

"Does Gender Affect Scientific Productivity?"

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General Outline

- Does Gender Affect Scientific Productivity?
A critical review of the empirical evidence
and a panel data econometric analysis for French physicists
- Work in Revision
Gender and Scientific Publication Productivity
of Graduate Students in an Elite US University
- Work in Progress
Analyzing the 'gender productivity puzzle'
in Middle Income Countries: The case of South Africa

Does Gender Affect Scientific Productivity?

A critical review of the empirical evidence
and
a panel data econometric analysis for French physicists

By Jacques Mairesse and Michele Pezzoni

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<http://www.cairn.info/revue-economique-2015-1-page-65.htm>

The so called productivity puzzle, gender gap or gender bias

- **“Productivity puzzle”** (Cole and Zuckerman 1984): The publication productivity of female scientists is found to be lower than male publication productivity in almost all scientific fields
- Although many studies in the economic, education and sociology literature have documented the gender gap or gender bias, relatively few of them have actually focused on analyzing the likely underlying causes
- Surprisingly, the puzzle remains...

For example, the empirical evidence on the importance of motherhood and family related factors in accounting for the gender gap seems at best ambivalent

- “Decades of research on gender differences in academic publication productivity has yet provided very little, if any, empirical support for the common sense understanding that **a certain measure of incompatibility** exists between being a mother and a productive academic researcher “.

Heidi Prozesky, 2008, “A career-History Analysis of Gender-Differences in Publication Productivity among South African Academics”, Science Studies, 21(2), 47-67 .

- “The intuitive belief that marriage and motherhood cannot be meshed with a demanding scientific career has been termed an **‘empirically untenable stereotype’** (Toren Nina, 1991) , or a **‘motherhood myth’**, and it is argued that the myth itself, rather than marriage and motherhood, may be the source of incompatibility in women’s careers (Henry Etzkowitz, Carol Kemelgor and Brian Uzzi, 2000)”.

- **SEE What It’s Like as a ‘Girl’ in the Lab, NYT, June 18, 2015 -- <http://nyti.ms/1epy5FF> and Tim Hunt formal apology to KOFWST- http://www.kofwst.org/files/KOFWST_0617.pdf**

The present analysis

- We aim at assessing a *counterfactual or unbiased gender productivity gap* that ideally would control for all factors affecting differently female and male scientists, and in practise attempts to take into account a few important factors.
- We have constructed two large panel data samples of French CNRS and university physicists (excluding nuclear and particle physicists). We observe in both cases that the productivity of women in terms of number of publications is, by about one third in average, largely lower than that of men.
- Our econometric analysis shows, however, that female physicists appear as productive as their male colleagues in CNRS, and even more productive in French universities, when we take into account several factors, in particular unequal chances of promotion and frequent non-publishing spells, which can reflect strong family engagements.

Publication productivity measure

$$\text{Prod}_{i,t} = \sum_{a=0}^{\text{art}_{i,t}} \text{if}_a$$

i -> Scientist

t -> Triplet

if_a -> Articles published in journals with five year impact factor at least equal to 0.5

<i>Prod</i>	Women-CNRS	Men-CNRS	M/W	Women-UNIV	Men-UNIV	M/W
Mean	38.58	59.96	1.55	13.14	27.15	2.06
Obs (Physicists)	815 (159)	4702 (839)		1848 (410)	7408 (1403)	

When we exclude *low-publishing spells*....

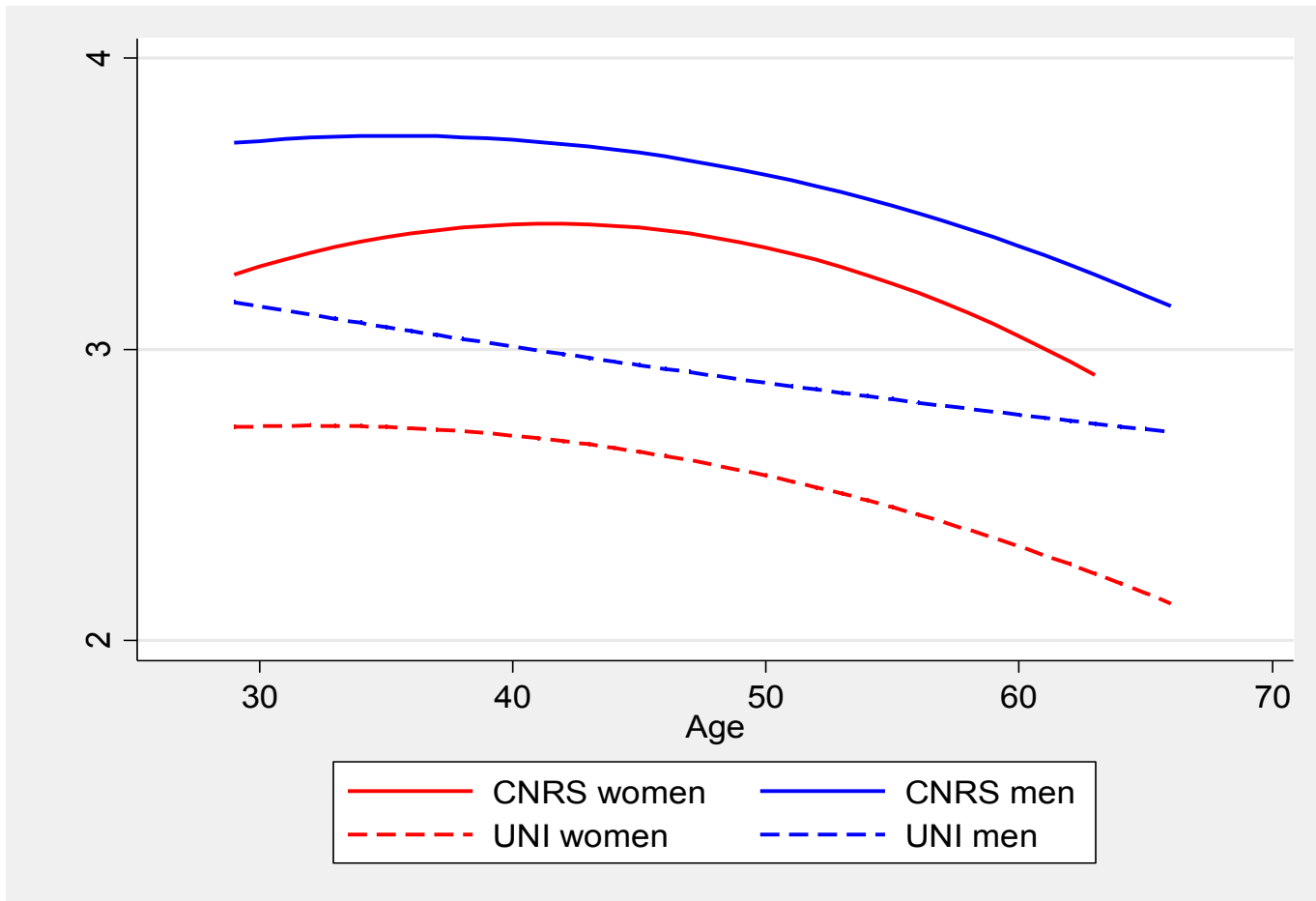
<i>Prod*</i>	Women-CNRS	Men-CNRS	M/W	Women-UNIV	Men-UNIV	M/W
Mean	48.52	65.99	1.36	30.2	37.13	1.23
<i>Log(Prod*)</i>			M-W			M-W
Mean	3.47	3.76	0.29	2.74	3.05	0.31
Obs (Physicists)	648(127)	4272(752)		804(176)	5415(973)	

**Productivity does not include non publishing spells*

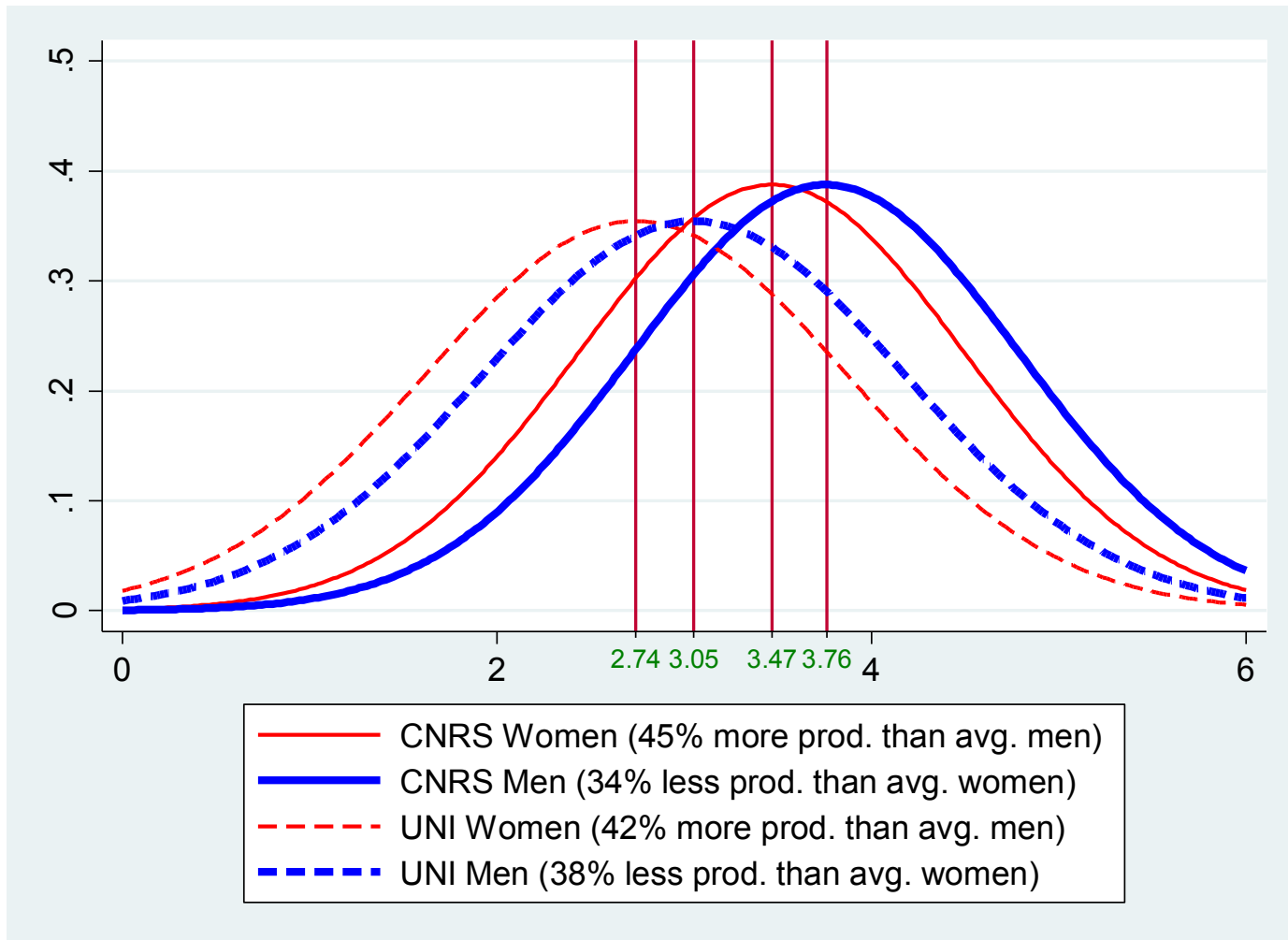
Shares of low-publishing spells

	CNRS	University	total (Gender)
Women	20%	56%	45%
Men	9%	27%	20%
All	11%	33%	

log(Prod) observed by age



log(Prod) observed



Estimation Strategy

- Productivity equation

$$\log(\text{Prod}^*) = f(\text{G}, \text{A}, \text{IC}, \text{Prob}(\text{Rank}), \lambda, \dots)$$

- Probit-type promotion equation

$$\text{Rank} = f(\text{G}, \text{A}, \dots)$$

- Probit-type publishing time spells selection equation

$$\text{Publishing} = f(\text{G}, \text{A}, \dots) - > \lambda$$

Other explanatory variables in productivity equation:

- Personal characteristics: gender [G] and age [A]
- Work environment: research related and collaboration variables [Env.]
 - Quality and quantity of (French) coauthors' productivity
 - Presence of international co-authors
 - Cross-discipline collaboration
 - Number of co-authors
 - Collaboration between university and CNRS
- Career (*Chargés de Recherche* -> *Directeurs de Recherche*; MCF-> *Professeur*) [Rank]
- Calendar year dummies [Time]

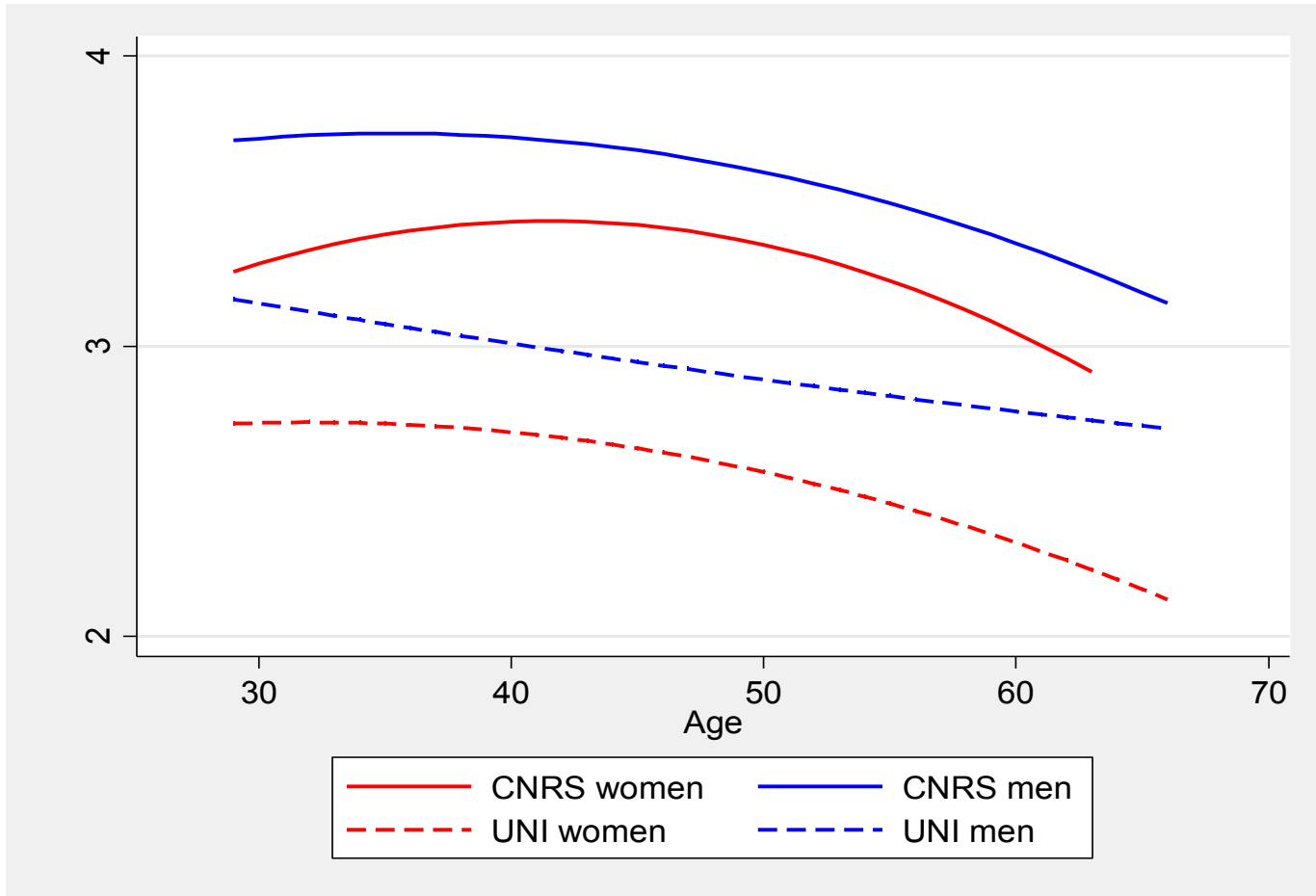
Explanatory variables in promotion equation:

- Personal characteristics: gender [G] and age [A]
- Past productivity (quality and quantity)
- Calendar year dummies [Time]

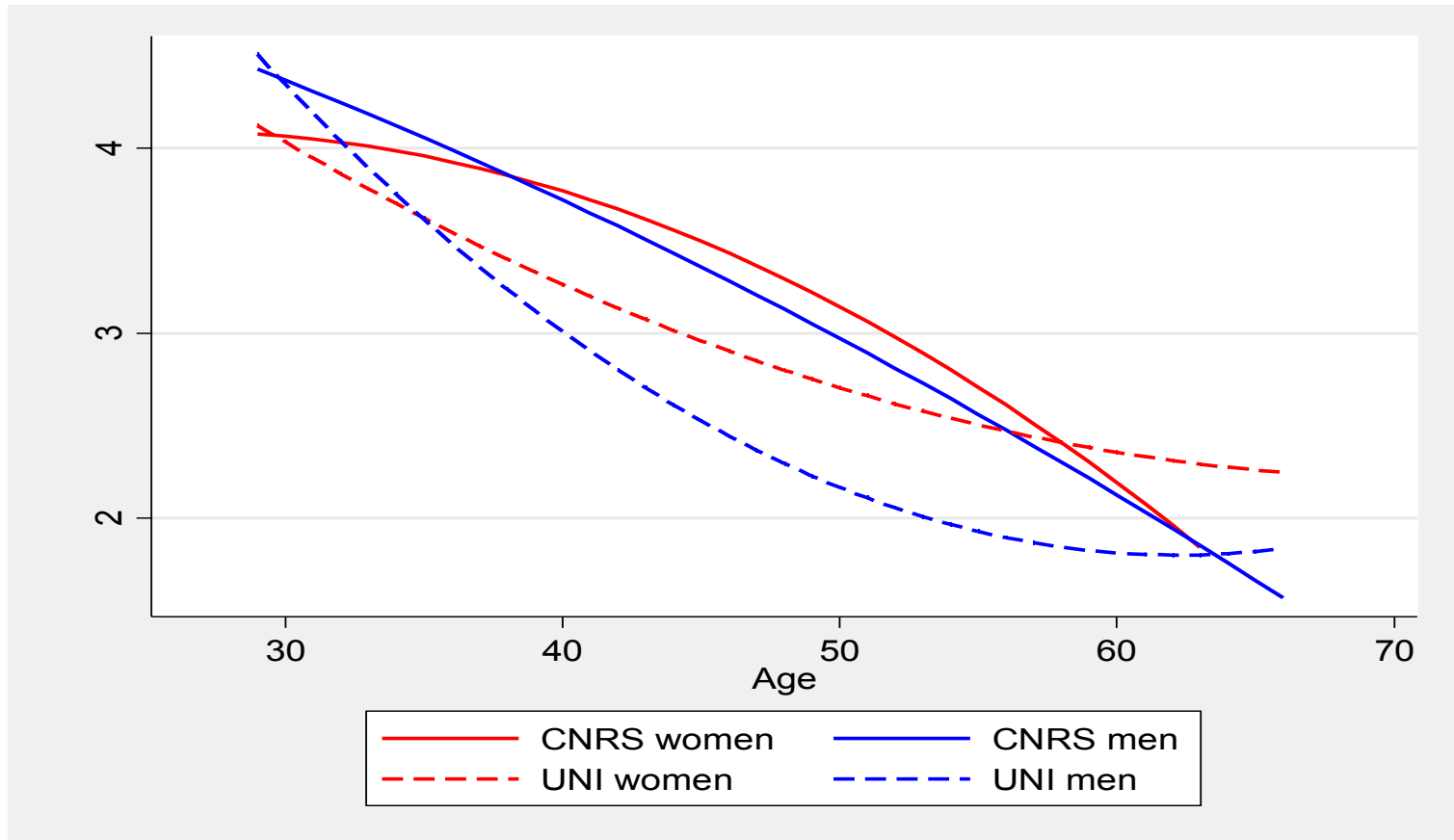
Explanatory variables in selection equation:

- Personal characteristics: gender [G] and age [A]
- Persistence in publishing during $t-1$, $t-2$ and $t-3$
- Calendar year dummies [Time]

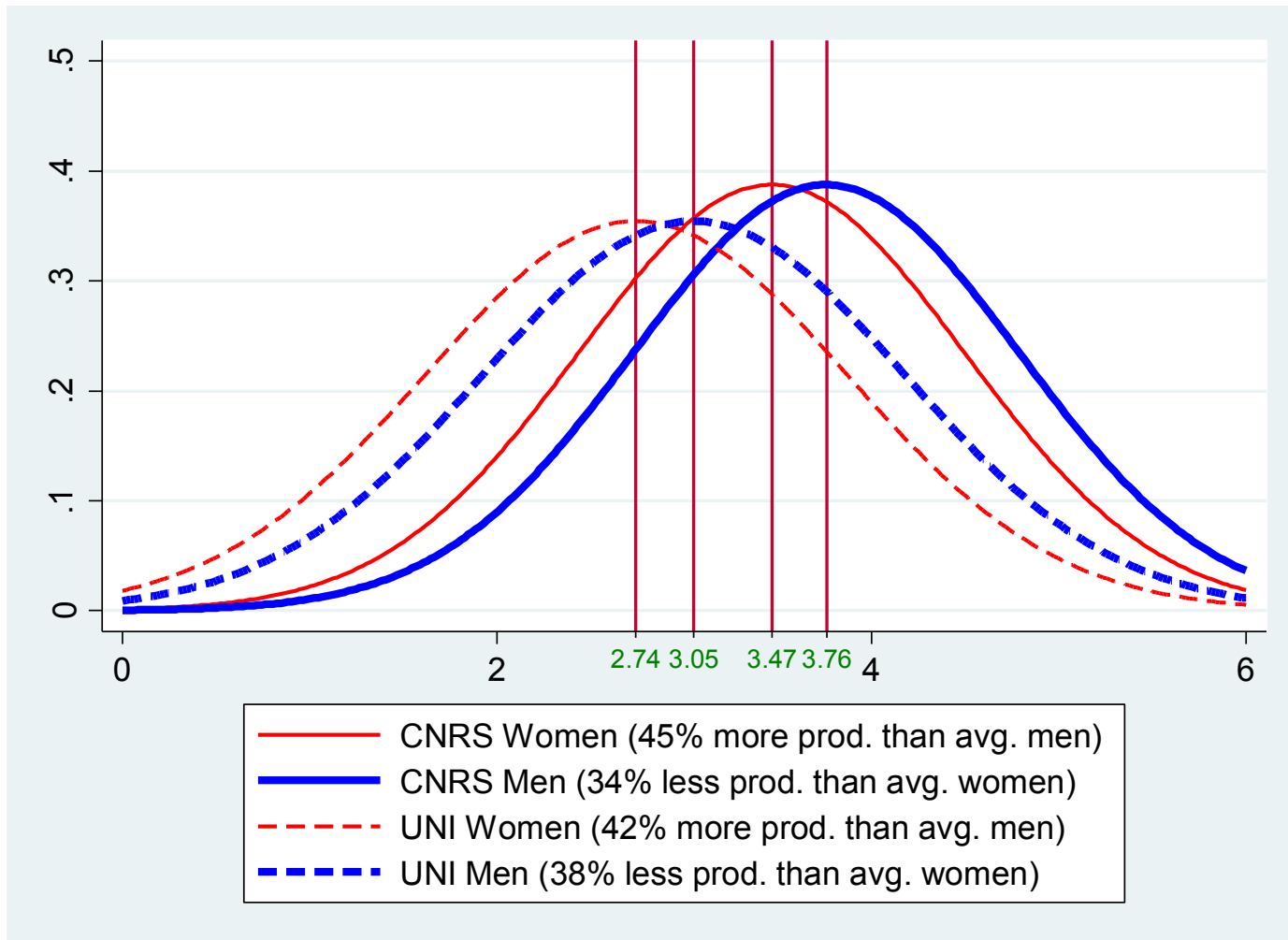
log(Prod) observed by age



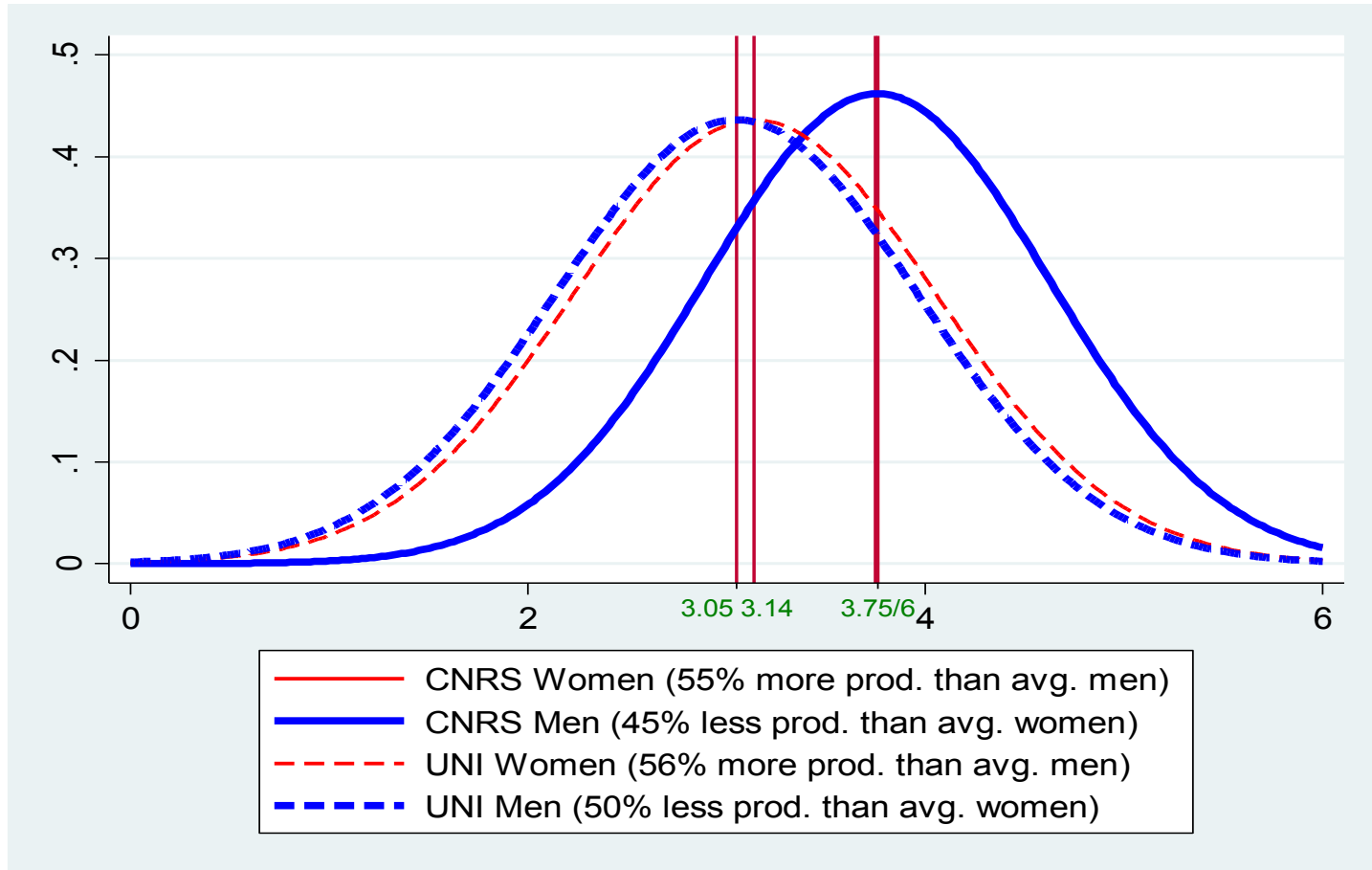
Predicted $\log(\text{Prod}^*)$ as a function of Age and Gender controlling for **Env.+IC+IV+ λ +Time**



log(Prod) observed



log(Prod*) predicted for full model



"Does Gender Affect Scientific Productivity? Evidence for PhD Students in an Elite US University"

With :

Julia Lane — Wagner School (New York University), University of
Strasbourg and University of Melbourne;

Michele Pezzoni — GREDEG,(Nice University), CRIOS (Bocconi
University);

Paula Stephan – Georgia State University and NBER.

Support: Alfred P. Sloan Foundation

Framing

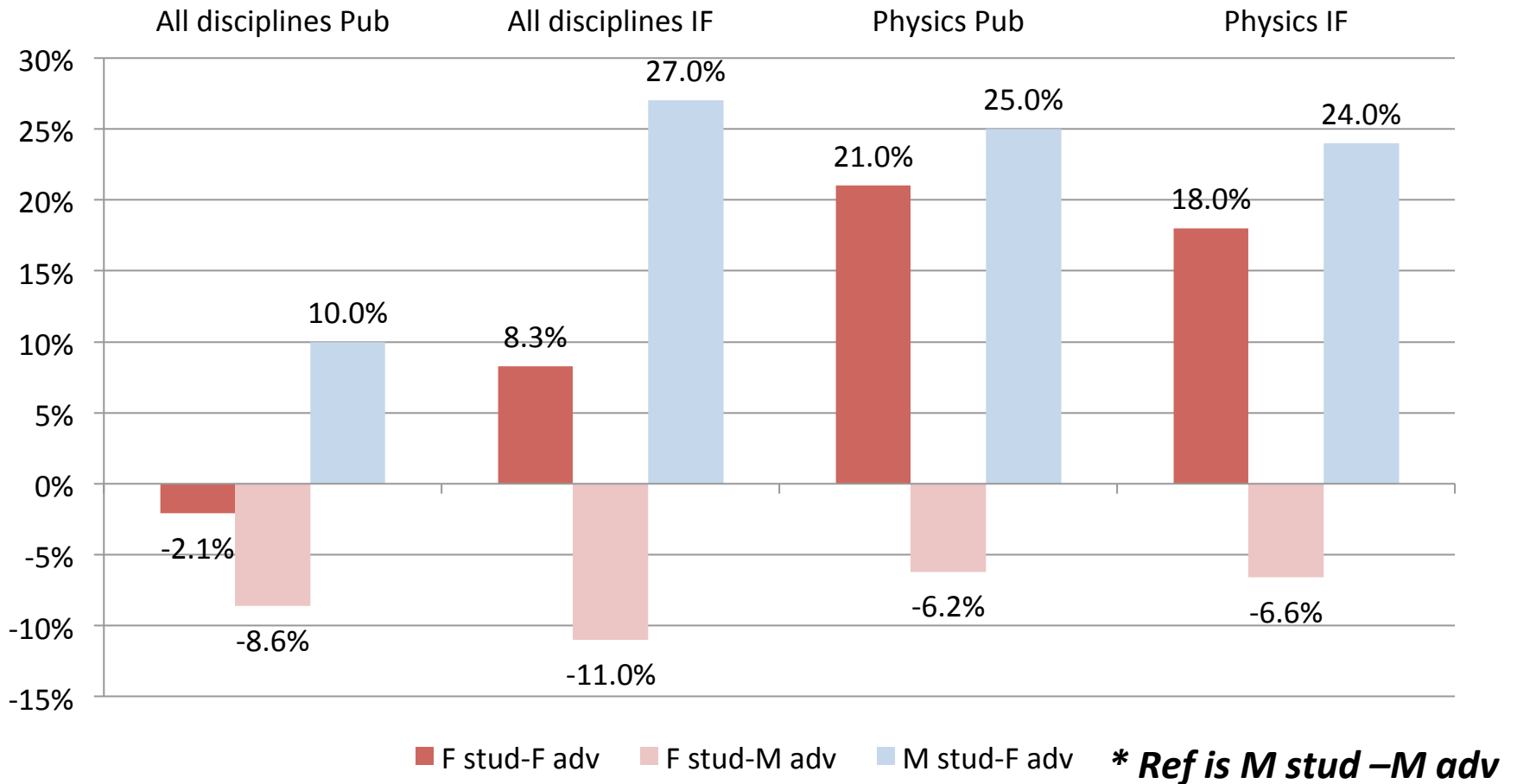
- We focus on PhD student scientific publication productivity in an elite US university to investigate further the productivity puzzle.
- PhD students play a key role in staffing labs and their productivity while a student is important in determining placement outcomes and career trajectories. Their key role reflects an implicit contract with the faculties they work with to produce research at the same that time they learn by doing.
- The analysis also considers the gender of the advisor, the advisor-advisee gender pairing, the gender composition of the team.

Sample of all PhD students who have defended their theses from 2004 to 2009

PhD disciplines	PhDs	Female PhDs	Advisors	Female Advisors
BIOLOGY	132	46 (34.8%)	49	9 (18.4%)
CHEMISTRY	192	64 (33.3%)	35	5 (14.3%)
ENGINEERING	249	66 (26.3%)	68	10 (14.3%)
GEOLOGY	33	17 (51.5%)	26	4 (15.4%)
MATH	91	17 (18.5%)	39	1 (2.5%)
OTHERS	69	21 (31.9%)	25	4 (16%)
PHYSICS	167	41 (24.4%)	62	6 (9.5%)
TOTAL	933	272 (29.1%)		

The majority of the PhDs are in *engineering, physics, chemistry, and biology*

PhD-Advisor gender dyads for All disciplines and for Physics only



First conclusions

We find:

- A significant gender gap in PhD student's publication productivity : -8.5% for number of publications and -11.0% for average impact factor (IF).
- Having a female advisor has a positive impact on PhD student's productivity: for a male student +10.0% and +27.0% for number of publications and average IF, for a female student +10.7% and 19.3% for number of publications and average IF.
- Gender composition of the adviser research team has no additional impact on student's productivity
- However , there are important differences across disciplines. The elite university we consider is certainly not representative of an average US university

Analyzing the ‘gender productivity puzzle’ in Middle Income Countries: The case of South Africa

Work in progress

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DO WOMEN RESEARCHERS PUBLISH AS MUCH AS MEN IN EMERGING COUNTRIES?

Analysing the 'gender productivity puzzle' in South Africa

LORENA RIVERA LEON, JACQUES MAIRESSE AND ROBIN COWAN

Men largely dominate academia. Studies on the presence of women in academia show that female researchers are largely under-represented in the highest levels of hierarchy. But, what is the reason for this relative weaker position of women in academia? Is the low presence of women in the scientific community simply showing a struggling pattern that confronts society in general? How and why does career development differs among researchers? Are women in science in emerging countries at a 'structural' disadvantage relative to their male peers? Or, are women, simply 'underperforming' men in terms of research outputs?

The main objective of this research is

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

What is the gender productivity puzzle

It refers to the lower comparative productivity of women in science, almost in all disciplines and regardless of the productivity measure used

BELLAS AND TOUTKOUSIAN, 1999

Evidence on the existence of the gender productivity puzzle in the context of emerging countries is very limited, however highly relevant, because of the small number of research positions with good and competitive work conditions. Although inequality between researchers exists in developed countries, and evidence is well documented in the literature, researchers in emerging countries have greater tolerance for unequal work arrangements. World-leading researchers in these countries may ultimately work in enclaves, which might lead to the marginalisation of non-leading and non-productive researchers.



National Research Foundation

We use data on rated researchers from the South African NRF for the period 2002-2011

- The study focuses on Science and Engineering disciplines
- Agriculture, Biology, Chemistry, Earth Sciences, Engineering, Health, IT, Mathematics, Physics, Technologies and Medicine

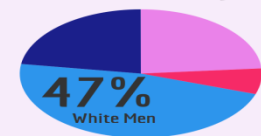
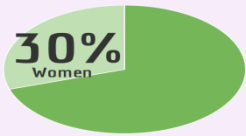
90%

of all South African peer-reviewed research outputs are written by NRF-rated researchers

1447 Researchers

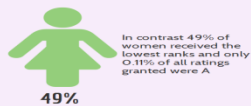
37,767 Publications in the period 1991-2011

Characteristics of researchers



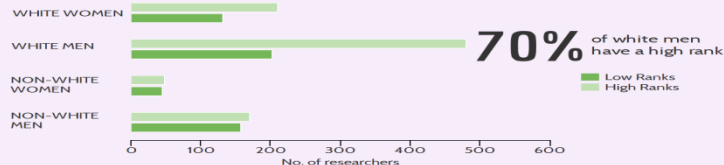
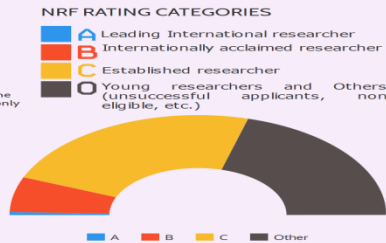
Number of researchers by gender and race

- White Women
- Non-white Women
- White Men
- Non-white Men



38% of ratings granted to men are at the lowest levels of seniority. Only 13% of male ratings were at A-levels

In contrast 49% of women received the lowest ranks and only 0.1% of all ratings granted were A



70% of white men have a high rank

Method

We use econometrics in order to understand the effect of gender on scientific production. We use a productivity function and correct for three potential biases and specification errors regarding selectivity, career promotion of researchers, and unobserved individual heterogeneity.

We explore three interrelated issues



Selectivity

Probability of occurrence of non-publishing spells



Promotion

Probability of advancement in NRF ratings, interpreted as career achievements: changes from 'Low Ranks' to 'High Ranks'

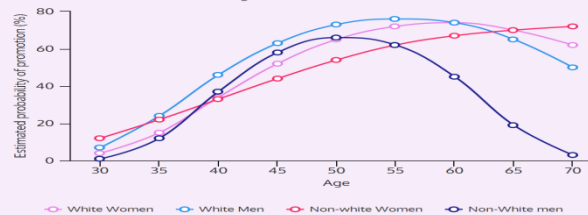


Productivity

Understanding of the determinants of scientific productivity accounting for the interrelated differences between female and male researchers, rank status and non-publishing spells

Results

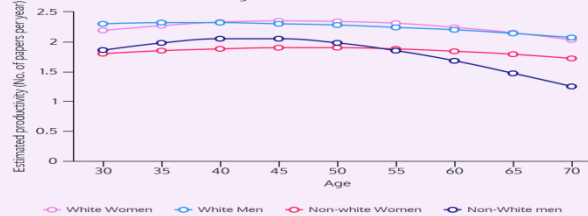
Graph 1. Change with age of predicted probability of promotion by gender and race



PROMOTION

- Women are less prone to promotion, with a stronger effect for non-white researchers
- Large differences by Age, more than by gender and race
- Number of publications in the past is highly significant and positive for promotion
- Having a Foreign PhD plays a positive role only for White researchers

Graph 2. Change with age of predicted scientific productivity by gender and race



PRODUCTIVITY

- Evidence of a 'race productivity gap'
- Productivity varies considerably by Age Non-White women are less productive
- Higher-rated researchers are more productive
- Researchers with a higher number of co-authors are more productive

The results suggest the existence of GENDER AND RACE PRODUCTIVITY GAPS

This research uses an adapted version of an econometric framework originally developed by Mairesse and Pezzoni (2015)

* Does Gender Affect Scientific Productivity? A critical review of the empirical evidence and an econometric panel data analysis for French physicists (in Revue Economique, January 2015)



Are you interested in this research?

Contact the authors!

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