios. Then, in subsection 2.2 we move the analysis to the dyad level to investigate the types of collaborations facilitated by a conference, and to examine the productivity of these collaboration-types. In subsection 2.3, we introduce some basic network analysis as a step to understanding the mechanisms underlying the results.

### 2.1. *Effects of Conferences on Academic Collaborations*

We begin by investigating how the 2012 APSA Meeting cancellation affected the likelihood of academic collaborations. Figures 1 and 2 illustrate this impact in terms of simple averages. Figure 1 shows the number of unique pairwise collaborations, as a percentage of possible pairwise collaborations, formed among conference participants. Of course, the chance of an individual forming a collaboration with a random participant in these conferences is very small. In the APSA 2009, the likelihood was around six out of 100,000 possible pairs of collaborators. A simple diff-in-diff

[13] One specific concern related to an early campaign against holding the 2012 APSA meeting in Louisiana, due to the state's refusal to recognise same-sex marriages. Within this campaign, 1,109 academics signed a petition advocating a boycott, approximately half of whom are in our data set. It transpired that, indeed, very few (only 30) of these registered to attend the 2012 meeting in New Orleans. However, we find no evidence – as shown in Figure A2 in online Appendix A – that the petitioners became, in turn, more likely to attend the 2012 MPSA instead (a potential threat to identification), or indeed that the petitioners differ in observables from the average conference participant in our sample. (These last findings are not shown, but are available under request.)

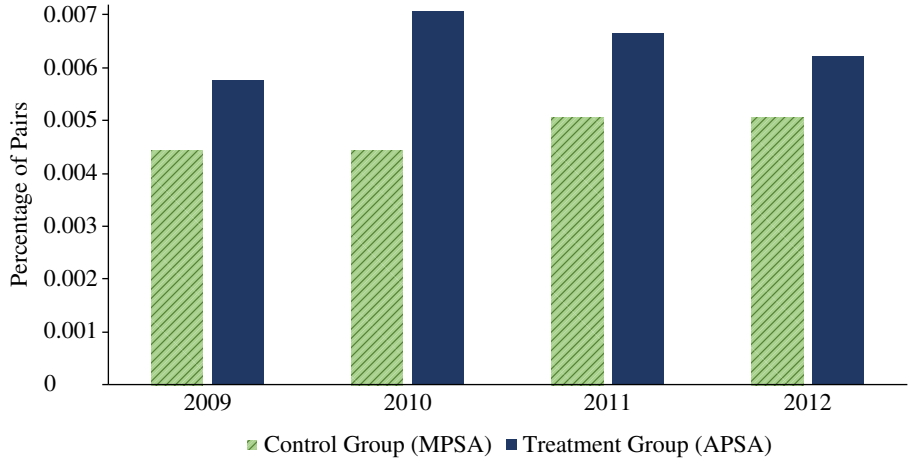


Fig. 1. *Percentage of Conference-author Pairs with Subsequent Collaborations*
*Note.* Colour figure can be viewed at wileyonlinelibrary.com.

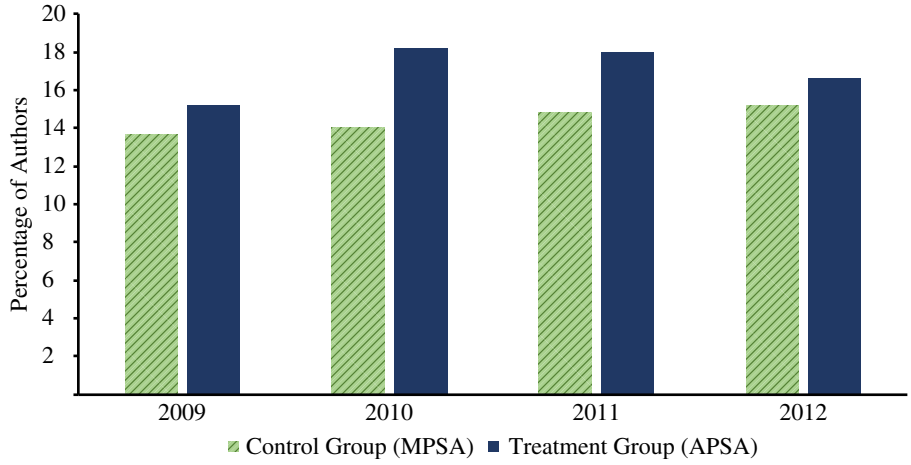


Fig. 2. *Percentage of Authors Subsequently Collaborating (with Another Conference Author)*
*Note.* Colour figure can be viewed at wileyonlinelibrary.com.

calculation indicates that this chance fell in the 2012 APSA Meeting: reflecting that 76 pairwise collaborations were lost due to the 2012 cancellation. In Figure 2, we show the effects at conference-author level (by aggregating pairwise collaborations). The graph shows the percentage of academics that subsequently co-author at least one article with another participant in the conference, and suggests that this percentage decreased by 1.6 percentage points as a consequence of the conference cancellation.

Next, we investigate the effects of conferences on authors' chance of forming collaborations in a more controlled way. We estimate (1) using a linear probability regression (OLS):

$$Collaboration_{ist} = \alpha + \beta_1[s = APSA][t = 2012] + \beta_2[s = APSA] + \sum_{T=2010}^{2012} \theta_T[t = T] + \phi_i + \lambda \mathbf{X}_{it} + v_{ist}, \quad (1)$$

where, $i$ indexes for individual, $s \in \{APSA, MPSA\}$ for conference series and $t \in \{2009, 2010, 2011, 2012\}$ for conference year. An observation corresponds to a conference-author (a combination of individual, conference series and year). $Collaboration_{ist}$ is an indicator for whether the conference-author subsequently collaborated with another participant in the same meeting (the same conference series and year). The dummies $[s = APSA]$ and $[t = T]$ indicate respectively whether the conference-author is associated with an APSA meeting, and with a year $T$ meeting. The terms $\phi_i$, $\mathbf{X}_{it}$, and $v_{ist}$ denote, respectively, individual fixed effects, a vector for time-varying author characteristics (the number of previous publications weighted by journal impact factor, the number of previous co-authors, previous co-authors with attendants in the same conference and size of affiliated institution), and a random term. Robust standard errors are clustered at the individual level.

The results are shown in the first row of Table 4. The diff-in-diff estimates indicate that the 2012 APSA cancellation led to a decrease in the likelihood of authors subsequently collaborating with others in the conference by 2.4 percentage points, around 16%. (So a conference increases the likelihood of collaboration by 18%.) The estimates of this effect are robust to using time-varying controls (columns (3) and (6)) and to restricting the sample to 'sure-participants' (columns (4)–(6)).[14]

The next rows in Table 4 show three different classifications for the collaboration outcome. First (rows (2)–(3)), by collocation *versus* non-collocation: i.e. showing the conference effect on authors' likelihood of forming a subsequent collaboration with another meeting participant:

(*i*) from their own institution; and then
(*ii*) from a different institution.

Second (rows (4)–(6)), by a proxy for research-closeness: author's likelihood of forming a subsequent collaboration with another meeting participant:

(*i*) from her own session(s) within the conference;
(*ii*) from a session in the same theme; and then
(*iii*) in a session from a different theme.

And third (rows (7)–(8)), by distinguishing between existing and new co-authors.

It is unclear whether the originally observed effect is present among collocated co-authorships: the coefficients are no longer significantly different from zero (and indeed change their sign within the sure-participant sub-sample). But the effect is detected among inter-institutional co-authorships: it is specifically the likelihood of forming a collaboration with an author from a different institution that fell, by 17–25%.

[14] In Table A5 in online Appendix A we show estimated impacts for the entire sample, weighting observations by the likelihood that the individual was at the conference. We use a probability of one for sure-participants (solo-authors, chairs and discussants) and of $1/n$ for other authors, where, for each author $x$, $n$ is the lowest number of co-authors for a paper that includes $x$ among the co-authors presented at the conference.

Table 4

*Effects of Conferences on the Formation of Academic Collaborations*

| Sample: | All Participants ($n$ = 36,956) | | | Sure-participants ($n$ = 25,433) | | |
|---|---|---|---|---|---|---|
| | Mean dependent variable | 2012 APSA estimates | | Mean dependent variable | 2012 APSA estimates | |
| Outcomes: | (1) | (2) | (3) | (4) | (5) | (6) |
| Formed a collaboration with another ... | | | | | | |
| (1) Conference participant | 0.1563 | −0.0241 (0.0088)*** | −0.0236 (0.0088)*** | 0.1389 | −0.0244 (0.0107)** | −0.0230 (0.0107)** |
| Formed a collaboration with another conference participant ... | | | | | | |
| (2) From the same institution | 0.0584 | −0.0085 (0.0064) | −0.0099 (0.0064) | 0.0521 | 0.0029 (0.0077) | 0.0046 (0.0077) |
| (3) From a different institution | 0.1205 | −0.0219 (0.0083)*** | −0.0200 (0.0083)** | 0.1062 | −0.0268 (0.0101)*** | −0.0253 (0.0100)** |
| Formed a collaboration with another conference participant ... | | | | | | |
| (4) In the same session | 0.0181 | −0.0020 (0.0043) | −0.0012 (0.0043) | 0.0177 | 0.0012 (0.0054) | 0.0020 (0.0054) |
| (5) In the same theme | 0.0489 | −0.0247 (0.0069)*** | −0.0240 (0.0069)*** | 0.0478 | −0.0121 (0.0083) | −0.0115 (0.0084) |
| (6) In a different theme | 0.1281 | −0.0119 (0.0087) | −0.0117 (0.0087) | 0.1112 | −0.0188 (0.0106)* | −0.0177 (0.0106)* |
| Formed a collaboration with another conference participant ... | | | | | | |
| (7) Who is an existing co-author | 0.0343 | −0.0052 (0.0054) | −0.0076 (0.0054) | 0.0291 | −0.0090 (0.0065) | −0.0105 (0.0065) |
| (8) Who is a new co-author | 0.1405 | −0.0185 (0.0084)** | −0.0165 (0.0084)** | 0.1255 | −0.0163 (0.0103) | −0.0134 (0.0104) |
| Time-varying controls? | | No | Yes | | No | Yes |

*Notes.* The unit of observation is at the conference-author level. Each entry in columns (2), (3), (5) and (6) represents OLS estimates for the 2012 APSA coefficient from a separate regression. Outcomes are indicators for whether the conference-author has come to collaborate with someone with the specific characteristics. All regressions include author fixed effects. Time varying controls include: total number of previous publications weighted by journal impact factor, number of previous co-authors, previous co-authors attending the same conference, and the size of own institution (as explained in subsection 1.4). The definition of 'sure-participant' is explained in subsection 1.2. Robust standard errors clustered at the individual level are in parentheses. ***Significant at the 1% level. **Significant at the 5% level. *Significant at the 10% level.

The results in rows (5)–(6) suggest that conferences mainly facilitate collaborations between academics already working on closely related topics (indicated here by having a paper in the same theme): doubling the likelihood of such a collaboration. Curiously, however, the results in row (4) do not seem to indicate that conferences facilitate collaborations specifically between authors assigned to the same session.[15] Finally, comparing rows (7) and (8), it seems to be that conferences facilitate collaborations

[15] We also did not detect effects of conferences increasing the chance of collaboration between within-session presenters-and-discussants, presenters-and-presenters, or presenters-and-chairs. (These results are not reported, but available under request.) These finding contrasts somewhat with the strong in-session effects reported in Boudreau *et al.* (2017).

Table 5

*Effects of Conferences on Authors' Publication Portfolio*

| 2012 APSA estimates | | | | |
|---|---|---|---|---|
| | Full sample | *n* | Excluding authors attending both conferences | *n* |
| Dependent variable: | (1) | (2) | (3) | (4) |
| (1) No. published papers | −0.0102 | 36,956 | −0.0288 | 26,328 |
| | (0.0206) | | (0.0391) | |
| | [0.621] | | [0.462] | |
| (2) No. co-published papers | −0.0053 | 36,956 | −0.0152 | 26,328 |
| | (0.0162) | | (0.0311) | |
| | [0.743] | | [0.624] | |
| (3) No. co-published papers with a conference author | −0.0236 | 36,956 | −0.0389 | 26,328 |
| | (0.0154) | | (0.0250) | |
| | [0.126] | | [0.121] | |
| (4) No. co-published papers without a conference author | 0.0182 | 36,956 | 0.0237 | 26,328 |
| | (0.0138) | | (0.0213) | |
| | [0.187] | | [0.267] | |
| (5) No. single-authored papers | −0.0049 | 36,956 | −0.0136 | 26,328 |
| | (0.0127) | | (0.0243) | |
| | [0.702] | | [0.577] | |
| (6) No. co-authors per paper | 0.0080 | 13,010 | 0.0449 | 7,544 |
| | (0.0206) | | (0.0615) | |
| | [0.697] | | [0.466] | |
| (7) No. new co-authors | 0.0162 | 36,956 | 0.0083 | 26,328 |
| | (0.0239) | | (0.0448) | |
| | [0.497] | | [0.851] | |
| (8) No. new co-authors that went to the conference | −0.0245 | 36,956 | −0.0559 | 26,328 |
| | (0.0135)* | | (0.0201)*** | |
| | [0.070] | | [0.005] | |

*Notes.* The unit of observation is at the conference-author level. The sample specified in columns (3) and (4) excludes conference-participants that attend both the APSA and the MPSA in the same year. 'Conference author' refers to an author attending the same conference. The variable no. co-authors per paper was calculated for the sample of authors that published at least one paper. Each entry in columns (1) and (3) represents OLS estimates for the 2012 APSA coefficient from a separate regression. All regressions include author fixed effects, number of previous publications weighted by journal impact factor, the number of previous co-authors and previous co-authors with attendants in the same conference and size of affiliated institution. Robust standard errors clustered at the individual level are in parentheses, and p-values are in square brackets. ***Significant at the 1% level. **Significant at the 5% level. *Significant at the 10% level.

between new, rather than existing, co-authors. However, statistically significant results are only detected for the full sample, with higher p-values for the sample of sure-participants (columns (5) and (6)) or when observations are weighted based on individuals' likelihood of attending the conference (Table A5).

Altogether, therefore, the results in Table 4 suggest that conferences facilitate collaborations between participants at the conference, and that these are collaborations between individuals with closely related existing research interests and who are not collocated.

We next, in Table 5, consider whether collaborative outputs triggered by the conference represent an overall boost to academics' productivity in terms of published papers, or rather a displacement of other co-authors and projects. We estimate (1), using

as the dependent variable various counts relating to the conference-author's published papers (within the same window as used for the analyses in Table 4).[16] These include counts of published papers, co-published papers (in total and also disaggregated to papers with and without a conference co-author) and sole-authored papers. They also include the average number of co-authors (per paper) in an author's portfolio, and counts of the conference-author's 'new' co-authors (co-authors not appearing in any co-authored paper preceding the conference) and new co-authors from the conference.

It should be noted that, in this analysis, it is natural to exclude from consideration authors that attended both the MPSA and APSA conferences in a given conference year. This is because several outcome measures will necessarily be the same for the MPSA conference-author as for the APSA conference-author.[17] Though we report results for the full sample in column (1), we show results excluding authors that attended both conferences in column (2).

Few of the estimated impacts in Table 5 are statistically significant, and indeed it seems reasonable that the consequence of missing one conference will be scarcely discernible in this bigger picture. However, the signs of coefficients are suggestive of a co-author substitution effect. Rows (3)–(4) show negative coefficients for the effect of the 2012 APSA cancellation on the numbers of published papers that are co-authored with a conference co-author ($p = 12.6\%$), and positive coefficients for the effects on the number of co-published papers with someone that is not in the conference programme ($p = 18.7\%$). The coefficients in row (7) suggest that 2012 APSA conference-authors were also able, notwithstanding the conference cancellation, to find new co-authors. The significant result in row (8) corroborates the findings in Table 4: the meeting cancellation made it less likely that a 2012 APSA conference-author found a new co-author from within the conference cohort.

A natural interpretation of the results is that conferences are an important instrument for networking and affect the formation of collaborations. However, we also need to consider whether the effects above may be mediated by other conference effects.

Leon and McQuillin (2016) suggest that papers' probability of becoming cited within two years was reduced by the APSA conference cancellation. So it is possible, in principle, that authors whose work gains recognition by being presented at a conference subsequently (due to this recognition) enjoy better opportunities to collaborate. Notice, however, that this advertisement effect would be noticed on authors' overall chance to collaborate and this is not noticed in Table 5, rows (2)–(4), (6) or (7).

Also, the APSA meeting is regarded as a significant event within the US political-science job-market. Alongside and separately to the conference, the APSA provides space and facilities for employers to interview job-market candidates. These interviews

[16] To avoid picking up a possible effect of the 2012 APSA Meeting on the probability that the paper presented in the conference becomes published, we excluded from the pool of published papers, the paper presented in the conference: i.e. published papers with both the same authorship and a 'similar' title to that of the conference paper. Title 'similarity' is determined using an algorithm developed and explained in Leon and McQuillin (2016): in essence, two titles are viewed as similar if enough (50%) of short, five-character sub-strings coincide.

[17] This exclusion was not necessary in the analyses of Table 4, but for comparison we have nevertheless replicated, in Table A6 in online Appendix A, the analyses on the sub-sample of authors who did not attend both conferences.

play a preliminary, sifting function (i.e. screening candidates for a campus flyout – described in Basu, 2012) for positions that are generally advertised to commence one year later, at the start of the following academic year. So the meeting potentially plays an important role in effecting efficient matches between US job-market candidates and academic employers. The overall proportion of candidates in the 2012/3 job market that secured positions (either as post-docs or as faculty) in academia exactly matched that of candidates in the 2011/2 and 2013/4 job markets,[18] but it remains possible that the proportion of *job candidates who were presenting at the APSA meeting* that remained in academia fell, or that the quality of candidate-employer matches in some sense diminished. We do not detect evidence consistent with such effects in the data: in particular, one would expect any effect mediated by conference-authors leaving academia or joining ill-fitted departments to have been observed consistently across measures in Table 5. As an additional check, in Table A7 in online Appendix A, we report results on likelihood of producing future publications (as a proxy for remaining in academia) for conference-authors with no previous publications (as a proxy for being in early career): in this, the effects of the APSA 2012 cancellation are weak, and ambiguous in direction.[19]

### 2.2. *Pair Level Analysis*: *Effects of Conferences on Collaborations and Quality of Co-publications*

For additional insights, we turn to analyses at the conference-author-pair (dyad) level. In particular, our analysis at this level – in Table 6 – is suggestive of a conference effect both in terms of increasing the likelihood of collaboration and in terms of the quality of the co-authored output.[20] Controls used in the regression include, firstly, dummy indicators for whether the authors have the same affiliation and whether they are previous co-authors. Further controls are proxies for productivity and propensity to collaborate. These are all measures at the author-level, but are included (at the dyad level) both as the average and as the absolute difference within the pair: the authors' total number of previous publications weighted by journal impact factor, the number of authors' previous co-authors, and size of own institution. To account for the

[18] See American Political Science Association (2015). Relative to 2011/2 and 2013/4, there was a small decrease in the proportion of candidates securing faculty positions, but an offsetting increase in the proportion of candidates securing post-doc positions.

[19] We also need to consider whether the control group (in particular 2012 MPSA participants) may have been affected: for example, whether academics in departments that made fewer, or 'worse' hires from the 2012/3 job-market cohort may have become more likely to seek out collaborations from within (occurring) conferences. Notice, however, that such academics would have only started to notice the effect of the 2012 conference cancellation through hires in September 2013, and so, by this chanel, it would have been collaborations emerging from the 2013 and 2014 conferences, not included in our analysis that would have been mainly been affected.

[20] In Table 6, we estimate (2) using a linear probability regression (OLS):

$$Collaboration_{\{[ij]st\}} = \alpha + \beta_1[s = APSA][t = 2012] + \beta_2[s = APSA] + \sum_{T=2010}^{2012} \theta_T[t = T] + \lambda \mathbf{Z}_{\{[ij]t\}} + v_{\{[ij]st\}}, \quad (2)$$

where, $\{ij\}$ indexes for a conference-author pair, $s$ for conference series and $t$ for conference year. An observation corresponds to a conference-author-dyad (a combination of author pair, conference series and year). $Collaboration_{\{[ij]st\}}$ is an indicator for whether the conference-author-dyad subsequently collaborated. The terms $\mathbf{Z}_{\{[ij]t\}}$ and $v_{\{[ij]st\}}$ denote, respectively, time-varying dyad characteristic controls, and a random term.

Table 6

*Likelihood and Outcomes of Collaborations Formed among Conference Participants*

| Dependent variable: | | | Strand of co-publication | | | |
|---|---|---|---|---|---|---|
| | A collaboration (1) | A co-publication (2) | Top 25% (3) | 25–50% (4) | 50–75% (5) | Bottom 75% (6) |
| Panel (*a*): sample: all dyads ($n$ = 86,068,533) | | | | | | |
| 2012 APSA estimates | −0.0000074 | −0.0000058 | −0.0000066 | −0.0000006 | 0.0000016 | −0.0000002 |
| | (0.0000038)** | (0.00000346)* | (0.00000188)*** | (0.00000213) | (0.00000188) | (0.0000008) |
| Panel (*b*): sample: dyads in the same theme ($n$ = 5,785,415) | | | | | | |
| 2012 APSA estimates | −0.0001649 | −0.0001221 | −0.0000727 | −0.0000007 | −0.0000338 | −0.0000148 |
| | (0.0000588)*** | (0.0000517)** | (0.000026)*** | (0.0000356) | (0.0000258) | (0.0000101) |

| Dependent variable: | Journal | | Strand of co-publication | | | |
|---|---|---|---|---|---|---|
| | Ranking (1) | Impact factor (2) | Top 25% (3) | 25–50% (4) | 50–75% (5) | Bottom 75% (6) |
| Panel (*c*): sample: dyads that co-published an article ($n$ = 3,828) | | | | | | |
| 2012 APSA estimates | 5.0316 | −0.1927 | −0.0906 | 0.0226 | 0.0690 | −0.0011 |
| | (2.2875)** | (0.0698)*** | (0.0318)*** | (0.0358) | (0.0348)** | (0.0143) |

*Notes.* The unit of observation is at the pair level. The outcome in column (1), panels (*a*) and (*b*), refers to an indicator for whether the pair has produced a joint SSRN working paper or co-published a paper in the timeframe detailed in Table 2. The dependent variables in columns (3)–(6) are indicators for whether the pair has co-published a paper according to the impact factor journal quartile. The reported estimates comes from linear probability regressions (OLS) including controls for same affiliation (dummy), previous co-authors (dummy), number of previous publications weighted by journal impact factor (average and absolute difference), number of previous co-authors (average and absolute difference), and affiliation size (average and absolute difference). In panel (*a*), robust standard errors are in parentheses. In panels (*b*) and (*c*), standard errors in parentheses are dyadic cluster-robust (Cameron and Miller, 2014). ***Significant at the 1% level. **Significant at the 5% level. *Significant at the 10% level.

dependence of the observations related to the dyadic setting, we use a two-way cluster robust estimator of standard error at the level of the two persons in the pair (Cameron and Miller, 2014).

In Table 6, panel (*a*), we consider the sample of all pairs of participants ($n$ = 86,068,533). In column (1), we show the conference effect on the likelihood of a collaboration among a pair. In column (2), we focus on the chance of a co-publication only. In both cases the coefficients are negative (i.e. suggesting that the cancellation led to a reduced likelihood of collaboration), and they are statistically significant at the 5% level and 10% level respectively. In the remaining panel (*a*) columns, we decompose the likelihood of a co-published paper into the chance of a co-publication in journals in the first, second, third and fourth quartiles, by impact factor. We observe a statistically significant effect of the 2012 APSA Meeting cancellation: decreasing the chance of publication in a top quartile journal. In panel (*b*), we restrict the data to pairs in the same theme-session, therefore focusing on dyads of more probable collaborators.[21] The estimated impacts corroborate the ones in panel (*a*) and become stronger, with lower p-values for the diff-in-diff coefficients.

In Table 6 panel (*c*), we restrict the data to dyads that produced a co-publication ($n$ = 3,828). In the regressions, we use – as dependent variables – the journal ranking of the co-publication (varying from 1 to 149), the normalised journal impact factor and indicators for publication among journal impact factor quartiles. The estimates indicate that collaborations among 2012 APSA meeting participants led to co-publications placed, on average, in journals that are 5.03 points lower-ranked (column (1)) and whose impact factor is 0.19 standard deviations lower (column (2)). The results for publication-quartile resemble the ones in panels (*a*) and (*b*), suggesting in particular that co-publications among 2012 APSA meeting participants were shifted to lower ranked journals because of the conference cancellation. They were less likely to be placed in first-quartile journals (by 9.1 percentage points) and more likely to be published in second (by 2.3 percentage points), and third-quartile journals (by 6.9 percentage points).

In Table 7, we further explore the findings above. We ask which types of collaborations specifically benefitted from the conferences (or were most negatively impacted by the cancellation). Repeating the analysis of Table 6 panel (*c*), we again use as the dependent variable the normalised impact factor of the journal within which the co-publishing dyad's output appears (in column (1)) and the journal ranking (column (2)).[22] However, we now run separate OLS regressions splitting the sample:

(*i*) into 'existing' *versus* 'new' co-authors, in rows (1)–(2);
(*ii*) into pairs that are 'collocated' *versus* 'non-collocated', in rows (3)–(4); and
(*iii*) into pairs whose authors are based in the same *versus* in a different country, in rows (5)–(6).

[21] Out of all 86,068,533 possible dyads in panel (*a*), only 3,828 came to collaborate, giving a success rate of 0.004%; while out of 5,785,415 dyads of participants in panel (*b*), the success rate is 0.016%.

[22] If the pair co-published more than one paper, we considered the paper with the highest journal impact factor.

Table 7

*Publication Outcomes of Collaborations Formed among Conference Participants by Pair Characteristics*

| | 2012 APSA estimates | | | | |
|---|---|---|---|---|---|
| | Journal impact factor | | Journal ranking | | |
| Outcome: | Coefficient | SE | Coefficient | SE | *n* |
| Sample split criteria: | (1) | | (2) | | |
| (1) Existing co-authors | 0.0393 | 0.1490 | 0.5740 | 4.6068 | 640 |
| (2) New co-authors | −0.2358 | 0.0763*** | 6.0344 | 2.5652** | 3,198 |
| (3) In the same institution (collocated) | −0.0554 | 0.1409 | 3.0693 | 4.0159 | 1,106 |
| (4) In a different institution (non-collocated) | −0.2554 | 0.0790*** | 6.2025 | 2.6310** | 2,732 |
| (5) In the same country | −0.1755 | 0.0732** | 4.9387 | 2.4199** | 3,281 |
| (6) In a different country | −0.2619 | 0.1727 | 5.6672 | 5.9425 | 557 |
| (7) Existing co-authors (wider window) | −0.2379 | 0.1095** | 8.3123 | 3.3404** | 1,213 |
| (8) New co-authors (wider window) | −0.1674 | 0.0821** | 3.5290 | 2.8237 | 2,623 |

*Notes.* The unit of observation is at the pair level and the sample is composed by pairs that co-published a paper subsequent to the conference. Each row in the table represents estimates for the 2012 APSA coefficient from a separate regression. All regressions include controls for number of previous publications weighted by journal impact factor (average and absolute difference), number of previous co-authors (average and absolute difference), and affiliation size (average and absolute difference). The classification of 'existing/new co-author' in rows (1) and (2) involves co-authorships realised between $[t-5, t-1]$. The classification of 'existing/new co-author' (wider) in rows (7) and (8) involve co-authorships realised between $[t-5, t+2]$. Standard errors are dyadic cluster-robust (Cameron and Miller, 2014). ***Significant at the 1% level. **Significant at the 5% level. *Significant at the 10% level.

We only detect statistically significant conference effects for collaborations formed between pairs that are non-collocated and that have not previously co-authored a paper (new co-authors).[23] We regard these results as providing suggestive evidence for differential effects (although it should be noted that a test for the null hypothesis of equality of coefficients across sub-samples in Table 7 produces high p-values).

In rows (7) and (8), we redefine 'existing' co-authors to include also those that co-author a paper that becomes published between the conference date and the start of our WoS observation window. We surmise that these authors are unlikely to have met (for the first time) within the conference, and indeed that by the time of the conference their collaboration is likely to have been well-established. Once 'existing' becomes a wider class (and 'new' correspondingly narrower), the conference effect on productivity becomes statistically significant for both groups: new and existing co-authors.

### 2.3. *Mechanisms*

A key question is then: why are collaborations formed within the cohorts of occurring conferences associated with better publication outcomes? We conjecture two main

[23] The results are robust to the use of alternative econometric models, as shown in Tables A8–A9 in online Appendix A.

possible explanations. One explanation is that conferences cause changes to patterns of co-authorship, in a direction which is in turn productivity-enhancing. An alternative explanation is that the conference itself provides an important opportunity for co-authors to meet, discuss and generally improve their work. The eventual outputs are better because of the face-to-face interaction between the co-authors that takes place within the conference.

The loci of benefit identified above (in Table 7) can be viewed as consistent with either of these two suggested mechanisms. Co-authors that are collocated or that have previous experience collaborating together are unlikely to have depended on the conference as an opportunity for face-to-face interaction to the same extent to as those that are non-collocated or newly collaborating. On the other hand, if a conference can help an author to find the right co-author then it is most likely to do so for authors looking for a new co-author, outside their own institution.

To disentangle the mechanisms, we conduct two further analyses. First, we look for conference effects on measures of clustering in collaboration networks, following a similar methodology used in Goyal *et al.* (2006) and Fafchamps *et al.* (2010).[24] We know (from the results in Table 6) that the conference cancellation did not affect the number of new co-authors with whom an author subsequently published, but it changed their identity (away from co-authors that went to the conference). We therefore want to test whether the new co-authors subsequent to the cancellation were, to a greater extent than subsequent to an occurring conference, already within the conference-authors' collaboration circle. In other words: do conferences help to de-cluster authorship networks?

To investigate this, we constructed two co-authorship networks, based on WoS authorships, associated with each conference year. In these networks, the nodes are given by the set $N$ of all published authors (in our WoS data set). In the two networks – $G_{1t}$ and $G_{2t}$ – associated to the conference taking place in year $t$, the links represent co-authorships in the calendar years from $t-5$ until, respectively, $t+2$ (the seven calendar years preceding our WoS observation period) and $t+4$ (including also our observation period). For any $i \in N$, we use $\mathcal{N}_i(G)$ to denote the set of authors with whom $i$ has a link in the network $G$ (i.e. the set of $i$'s co-authors in the relevant period), and $\eta_i(G) \equiv |\mathcal{N}_i(G)|$ to denote the degree of $i$. We then use $C_i(G)$, to denote the clustering coefficient for $i$ in the network $G$: i.e. the measure of tendency for $i$'s co-authors to be co-authors with each other:

$$C_i(G) \equiv \frac{\left|\left\{(j,k) : j \in \mathcal{N}_i(G), k \in \mathcal{N}_i(G) \cap \mathcal{N}_j(G)\right\}\right|}{\eta_i(G)[\eta_i(G)-1]}.$$

Subsets of nodes $N_{st} \subset N$ represent conference-authors from conference series $s \in \{MPSA, APSA\}$, year $t$. We use $C_{st}(G)$ to denote the global clustering coefficient calculated on the set $N_{st}$: i.e. the overall measure of tendency for of authors in the $st$ conference to work within cliques. Notice that we calculate the global coefficient using a weighted average over authors in the respective conference, of these authors' individual coefficients within the wider network of all published authors:

[24] Goyal *et al.* (2006) and Fafchamps *et al.* (2010) analyse co-authorship network formation focusing on authors in the field of Economics.

$$C_{st}(G) \equiv \frac{\sum_{i \in N_{st}:\eta_i(G)\geqslant 2} \left|\left\{(j,k) : j \in \mathcal{N}_i(G), k \in \mathcal{N}_i(G) \cap \mathcal{N}_j(G)\right\}\right|}{\sum_{i \in N_{st}:\eta_i(G)\geqslant 2} \eta_i(G)[\eta_i(G)-1]}.$$

In Table 8 we report, for each conference series $s$ and year $t$, the global clustering coefficients on the relevant cohorts of authors, at the start and at the end of our WoS observation period: $C_{st}(G_{1t})$ and $C_{st}(G_{2t})$, respectively. Our interest is in how the global coefficient changes during the observation period, accounting for new authorship links during the observational period, so we also report $C_{st}(G_{2t}) - C_{st}(G_{1t})$ and we illustrate this variable in Figure 3.

For all cohorts, the global clustering coefficient falls during the observation period (Table 8, columns (3) and (6)), but it is striking that, among the APSA cohorts, the fall for the APSA 2012 conference authors is smallest.

To investigate this in a controlled way, we replicate the analysis we presented in Table 5, but use, as the dependent variable associated with author $i$, conference series $s$, year $t$, $C_i(G_{2t})$. In the regression, we control for the clustering coefficient $C_i(G_{1t})$, constructed using links formed before the observation period. The results are reported in Table 9. The positive and statistically significant coefficients associated with the APSA 2012 coefficient (p = 10.7% and 4% in columns (1) and (3), respectively) support a claim that conferences help to 'de-cluster' co-authorships networks: an effect which could plausibly account for an increase in co-authorship productivity.

This account fits well with the finding in Table 7 (rows (2) and (8)) of conference effects on productivity that prevail upon the pool of new collaborations. However, the conference effect on the productivity of 'existing' co-authorships (Table 7, row (7)), could have be driven either by these co-authors holding beneficial discussions within the conference, or by a similar switching to that between new co-authors. By meeting at

Table 8

*Global Clustering Coefficients by Conference*

| Conference series ($s$): clustering coefficient: | APSA | | | MPSA | | |
|---|---|---|---|---|---|---|
| | $C_{st}(G_{1t})$ (1) | $C_{st}(G_{2t})$ (2) | (3) = (2) − (1) | $C_{st}(G_{1t})$ (4) | $C_{st}(G_{2t})$ (5) | (6) = (5) − (4) |
| Conference year ($t$): | | | | | | |
| 2009 | 0.3158 | 0.2688 | −0.0469 | 0.2835 | 0.2582 | −0.0252 |
| 2010 | 0.2886 | 0.2484 | −0.0402 | 0.2732 | 0.2514 | −0.0218 |
| 2011 | 0.2663 | 0.2276 | −0.0387 | 0.2606 | 0.2181 | −0.0425 |
| 2012 | 0.2399 | 0.2100 | −0.0299 | 0.2326 | 0.2012 | −0.0314 |

*Notes.* The table reports, for each conference series ($s$) and each conference year ($t$), the global clustering coefficients $C_{st}$ ($G_{1t}$) and $C_{st}$ ($G_{2t}$) and the difference between these. Columns (1) and (4) refer to co-authorship network $G_1$, calculated using WoS published authors as nodes and co-authorship links, including nine years of all publications, from $t - 5$ to $t + 2$, where t is the year of the conference. Columns (2) and (5) refer to co-authorship network $G_2$, calculated using WoS published authors as nodes and co-authorship links, including nine years of all publications, from $t - 5$ to $t + 4$, where $t$ is the year of the conference.

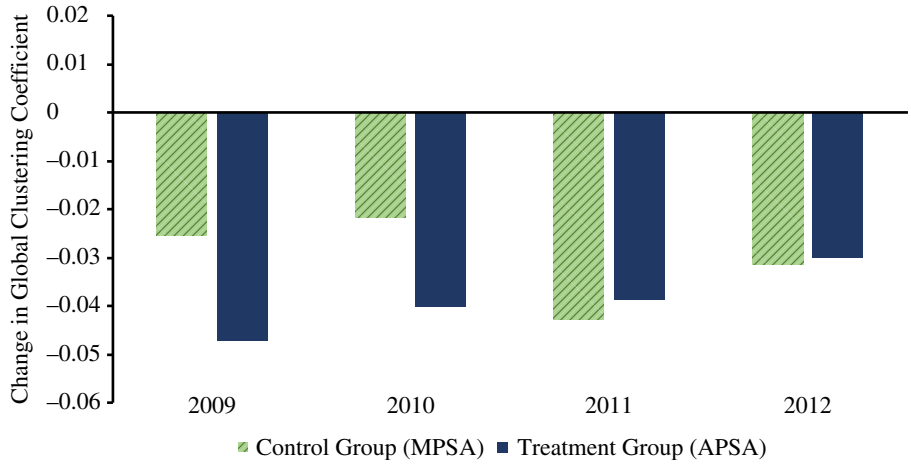


Fig. 3. *Change in Global Clustering Coefficient*
*Note*. Colour figure can be viewed at wileyonlinelibrary.com.

Table 9
*Effects of Conferences on Authors' Clustering Coefficient*

| | 2012 APSA estimates | | | |
|---|---|---|---|---|
| | Full sample | *n* | Excluding authors attending both conferences | *n* |
| Dependent variable: | (1) | (2) | (3) | (4) |
| Clustering coefficient | 0.0056<br>(0.0034)<br>[0.107] | 11,250 | 0.0211<br>(0.0102)**<br>[0.040] | 5,954 |

*Notes*. The unit of observation is at the conference-author level. The sample specified in columns (3) and (4) excludes conference-participants that attend both the APSA and the MPSA in the same year. Each entry represents OLS estimates for the 2012 APSA coefficient from a separate regression. The dependent variable is the clustering coefficient for network $G_2$. The co-authorship network $G_2$ was calculated, using WoS published authors as nodes and co-authorship links, including nine years of all publications, from $t - 5$ to $t + 4$, where $t$ is the year of the conference. All regressions include author fixed effects, number of previous publications weighted by journal impact factor, the number of previous co-authors and previous co-authors with attendants in the same conference and size of affiliated institution, and for the clustering coefficient calculated for network $G_1$. Robust standard errors clustered at the individual level are in parentheses, and p-values are in square brackets. ***Significant at the 1% level. **Significant at the 5% level. *Significant at the 10% level.

the conference, authors may have been able to revive productive but harder-to-sustain (perhaps non-collocated) existing collaborations.[25]

[25] It is possible that new collaborations may have replaced existing collaborations, but we do not find evidence for this, as shown in Table A10 in online Appendix A. In Table A10 report estimated effects of the 2012 APSA cancellation on the composition of occurred co-authorships, and there is no detected effect of a decrease in the likelihood of pairs of 'new co-authors' (by either classification). The results show instead that occurring conferences lead to subsequent collaborations between authors whose existing research is more closely related, and that are more likely to be based in different countries. The collaborations that had the best chance of 'surviving' the conference cancellation were those in which both authors were in large-institutions.

Table 10

*Effects of Face-to-face Meeting on Articles' Publication Outcomes*

| | Published (1) | | | Impact factor of co-publication (2) | | | |
|---|---|---|---|---|---|---|---|
| Outcome: | Coefficient | SE | *n* | Coefficient | SE | *n* | Sample: co-authored papers written by... |
| (1) 2012 APSA | −0.0080 | 0.0381 | 1,028 | −0.5254 | 0.6430 | 59 | (I) at least two sure-participants |
| (2) 2012 APSA | −0.0180 | 0.0154 | 3,710 | 0.3297 | 0.3036 | 147 | (II) only one sure-participant |
| (3) 2012 APSA x (At least two sure-participants) | 0.0097 | 0.0410 | 4,738 | −0.8644 | 0.7088 | 206 | Pooled: (I) + (II) |

*Notes.* The unit of observation is the paper presented in the conference and the data is restricted to co-authored conference papers with at least one sure-participant. Each entry represents OLS estimates from a separate regression. The coefficients reported in rows (1) and (2) are diff-in-diff estimates for the 2012 APSA Meeting, for subsamples. These regressions include controls for whether the paper was presented at the APSA Meeting, year dummies and the number of authors in the paper. The coefficients reported in row (3) are triple differences estimates, reflecting the differential effect of 2012 APSA Meeting among the subsample 'at least two sure-participants'. The regressions for the pooled sample include the additional controls: an indicator for whether the paper was written by at least two sure-participants, and pairwise interactions between the 2012 year dummy, the indicator for whether the paper was presented at the APSA Meeting and the indicator for whether the paper was written by at least two sure-participants. We restrict the sample of published papers to be those published in the window $[t + 1, t + 4]$, where $t$ is the year of the conference. We assume a conference paper is published if there is a published paper, in this window, with the same authorship and a 'title overlap' of at least 50%. In Leon and McQuillin (2016), we explain the algorithm that determines whether two titles meet this overlap threshold. ***Significant at the 1% level. **Significant at the 5% level. *Significant at the 10% level.

We therefore test also for evidence of a face-to-face interaction benefit on the quality of existing outputs, holding constant the match quality of co-authors. To do this, we look into the set of papers presented at the conferences. We examine whether co-authored papers in which at least two of the authors were at conference (at least two 'sure participants') and, therefore, could have benefited from a face-to-face discussion, were more harmed by the 2012 APSA meeting cancellation than co-authored conference papers in which only one 'sure participant' was present at the conference. We consider as outcomes the likelihood of the paper becoming published and, for papers that were published, the journal impact factor of the publication. The results are reported in Table 10. Rows (1) and (2) describe the 2012 APSA diff-in-diff estimates for separate samples: papers authored by at least two sure participants and papers authored by only one sure author, respectively. Row (3) shows results for the pooled sample, for which we report the results for the triple difference coefficient, for a differential effect of the 2012 APSA Meeting cancellation on publication outcome for papers co-authored by more than one 'sure-participant'. We do not detect any statistical difference between these groups, nor any significant effect in the data.

Altogether, of the two mechanisms we have proposed, the thesis that conferences improve matching of co-authors corresponds best with our evidence.

## 3. Discussion

We have found that the cancellation of the 2012 APSA meeting reduced participants' likelihood of subsequently co-authoring a paper with another scheduled participant at the meeting. It particularly reduced the likelihood of forming an inter-institutional collaboration. We have also observed that collaborations formed among participants in occurring conferences were associated with better publication outcomes than those formed among the participants of the conference that was cancelled. This seems to have been because an occurring conference improves the matching of co-authors, by enabling authors to find and sustain productive collaborations, outside their own institution and existing authorship network.

There is no question that conferences feature prominently in academic and scientific life. Our findings give scientific corroboration to the previously untested (but commonly held) supposition that conferences are commensurably instrumental in the formation of scientific work, providing a platform for academics to meet, and subsequently collaborate with others that are geographically and socially distant.

To some extent, our findings also throw light on broader issues in a literature that more generally explores team formation and network effects in scientific production. Freeman and Huang (2015) have suggested that the characteristics of collaborations that are most productive are not necessarily the characteristics that are most commonly observed.[26] There could be two reasons for this. It could be that that the teams that commonly arise are relatively inefficient, and that working with distant co-authors improves the potential for a project; or it could be instead that the scientist's decision to work with different (new, less usual) co-authors is itself endogenous to the potential of the project. The fact that, in our results, an exogenously induced reduction in inter-institutional collaboration seems to have dented publication outcomes, could be viewed as support for the first of these two accounts. This then begs a further question: why do academics or scientists not reach out beyond their usual (for example, collocated) pool of co-authors more often? The answer could lie in communication (or other) costs,[27] or it could lie in network constraints that affect the pattern of co-author matching and, therefore, reduce scientific productivity. A conference represents a (slight) relaxation of network constraints, and so the fact that academics respond by increasingly forming productive, inter-institutional and new collaborations suggests that (to some degree at least), the networks account lies behind existing inefficiencies.

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[26] Specifically, they find that ethnic similarity within authorship teams exceeds that which would be predicted by random allocation, while simultaneously being associated with publication in lower impact journals and with fewer citations.

[27] In fact, Agrawal and Goldfarb (2008) provide evidence in this regard.

Additional Supporting Information may be found in the online version of this article:

**Appendix A.** Other Figures and Tests.
**Data S1.**

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