Ten Years of the
Partnerships in
International Research
and Education (PIRE)
Program

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Overview

- NSF’s PIRE Program
- Evaluation Objectives, Data Sources and Methods
  - Constructing a project-level comparison group
  - Constructing participant-level comparison group
- Key Findings
  - Research outcomes
  - U.S. graduate student experiences
  - U.S. institutional support for graduate students’ international opportunities
- Limitations
The PIRE program

- Supports intellectually substantive collaborations between U.S. and foreign researchers in which **the international partnership is essential** to the research effort

- Provides international opportunities to early-career researchers and students

- Awards last a minimum of 5 years

- Per-award funding: $2.5m to $5m per award

- 59 awards were made in the first 4 cohorts (2005, 2007, 2010, 2012)
PIRE Program Goals

- Catalyze long-term, sustainable international partnerships
- Prepare next generation of U.S. scientists and engineers for global engagement
- Produce a strong record of research excellence
Evaluation Objectives

- Examine the effectiveness of PIRE using an appropriate comparison group
- Measure the research outcomes of PIRE
- Describe participant experiences
Data Sources (1)

- NSF Administrative Data
- Award databases
  - Program solicitations
- PIs’ annual, final reports

Identify Publications

Identify Participants

Bibliometric Data from Thomson Reuters’ Web of Science

- Project’s resulting publications
  - Citation impacts
  - % foreign contributors per paper

- Participants’ pre- and post-onset
  - # of publications
  - Citation impacts
  - % foreign contributors per paper
Data Sources (2)

- NSF Administrative Data
- Award databases
  - Program solicitations
- PIs’ annual, final reports

Identify Participants

Identify Comparison Projects

Survey Data
- PIs, Postdocs, Graduate Students, Undergraduates, Foreign Senior Investigators

Participants’ Experiences
- Collaborations with foreign partners (before, after project)
- Travel & activities abroad
- Benefits, challenges of participation
- Career/educational outcomes
The purpose of a comparison group is to represent the counterfactual:

What would occur in the absence of PIRE?

- How much and what kind of international collaboration?
- What quantity and quality of research?
Matching PIRE-Comparison Projects

- **Goal:** Match each of 59 PIRE projects to another NSF-funded project using criteria that were likely correlated with the key outcomes.

- We restricted the comparison group to other NSF programs where:
  - International collaboration was possible.
  - But international collaboration was *not required* by the NSF program as a condition of award.
STEP 1

Filter all non-PIRE NSF awards that match a PIRE project on initial criteria:

NSF awards 2003 - 2014

Find awards where, compared to the PIRE project:

- Research fields similar
- Award $ ± 20%
- Duration ± 12 months
- Project starts ± 12 months
- Project ends ± 12 months
- Continuing grant

Initial Candidates for Comparison Group
Screen each candidate comparison project

- Scrutinize research fields further:
  - Review project abstract, proposal, reports
  - PhD disciplines of key personnel
- Must be a research grant (e.g., not equipment purchase grant)
- Must include ≥ 2 different institutions (US or foreign)
- Must include graduate student participants
- Program could *allow or encourage* international collaboration, but could not *require* it
STEP 3

- If multiple matches, select grant with closest match on research fields

- If no match, return to Step 1, expand criteria to generate new candidates
  - Add other research fields
  - Expand award amount to ± 25%
  - Expand start, end dates to ± 24 months
  - Expand duration to ± 24 months
  - Add standard grant to eligible award type
Results of Project Level Matching

Matched 55 of the 59 PIRE projects

- MPS: 36%
- GEO: 11%
- BIO: 18%
- CISE, SBE, EHR: 26%
- ENG: 9%

<table>
<thead>
<tr>
<th>Award amount of the comparison project</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within 20% of PIRE award</td>
<td>91%</td>
</tr>
<tr>
<td>Within 21-25% of PIRE award</td>
<td>9%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Duration</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within 0-12 months of PIRE project's duration</td>
<td>87%</td>
</tr>
<tr>
<td>Within 13-24 months of PIRE project's duration</td>
<td>13%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Program’s emphasis on international collaboration</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not mentioned in solicitation</td>
<td>56%</td>
</tr>
<tr>
<td>Encouraged</td>
<td>29%</td>
</tr>
<tr>
<td>Mentioned as optional</td>
<td>15%</td>
</tr>
</tbody>
</table>
Citation Impact of PIRE journal articles

- PIRE articles have above average citation impact (average field-Normalized Citation Impact, NCI = 1.8; 1.0=World average)

![Chart showing citation impact distribution](chart.png)
PIRE and Comparison Project Journal Articles

- No differences between PIRE, comparison group publication quantity or citation impact ($p > .05$)
- PIRE publications had significantly higher mean percentage of foreign contributors per paper than comparison group ($p < .01$)

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Mean PIRE</th>
<th>Mean Comparison</th>
<th>Difference</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of articles per project</td>
<td>29</td>
<td>25</td>
<td>4</td>
<td>0.33</td>
</tr>
<tr>
<td>Field Normalized Citation Impact (NCI)</td>
<td>1.6</td>
<td>1.7</td>
<td>-0.1</td>
<td>0.62</td>
</tr>
<tr>
<td>Journal NCI</td>
<td>1.2</td>
<td>1.3</td>
<td>-0.1</td>
<td>0.45</td>
</tr>
<tr>
<td>% foreign institutions on articles produced by matched project pairs</td>
<td>35%</td>
<td>17%</td>
<td>18</td>
<td>&lt; .01</td>
</tr>
<tr>
<td>% foreign authors on articles (2009 +) produced by matched project pairs</td>
<td>29%</td>
<td>13%</td>
<td>15</td>
<td>&lt; .01</td>
</tr>
</tbody>
</table>

Sources: Annual reports submitted by PIs to NSF; Thomson Reuters’ Web of Science
PARTICIPANT EXPERIENCES

<table>
<thead>
<tr>
<th>Survey Response Rates</th>
<th>PIRE</th>
<th>Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIs</td>
<td>58%</td>
<td>56%</td>
</tr>
<tr>
<td>Postdocs</td>
<td>55%</td>
<td>50%</td>
</tr>
<tr>
<td>Graduate Students</td>
<td>54%</td>
<td>47%</td>
</tr>
</tbody>
</table>
Significantly higher percentages of PIRE participants than comparison group participants traveled abroad for their project.

**p < .01
### PIRE and Comparison Graduate Students who Traveled Abroad

<table>
<thead>
<tr>
<th></th>
<th>PIRE</th>
<th>COMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average number of trips abroad</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Average duration of trips abroad, in weeks</td>
<td>11</td>
<td>5</td>
</tr>
<tr>
<td>Longest trip abroad, in weeks</td>
<td>13</td>
<td>6</td>
</tr>
</tbody>
</table>
Collaborations During the Project With U.S. and non-U.S. Personnel

- Higher percentages of PIRE than comparison group participants collaborated with foreign personnel

<table>
<thead>
<tr>
<th></th>
<th>PIs</th>
<th>Postdocs</th>
<th>Graduate students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within the U.S.: PIRE</td>
<td>97</td>
<td>100*</td>
<td>95**</td>
</tr>
<tr>
<td>Within the U.S.: Comparison</td>
<td>99</td>
<td>96</td>
<td>100</td>
</tr>
<tr>
<td>Outside the U.S.: PIRE</td>
<td>96**</td>
<td>78**</td>
<td>81**</td>
</tr>
<tr>
<td>Outside the U.S.: Comparison</td>
<td>44</td>
<td>36</td>
<td>30</td>
</tr>
</tbody>
</table>

**p<.01
Continued Collaborations With Foreign Researchers Post-Project

- Higher percentages of PIRE PIs and graduate students continued to collaborate with foreign researchers after the project had ended\(^a\)

\[\text{Percent} \]

\begin{tabular}{l|c|c|c}
& PIs & Postdocs & Graduate Students \\
With foreign former project member & 29 & 12 & 31** \\
With other foreign researcher (not affiliated with the project) & 65** & 55 & 34** \\
\end{tabular}

\(\text{PIs, Postdocs, Graduate Students}\)

\(^a\) i.e., after the award end date, or after the participant’s role in project had concluded. Analyses restricted to those who reported a collaboration during the project with a foreign researcher.

\(^{**p<.01}\)
What effect did PIRE have on its graduate students’ research outcomes?

- Compared the difference in pre- and post-onset publication record for PIRE versus comparison graduate students
- Restricted to journal articles published by June 2014 in Thomson Reuters’ Web of Science
Matching PIRE-Comparison Participants

- Within matched project pairs, we matched individual participants (postdoctoral researchers, graduate students) on outcomes prior to onset of participation (“pre-onset”) in the project
  - Starting year of participation in project
  - Number of publications per year
  - Average citation impact of publications

- Goal: < .25 standardized mean difference
Pre-onset Participant Level Matching

- PIRE-Comparison group graduate students were well-matched on pre-onset measures before testing for post-onset differences in research outcomes.

<table>
<thead>
<tr>
<th></th>
<th>Pre-onset standardized differences</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Start Year</td>
</tr>
<tr>
<td>Graduate students</td>
<td>0.20</td>
</tr>
</tbody>
</table>

*Using the average field normalized citation impact across a participant’s articles published before participation in the PIRE or comparison project*
Impact of PIRE on Graduate Students’ Research Outcomes

- PIRE graduate students produced more annual publications post-onset than comparison group graduate students ($p<.01$)
- No statistically significant difference between PIRE, comparison graduate students’ post-onset citation impact
PIRE graduate students’ publications had a greater percentage of foreign contributors on average, but this difference was not statistically significant.

<table>
<thead>
<tr>
<th>Respondent Group</th>
<th>Adjusted Mean Percentage of Non-U.S. Institutional Affiliations for Post-Onset Publications $^a$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PIs</td>
</tr>
<tr>
<td>Pls</td>
<td>16</td>
</tr>
<tr>
<td>Postdocs</td>
<td>16</td>
</tr>
<tr>
<td>Graduate students</td>
<td>17</td>
</tr>
</tbody>
</table>
### Subsequent Postdoctoral Appointments

<table>
<thead>
<tr>
<th>Former Graduate Student Participants</th>
<th>PIRE</th>
<th>Comparison</th>
<th>Difference</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ever had a postdoctoral appointment</td>
<td>60%</td>
<td>70%</td>
<td>-9.4</td>
<td>0.206</td>
</tr>
<tr>
<td>Had a postdoctoral appointment outside the U.S.</td>
<td>31%</td>
<td>17%</td>
<td>13.9</td>
<td>0.089</td>
</tr>
</tbody>
</table>
The opportunity to observe the way in which research is conducted abroad has helped inform my scientific approach in many ways. Most importantly, I now structure my research being mindful of the methods and techniques that are globally available so that my work can be reproduced outside of the US. My scientific …writing and speaking are much clearer now that I have interacted so closely with international researchers.

-- PIRE graduate student
In their own words

Like any field, collaborations are driven by relationships. Relationships are underpinned by trust and understanding between two parties. In the case of "foreign" parties, working and living in an international setting is critical in developing such understanding. Even if one's work remains in the US, it is highly probable that one's colleagues have foreign origins, and shared experiences in foreign countries is one of the most direct routes to developing a positive relationship.

-- PIRE graduate student
Limitations

- Because the study used a non-experimental comparison group, interpretation of these results requires caution.

- Research outcomes were limited to journal articles, likely under-representing some disciplines’ research output.

- Difficult to locate former graduate students, especially those who leave academia.
Summary

- PIRE engages postdocs, graduate & undergraduate participants in on-site international research

- PIRE fosters meaningful international collaborations, and participants continue to collaborate globally afterward

- On average, PIRE projects have produced research equivalent in impact to that of other NSF-funded research projects, with greater proportions of foreign co-authorship

- PIRE increases postdocs’ and grad students’ research productivity and the impact of postdocs’ publications.
Acknowledgements

Study participants: PIs, postdocs, graduate students from PIRE and comparison projects, PIRE undergraduates and foreign senior investigators, administrators at PIRE awardee institutions

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