Publishing while female
Are women held to higher standards?
Evidence from peer review.

Erin Hengel
University of Liverpool

Gender Economics Workshop, DIW Berlin
18 October 2018
Background

**Women are underrepresented in economics**

- Roughly 25–30 percent of PhDs, assistant professors and associate professors.
- Almost 15 percent of full professors (Lundberg, 2017).
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Women are really underrepresented at top journals

- In 2015, the average ratio of female authors was 15 percent. Only 7.5 percent of papers were majority female-authored. Just 4 percent were written entirely by women.
- *QJE* did not publish a single exclusively female-authored paper in 2015…or 2016…or 2017…
- …in several recent years, *Econometrica* and *JPE* have not either.
Is peer review in economics affirmative action for men?

Women are not creating the ideas we publish in top journals.
Background

Is peer review in economics affirmative action for men?

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Women are held to higher standards

- Men are rated more competent when compared to otherwise equally competent women (Foschi, 1996).
- Male undergraduate students underestimate female classmates’ ability (Grunspan et al., 2016).
- Female graduate students are rated less qualified for laboratory management positions (Moss-Racusin et al., 2012).
- When collaborating with men, women are given less credit for mutual work (Heilman and Haynes, 2005; Sarsons, 2017).
- Manuscripts by female authors are rated lower quality (Goldberg, 1968; Paludi and Bauer, 1983; Krawczyk and Smyk, 2016).
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“Women must do twice as well to be thought half as good.”

–Charlotte Whitton

1 Lightly paraphrased.
Gender discrimination in peer review

Are women held to higher standards in peer review?

Little evidence gender impacts acceptance rates (see Blank, 1991; Gilbert et al., 1994; Ceci et al., 2014). Women may respond by submitting better papers. Most papers undergo major referee-requested revisions (Abrevaya and Hamermesh, 2012)—referees and editors may be more likely to double-check technical details, demand robustness checks or require clearer exposition in a female-authored paper. Consequently, female-authored papers should be higher quality in dimensions where higher standards apply.

"I have no doubt that one of [discrimination's] results has been that those women who do manage to make their mark are much abler than their male colleagues."

–Milton Friedman
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Writing clarity

1. Clear writing is valued by journals.
   - Stated explicitly in submission guidelines.
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2. Good writing is highly correlated with simple vocabulary and short sentences.
   - Flesch Reading Ease, Flesch-Kincaid, Gunning Fog, SMOG and Dale-Chall.
   - Developed primarily for adults and tested on technical documents (see DuBay, 2004).
   - Used in research, particularly in finance and political science (see Loughran and Mcdonald, 2016; Benoit et al., 2017).
   - Validated against surrogate measures of reading comprehension, including readership (Swanson, 1948; Richardson, 1977), reading persistence, efficiency and retention (Klare et al., 1957; Klare and Smart, 1973).
   - Readable academic articles win more awards (Sawyer et al., 2008), are downloaded more often (Guerini et al., 2012) and cited more frequently.
Correlation with alternative measures

- Oral reading fluency: N = 27, 4 studies
- Comprehension tests: N = 24, 15 studies
- Human judgement†: N = 62, 12 studies
- Cloze procedure: N = 54, 15 studies
- Readability scores: N = 169, 26 studies

Correlation range: 0.2 to 1.0
Every article abstract published in the AER, Econometrica, JPE and QJE since 1950.
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- Using abstracts reduces measurement error.
  - Largely exist as machine readable text.
  - Contain few citations and equations which distort readability scores.
  - Standardised layout—readability less influenced by non-textual cues.
  - Most read portion of a paper (King et al., 2006).
Text used in the analysis

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    - Contain few citations and equations which distort readability scores.
    - Standardised layout—readability less influenced by non-textual cues.
    - Most read portion of a paper (King et al., 2006).
  - Readability scores highly correlated across abstract, introduction and discussion sections of a paper (Hartley et al., 2003; Plavén-Sigray et al., 2017).
Empirical strategy

Establish that there is a gender difference in readability.
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Identification

1. Causally link the gender gap to the peer review process.
2. Establish sufficient conditions to verify discrimination is present in academic publishing.
   - Conditions are satisfied on average for two different measures of research quality: readability \emph{and} citation counts.
   - Use matching to make the causal link between women’s better writing and higher standards by referees and/or editors.
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Consequences

- **Time tax.** Female-authored papers take longer in peer review.
- **Behavioural change.** As women update beliefs about referees’ standards, they increasingly meet those standards before peer review.
Article-level analysis

\[ R_j^s = \beta_0 + \beta_1 \text{female ratio}_j + \theta \mathbf{X}_j + \varepsilon_j. \]

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|                      | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    |
| Edit effects         | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    |
| Journal effects      | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    |
| Year effects         | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    |
| Journal × Year effects| ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Institution effects  | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    |
| Quality controls     | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    |
| Native speaker       | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    |
| JEL (primary) effects| ✓    | ✓    | ✓    | ✓    | ✓    | ✓    | ✓    |
| JEL (tertiary) effects| ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

Notes. 9,122 articles in (1)–(5); 5,216 articles in (6); 5,777 articles—including 561 from AER Papers & Proceedings—in (7). Figures represent the coefficient on female ratio from an OLS regression on the relevant readability score. Quality controls denoted by ✓ include citation count and max. Tj fixed effects. Standard errors clustered on editor in parentheses. ***, ** and * statistically significant at 1%, 5% and 10%, respectively.

Female-authored abstracts are 1–2 percent more clearly written.

- Women write every paragraph 1–2 percent more clearly.
- Substantial difference in a paper of 200–300 paragraphs.
Author-level analysis

Everyone writes better when co-authoring with women!

- Female-authored abstracts are 2–6 percent more clearly written.
- Convex relationship between readability and female ratio.

\[ R_{jit}^s = \beta_0 R_{it-1}^s + \beta_1 \text{female ratio}_j + \beta_2 \text{female ratio}_j \times \text{male}_i + \theta X_j + \alpha_i + \varepsilon_{it}. \]

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<th>Gunning Fog</th>
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Notes. Sample 9,186 observations (2,827 authors). Figures from first-differenced, IV estimation of the regression equation (Arellano and Bover, 1995; Blundell and Bond, 1998). Quality controls denoted by ✓\(^1\) include citation count and max. \( T_j \) fixed effects. Regressions weighted by \( 1/N_j \); standard errors adjusted for two-way clustering on editor and author (in parentheses). ***, ** and * statistically significant at 1%, 5% and 10%, respectively.
Causal impact of peer review

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Peer review causes a large increase in the readability gap

- Readability gap is 2–3 times as large in the published article.
- Suggests peer review causes female-authored abstracts to become about 2–5 percent more readable.
Robustness

- Using the change in score as the dependent variable implicitly controls for field.
- Adding field controls to FGLS estimates does not change results.
- No significant gap under double-blind review.  
  - Caution: small samples, particularly of female-authored papers.
- Abstract word limits do not seem to drive results.
- Timing independence: female-authored manuscripts are submitted to journals first; released as NBER Working Papers second.
Causal impact of discrimination: theory

Why does peer review cause women to write more clearly?

Possibility 1  Women voluntarily write better papers—e.g., they’re more sensitive to referee criticism.

Possibility 2  Better written papers are women’s response to higher standards imposed by referees and/or editors.

☐ Model an author’s decision making process within a subjective expected utility framework.
Causal impact of discrimination: theory

Experience

Readability

Higher acceptance rate OR tougher standards

Tougher standards (weaker)
Causal impact of discrimination: theory

Readability

Experience

Tougher standards (weaker)
Causal impact of discrimination: theory

Experience

Readability

Higher acceptance rate OR tougher standards

Tougher standards (weaker)
Causal impact of discrimination: theory

Higher acceptance rate OR tougher standards

Tougher standards (weaker)
Causal impact of discrimination: theory

Readability

Experience
Causal impact of discrimination: theory

Higher acceptance rate OR tougher standards

Tougher standards (weaker)

Experience

Readability
Causal impact of discrimination: theory

Experience

Readability

Higher acceptance rate
OR tougher standards

♀
♂
Causal impact of discrimination: evidence (II)

1. Experienced women write better than equivalent men.
2. Women improve their writing over time.
3. Female-authored papers are accepted no more often than equivalent male-authored papers.

☑ Establishes 3 sufficient conditions that distinguish Possibility 1 from Possibility 2.

- Higher acceptance rate
- OR tougher standards
- Experience
- Readability

Establishes 3 sufficient conditions that distinguish Possibility 1 from Possibility 2.
1. Experienced female economists write better than equivalent male economists

2. Women improve their writing over time.

No female advantage in acceptance rates (Ceci et al., 2014).
Causal impact of discrimination: evidence (I)

1. Experienced female economists write better than equivalent male economists
2. Women improve their writing over time.

1. Experienced female economists are cited more than equivalent male economists.
2. Women increase citation counts over time.

No female advantage in acceptance rates (Ceci et al., 2014).
Causal impact of discrimination: evidence (II)

- Use a matching estimator to account for the fact that each condition must hold for the same author in two different situations:
  - Before and after gaining experience.
  - When compared to an equivalent, experienced author of the opposite gender.
- Matches based on observable characteristics: primary JEL category, citation counts, decade, institution, etc.

Results

- Evidence of discrimination in 60–70 percent of matched pairs; almost always against women.
- Suggests discrimination causes women to write 7 percent more clearly than they otherwise would.
Behavioural changes

Flesch Reading Ease

Draft

Male
Female

$t$ th article
Behavioural changes

Flesch Reading Ease

Draft

Final

Male

Female

1 2 3 4-5 6+

$t$ th article
Behavioural changes

Flesch Reading Ease

Draft

Final

Male

Female

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4-5

6+

1 th article
Behavioural changes

Flesch Reading Ease

Draft Final Draft Final Draft Final

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Male Female

Draft Final

Male Female

t th article
Behavioural changes
Behavioural changes

Flesch Reading Ease

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Behavioural changes

Flesch Reading Ease

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Behavioural changes

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Behavioural changes

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Behavioural changes

Flesch Reading Ease

1. Male
2. Female

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Male Female

Final Draft Final Draft
### Prolonged peer review

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- Editor effects: ✔
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** Institution effects **

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**Institution effects**
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Econometrica

- 5–9 months longer in peer review

Energy Economics

- 27–29 days longer in peer review
- More revision rounds & referee reports
- Desk rejected at higher rates
Conclusions for academia

Implications for measuring productivity

- Women may produce better quality output...
- But quality costs time, so women produce less.
- Women appear less productive than they actually are.

“Publishing Paradox” may not be so paradoxical...
Quantity vs. quality tradeoff elsewhere...

1. Lower quantity
   - Female academics publish fewer academic articles (Ceci et al., 2014).
   - Female physicians see fewer patients (Bloor et al., 2008) and submit fewer grant proposals (Waisbren et al., 2008; Gordon et al., 2009).
   - Female novelists produce less non-fiction output (Crozier, 1999).
   - Female reporters write fewer front-page bylines (Klos, 2014).
   - Female real estate agents list fewer homes (Trulia.com, 2011).

2. (Unrewarded) Higher quality
Quantity vs. quality tradeoff elsewhere...

1. Lower quantity
2. (Unrewarded) Higher quality
   □ Female students earn better grades (Voyer and Voyer, 2014).
   □ Female auditors are more accurate and efficient (Chung and Monroe, 2001; O’Donnell and Johnson, 2001; Niskanen et al., 2011; Ittonen et al., 2013).
   □ Congresswomen secure more federal funding for their districts, sponsor more legislation and score higher on a composite measure of legislative effectiveness (Anzia and Berry, 2011; Volden et al., 2013);
   □ Houses listed by female real estate agents sell for higher prices (Salter et al., 2012; Seagraves and Gallimore, 2013);
   □ Patients treated by female physicians are less likely to die or be readmitted to hospital (Tsugawa et al., 2017).
   □ Female pilots are involved in fewer fatal accidents (Vail and Ekman, 1986; Bazargan and Guzhva, 2011).
Conclusions beyond academia

Modified “Lucas Critique” may apply to observational studies of gender differences

- May explain lower female productivity in a variety of high-skilled professions, e.g., female lawyers (Azmat and Ferrer, 2017).

- Suggests wage equations that control for unadjusted performance indicators may underestimate labour market discrimination.

- Efforts to increase female productivity (flexible hours, sharing household responsibilities) will have a limited effect on breaking the “glass ceiling”.


References II


References III

Chauvin, A. et al. (2015). “The most important tasks for peer reviewers evaluating a randomized controlled trial are not congruent with the tasks most often requested by journal editors”. *BMC Medicine* 13(1), pp. 1–10.


References IV


References V


References VI


References VII


Trulia.com (2011). *Is Real Estate a Man’s or Woman’s World?*. 


Waisbren, S. E. et al. (2008). “Gender Differences in Research Grant Applications and Funding Outcomes for Medical School Faculty”. *Journal of Women’s Health* 17(2), pp. 207–14.
APPENDIX
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<td>(0.82)</td>
<td>(0.59)</td>
<td>(0.18)</td>
</tr>
<tr>
<td>Difference</td>
<td>2.44</td>
<td>1.00</td>
<td>0.95</td>
<td>0.59</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td>(3.14)</td>
<td>(0.75)</td>
<td>(0.87)</td>
<td>(0.61)</td>
<td>(0.18)</td>
</tr>
</tbody>
</table>

- Editor effects: ✓ ✓ ✓ ✓ ✓ ✓
- Journal effects: ✓ ✓ ✓ ✓ ✓ ✓
- Journal × Year effects: ✓ ✓ ✓ ✓ ✓ ✓
- Quality controls: ✓³ ✓³ ✓³ ✓³ ✓³ ✓³
- Native speaker: ✓ ✓ ✓ ✓ ✓

Table:<br>Sample 1,988 NBER working papers; 1,986 published articles. Standard errors clustered by year in parentheses. Quality controls denoted by ✓³ includes max. t_j, only. ***, ** and * statistically significant at 1%, 5% and 10%, respectively.

**No significant gap under double-blind review**
Double-blind review

Double blind pre-internet

Single blind or double-blind post-internet

causal impact of peer review
Timing independence

Female-authored manuscripts are submitted to journals \textit{first}; released as NBER Working Papers \textit{second}. 
Are abstract word limits driving results?

<table>
<thead>
<tr>
<th></th>
<th>OLS Published article</th>
<th>FGLS Working paper</th>
<th>OLS Published article</th>
<th>Change in score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flesch Reading Ease</td>
<td>0.91 (0.88)</td>
<td>2.29 (1.53)</td>
<td>2.83* (1.61)</td>
<td>0.54 (0.83)</td>
</tr>
<tr>
<td>Flesch-Kincaid</td>
<td>0.55** (0.27)</td>
<td>0.04 (0.35)</td>
<td>0.58* (0.33)</td>
<td>0.54** (0.27)</td>
</tr>
<tr>
<td>Gunning Fog</td>
<td>0.56** (0.24)</td>
<td>0.19 (0.39)</td>
<td>0.71** (0.35)</td>
<td>0.52** (0.26)</td>
</tr>
<tr>
<td>SMOG</td>
<td>0.27* (0.15)</td>
<td>0.21 (0.27)</td>
<td>0.44* (0.23)</td>
<td>0.23 (0.16)</td>
</tr>
<tr>
<td>Dale-Chall</td>
<td>0.23*** (0.09)</td>
<td>0.33*** (0.12)</td>
<td>0.50*** (0.12)</td>
<td>0.17** (0.07)</td>
</tr>
</tbody>
</table>

Sample restricted to abstracts below journals’ official word limits

No meaningful impact

- Sample size is smaller.
- Coefficients and standard errors are generally larger.

Editor effects
Journal effects
Year effects
Journal × Year effects
Quality controls
Native speaker

Notes. Sample 1,067 NBER working papers; 1,065 published articles. ***, ** and * statistically significant at 1%, 5% and 10%, respectively.
## Accounting for field

<table>
<thead>
<tr>
<th></th>
<th>OLS Published article</th>
<th>Working paper</th>
<th>FGLS Published article</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flesch Reading Ease</td>
<td>1.32***</td>
<td>2.80***</td>
<td>3.68***</td>
<td>0.88</td>
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<tr>
<td></td>
<td>(0.58)</td>
<td>(1.04)</td>
<td>(1.17)</td>
<td>(0.59)</td>
</tr>
<tr>
<td>Flesch-Kincaid</td>
<td>0.55***</td>
<td>0.46*</td>
<td>0.90***</td>
<td>0.44**</td>
</tr>
<tr>
<td></td>
<td>(0.18)</td>
<td>(0.24)</td>
<td>(0.30)</td>
<td>(0.20)</td>
</tr>
<tr>
<td>Gunning Fog</td>
<td>0.51***</td>
<td>0.53**</td>
<td>0.92***</td>
<td>0.39*</td>
</tr>
<tr>
<td></td>
<td>(0.18)</td>
<td>(0.24)</td>
<td>(0.32)</td>
<td>(0.21)</td>
</tr>
<tr>
<td>SMOG</td>
<td>0.29**</td>
<td>0.39***</td>
<td>0.60***</td>
<td>0.21</td>
</tr>
<tr>
<td></td>
<td>(0.12)</td>
<td>(0.15)</td>
<td>(0.19)</td>
<td>(0.13)</td>
</tr>
<tr>
<td>Dale-Chall</td>
<td>0.14***</td>
<td>0.32***</td>
<td>0.42***</td>
<td>0.10*</td>
</tr>
<tr>
<td></td>
<td>(0.05)</td>
<td>(0.10)</td>
<td>(0.10)</td>
<td>(0.05)</td>
</tr>
<tr>
<td>Editor effects</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<td>Journal effects</td>
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<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Year effects</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Journal × Year effects</td>
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<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Quality controls</td>
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<td>✓&lt;sup&gt;2&lt;/sup&gt;</td>
<td>✓&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>Native speaker</td>
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<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>JEL (primary) effects</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

**Notes.** Sample 1,505 NBER working papers; 1,503 published articles. ***, ** and * statistically significant at 1%, 5% and 10%, respectively.

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Adding field controls does not change results.
Determine whether conditions 1 and 2 hold for one member in each matched pair.

If so, then discrimination is present within that matched pair.

If not, then my test for discrimination is inconclusive.
Causal impact of discrimination: evidence (II)

Notes. Blue bars represent (unweighted) matched pairs in which the man satisfies Conditions 1 and 2; pink bars are pairs in which the woman does. Estimated density functions drawn in grey, weighted by frequency observations are used in a match. Conditional means, standard deviations and sample sizes shown in the first two panels of Table 8.