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Analysing the 'gender productivity puzzle' in Middle Income Countries

The Case of South Africa

Lorena Rivera León
PhD Research Fellow, UNU-MERIT

Jacques Mairesse
CREST-ENSAE, France; UNU-MERIT, Maastricht University, Netherlands; NBER

Prof. Dr. Robin Cowan
UNU-MERIT and BETA Université de Strasbourg

Dr. Moritz Muller
BETA Université de Strasbourg

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Motivation and Research Gap

- Study knowledge creation from an *economics of science* perspective
- Focus on MICs – most of the existing evidence in the field is for developed countries
  - Characteristics of science systems in MICs are very different: scarcity of resources for research, limited knowledge access, differences in publication polices, limited scientific infrastructure, research priorities
- Why this is relevant?
  - It will ideally provide tools for informing policy discussions on how best to implement science policies in MICs, best allocate (limited) funds for research, and link between supply and demand of knowledge

Literature

- Studies on research productivity generally reveal that women publish less than men (Bellas and Toutkoushian, 1999), although the gender gap has been decreasing over time.

- Not only gender – but also family-related aspects

- Mixed results:
  - Being married and having children has a negative effect on women's productivity, and others finding no influence at all.

- No gender differences in the technological outcome of inventors, but there are in terms of income (Hoisl and Mariani, 2012), particularly in women with children.
  - Bargaining power of women in job-negotiations, as a consequence of the higher allocation of tasks at home for women.

- Evidence in MICs is very limited, but highly relevant, because of the small number of research positions with good and competitive work conditions (e.g. arguably, competition for these positions is higher in MICs).

Main objectives of research

- To understand whether the publication productivity gender gap exists in South Africa, even after controlled for selectivity, career promotion and unobserved individual heterogeneity

    – How and why does career development differs among researchers?

    – Are women in science in MICs at a 'structural' disadvantage relative to their male peers due to family responsibilities?

    – Do marriage, children and other family-related factors influence research productivity?

Data

- Data from the National Research Foundation (NRF) of South Africa
  - One of the key roles of the NRF is to facilitate the 'ranking' of researchers and universities through a process focused on research outputs
  - We have access on data on 'rated researchers' for the period 2002-2011: sample of 3,340 rated researchers
    - 978 are female researchers (29.3%), and 2,362 are male researchers (70.7%).
  - Publication record of rated researchers in the period 1991-2011: 100,948 publications

Methods of Analysis

- Adapted version of a method recently developed by Mairesse and Pezzoni to understand the gender productivity gap of French physicists.

- Productivity function with three corrections:

  - Selectivity: selection function or the probability of having high-quality publishing time periods

  - Career promotion of researchers: promotion function or probability of positive career development and the granting of higher ranks

  - Unobserved individual heterogeneity.

  - In addition, the productivity function will account for:

  - personal characteristics (age, gender, ethnicity), and

  - research and collaboration characteristics (institutional affiliation, academic discipline, characteristics of co-publications, and other network characteristics of NRF researchers).

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Number of ratings granted in period

	Men	Women	Total
A1	47	1	48
	97,9%	2,1%	100%
A2	138	16	154
	89,6%	10,4%	100%
B1	287	32	319
	90,0%	10,0%	100%
B2	369	81	450
	82,0%	18,0%	100%
B3	361	88	449
	80,4%	19,6%	100%
C1	572	147	719
	79,6%	20,4%	100%
C2	993	396	1.389
	71,5%	28,5%	100%
C3	625	225	850
	73,5%	26,5%	100%
Other	1.213	607	1.820
	66,6%	33,4%	100%
Total	4.605	1.593	6.198
	74,3%	25,7%	100%

Average number of publications by rating and gender

Rating	Men	Women
A1	6,35	1,40
A2	4,65	3,06
B1	3,62	3,71
B2	2,95	3,00
B3	2,76	2,59
C1	2,09	2,22
C2	1,99	1,84
C3	1,66	1,54
Other	1,43	1,36
Total	**1,98**	**1,61**

• 'Minimal' gender gap
• Affects mainly the higher levels of seniority.
• No major differences on the number of non-productive years (5.7 years for men vs. 5.8 for women)

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Average productivity of researchers with and without non-productive years

	Women	Men	M/W
Including non-productive years			
Mean	1,61	1,98	1,23
Median	1,00	1,00	
SD	2,30	2,95	
Obs.	15.005	38.729	
1st quartile	0,00	0,00	
4th quartile	2,00	3,00	
Number of researchers	978	2.362	
Excluding non-productive years			
Mean	2,57	3,04	1,18
Median	2,00	2,00	
SD	2,45	3,18	
Obs.	9.374	25.239	
1st quartile	1,00	1,00	
4th quartile	3,00	4,00	
Number of researchers	978	2.362	

Career achievements by gender

No. of changes in period		Male	Female	Total
Decreases	Count	120	27	147
	% of gender	5,09	2,77	4,41
0	Count	1,422	660	2,082
	% of gender	60,28	67,69	62,45
1	Count	343	97	440
	% of gender	14,54	9,95	13,2
2	Count	249	122	371
	% of gender	10,56	12,51	11,13
3	Count	105	44	149
	% of gender	4,45	4,51	4,47
4	Count	60	13	73
	% of gender	2,54	1,33	2,19
5	Count	41	8	49
	% of gender	1,74	0,82	1,47
6	Count	15	3	18
	% of gender	0,64	0,31	0,54
7	Count	4	1	5
	% of gender	0,17	0,1	0,15
Total	Count	2,359	975	3,334
	% of gender	100	100	100

Transition matrix between NRF broad rating categories by gender

All researchers

	Other	C	B	A
Other	91,78	7,5	0,73	0
C	0,65	96,92	2,39	0,04
B	0,12	1,21	97,56	1,11
A	0,24	0	2,57	97,18

Male researchers

	Other	C	B	A
Other	91,61	7,49	0,9	0
C	0,67	96,84	2,44	0,06
B	0,14	1,28	97,44	1,14
A	0,13	0	2,59	97,28

Female researchers

	Other	C	B	A
Other	92,11	7,51	0,38	0
C	0,58	97,19	2,22	0
B	0	0,82	98,23	0,95
A	2,17	0	2,17	95,65

Promotion Equation

	Model 1	Model 2
Personal characteristics		
Age-40	0.05***	0.09***
(Age-40)^2	-0.0002	-0.0010***
Woman (=1)	-0.41***	12.42***
Age X Woman		-0.4596***
Age^2 X Woman		-0.0040***
Past productivity		
L.log(Art)	0.13***	0.13***
L.No Publications	-0.0008	-0.0019
Time dummies	Yes	Yes
Constant	0.41***	0.15
Observations	6375	6375
Pseudo R2	0.38	0.39

Conclusions

- Initial results suggest that NRF rating system is not gender-biased
  - Gender productivity gap disappears and in some cases favours women when controlled for non-productive years.
- Overall women have it harder to reach the highest levels of seniority
  - Results show broadly that women have less chances than men to move across rating categories
  - They need higher number of publications to reach the same levels of rating than men
  - Women have less career achievements than men, but for those that do, they have more increases than men, but at lower levels of seniority than men

Conclusions

- Two possible interpretations of model 2 with age variables (interactions):
    - Evolution of research system in favour of women. In the olden days women were actively discriminated against. Today, there is active positive discrimination: women are now being promoted much more easily than men.
    - Composition effect. Older women tended to go to disciplines where there is not so much scope for promotion. Younger women go to disciplines that are more active.

Next steps in research

- NRF Survey: capturing family-related aspects (summer 2014)
- Analysis by academic disciplines
- Adding a variable of quality of co-authors to the promotion equation
- Controlling also for the age of men?
- Is there a story behind 'race'?
- Selection equation, productivity function

Thank you!

- Questions and comments