GENDER GAP IN SCIENCE IN JAPAN

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Content

- Gender gap in Japan: some evidence
- Determinants of exit from academic research career;
- Data: cohort based study, Japan doctoral holders 1985-04 (97,422) in hard sciences;
- Econometric strategy and results.

Gender gap in japan

Some facts: Female are underrepresented in employment

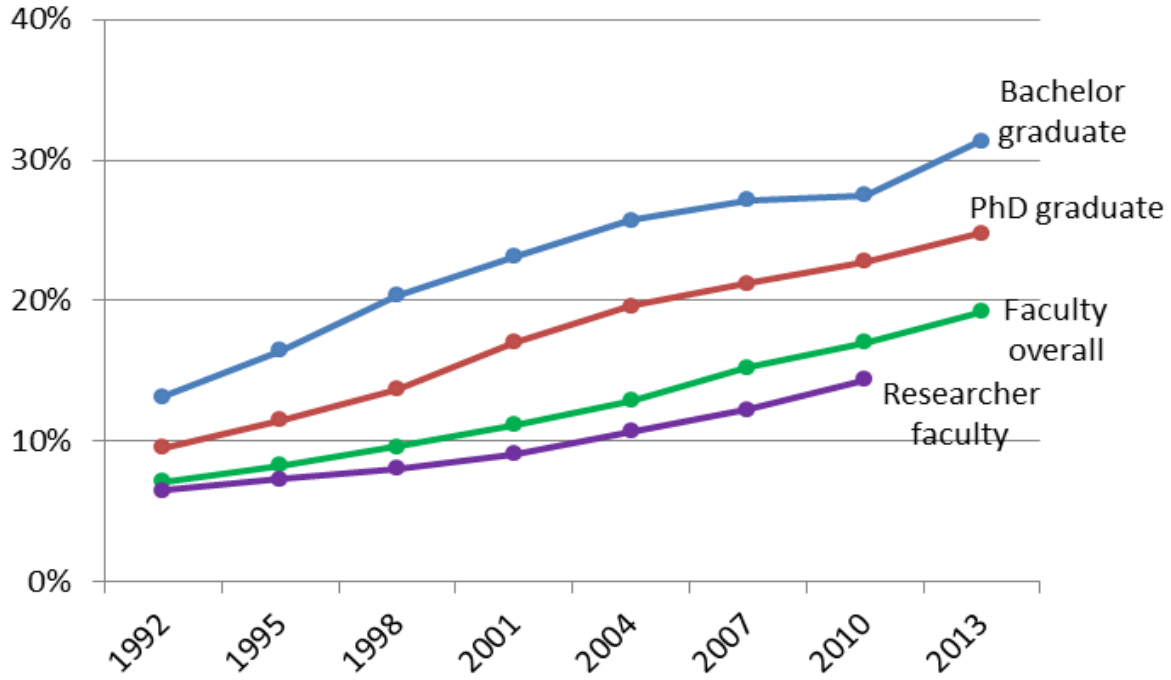
- Japan is ranking 104th out of 142 countries covered by the World Economic Forum's gender gap index in 2014.
- Government recognized that gender imbalance in general employment as a serious social issue in early 1990s (GEBCO, 2014; Kato et al., 2012), but policy action had limited effect.

Some facts: Female are underrepresented in SCIENCE (1)

- Japan has the smallest proportion of females among academics (ALL FIELDS) in 2010 (some country comparability problems, J and EU include PhDs) 25% (UK: 44%, Italy: 39%, USA: 36%, Germany: 36%, France: 33%, Canada: 33%).
- In 2013 J statistics for ALL FIELDS: 50% BA; 30% PhD grads; 30% New Assistant prof; 22% of Associate and 14% of Full Prof in service.

Some facts: Female are underrepresented in SCIENCE (2)

- For STEM: 31% of bachelor graduates, 25% of PhD graduate and 17% of females in the overall faculty.



PhD grads was 50% in US, 39% in UK and 44% in D;
%female of overall faculty was 39% in US

Determinants of exit

Exit from academic research

- **Exit from academic research** occurs when academic researchers either move into positions in academe which concentrate on non research activities, such as teaching or administration, or leave an academic research career and move into industry.

Times of exit

- We identify three main periods when an academic researcher holding a PhD may exit academic research:
  1. After PhD graduation: the postdoc period;
  2. At the time of tenure/permanent position;
  3. After having being promoted to associate professor (tenure/permanent position).

Determinants of exit

- We identify ***individual***, ***institutional*** and ***geographical factors*** correlated to persistence in an academic research job.

Individual control factors

- **Scientific productivity**: a) neg. higher productivity is associated with higher probability to get an academic research career; b) pos. high productivity => high reputations => higher probability to get offer a top administrative job (but not too frequent); c) pos. high productivity in Pasteur quadrant science => higher probability to get a job offer from industry (but not too frequent).

Individual control factors 2

- **Funding inputs**: neg. in hard sciences research is lab based, the PI/head of the lab spends quite some time to raise money for the lab, stable and significant funding inputs are a precondition for building up a successful lab and carrying out research.

Other individual control factors

- We also control for individual **academic career characteristics** such as time of tenure and academic rank and some proxy for **individual network connection** and **mobility**.

Institutional control factors

- **Organizational prestige**: neg There is a wide literature that links prestige to future employment (Gaughan and Robin, 2004), promotion (Long et al., 1993) and future productivity (Allison and Long, 1990).
- Organizational prestige is difficult to measure, however in Japan the ***top seven*** (Tokyo, Kyoto, Osaka, Tohoku, Hokkaido, Kyushu, and Nagoya) pre-imperial universities are clearly the most prestigious.
- We also control for ***financial inputs*** and **institutional *social network*** as proxies for OP.

Other institutional control factors

- **Field specificities** affect the probability of exit, we expect that fields will differ depending on the probability of receiving an external job offer (**Pasteur Quadrant Sciences** have more firm job opportunities) and depending on their growth rate, **growing fields** will have lower probability of exit.

Geographical control factors

- We control for a few geographical factors (47 prefectures) that can influence the exit likelihood.
  - Local concentration of research-intensive universities will be neg correlated with exit
  - Local concentration of teaching-oriented universities will be pos correlated with exit.
  - We also control the size of the local industrial labour market and local supply of PhD graduates.

Data

Samples: 4 cohorts of PhDs

- 4 Cohorts of PhD graduates who were awarded a doctoral degree in hard sciences (all scientific fields except social sciences and humanities) in the period 1985-2004 – 5 years window. Total of 97,422 graduates.
- We matched this sample to the list of recipients of the most reputable and largest source of funding for academic research in Japan the *GiA programme;*

Samples: research active

- Having a GiA (as PI o co-grantees) grant means being research active. In 2006 only 3% of researchers had a research budget coming mostly from non GiA sources – 13% for Engineering.
- About 30% were financed at least once.

Samples: two estimations

- First we study for each cohort the sample of researchers that got a PhD but never received a GiA grant –i.e. they never started an academic research career according our definition (***Pre-employment Exit***).
- Second, we consider the sample of PhD graduates in the 1985-1989 cohort that received at least once a GiA grant (***Post-employment Exit***). We used the 2012 version of the GiA database, and regard academics whose latest record in the database occurred in 2006-2010 as survivors (robustness check).

Econometric strategy and results

Pre-employment Exit

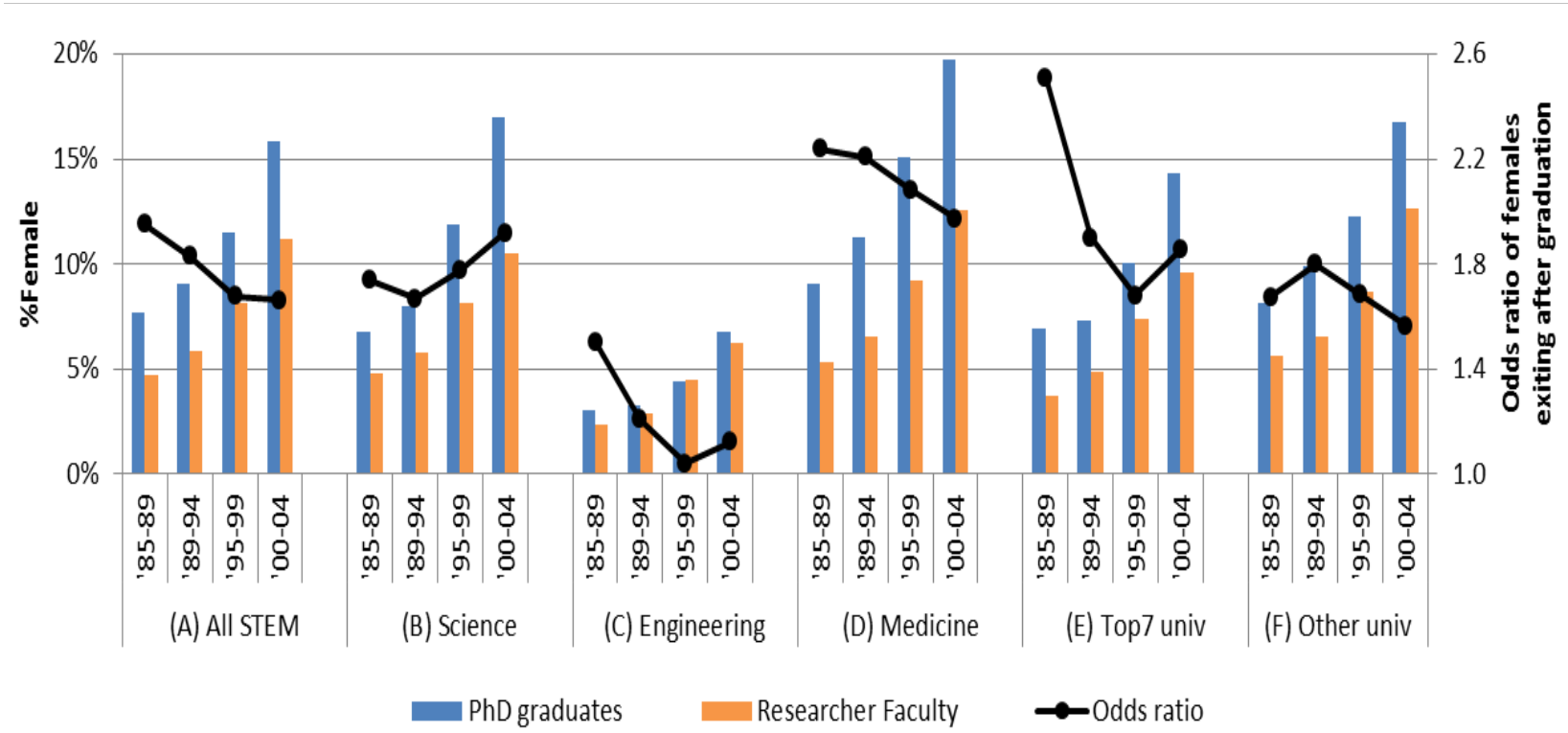
- We assigned zero if the PhD graduate appears in the funding database and 1 otherwise. The researcher got at least once a GiA grant (30%). We look at a window of 8 years after graduation and for robustness check also 13 years (only 3 cohorts)
- We estimate the likelihood of exit by logit regressions.

Prediction of Pre-employment Exit

	Model 1 1985-1989		Model 2 1990-1994		Model 3 1995-1999		Model 4 2000-2004	
female	,671 ***	(,080)	,601 ***	(,064)	,515 ***	(,049)	,501 ***	(,040)
year of graduation	-,015	(,021)	,012	(,013)	,016	(,012)	,062 ***	(,009)
Top 7	-,186 **	(,063)	-,101 †	(,054)	-,190 ***	(,045)	-,132 **	(,040)
ln(*#researcher*)	-,255 ***	(,034)	-,282 ***	(,029)	-,221 ***	(,024)	-,211 ***	(,021)
field growth	-,028	(,142)	,396	(,274)	-,115	(,180)	-,293	(,194)
field dummies	YES		YES		YES		YES	
ln(*#national univ employment*)	-,220 **	(,077)	-,181 **	(,061)	-,147 **	(,057)	-,071	(,056)
ln(*#private univ employment*)	,078 ***	(,021)	-,001	(,021)	-,012	(,021)	-,019	(,026)
ln(*#industrial employment*)	-,026	(,049)	,033	(,044)	,065	(,040)	,126 ***	(,037)
ln(*#PhD graduate*)	,064	(,063)	,119 *	(,056)	,055	(,050)	-,025	(,052)
χ^2 test	506,82 ***		598,09 ***		673,90 ***		812,86 ***	
Log likelihood	-8499,18		-11053,80		-15363,83		-18349,03	
N	13776		18387		27236		35585	

Two-tailed test. †p<0.1; * p<0.05; ** p<0.01; *** p<0.001.

Odds-ratios for female



Odds-ratios – university prestige

Odds-Ratios of Female Exit before First Academic Employment by University Prestige

Cohort	[1] Top7 univ	[2] Other univ	[3] Top7 vs. Others
1985-1989	2.51***	1.67***	*
1989-1994	1.89***	1.79***	N.S.
1995-1999	1.67***	1.68***	N.S.
2000-2004	1.84***	1.55***	†

Two-tailed test. †p<0.1; * p<0.05; ** p<0.01; *** p<0.001.

Post-employment Exit- Cohort 1985-1989

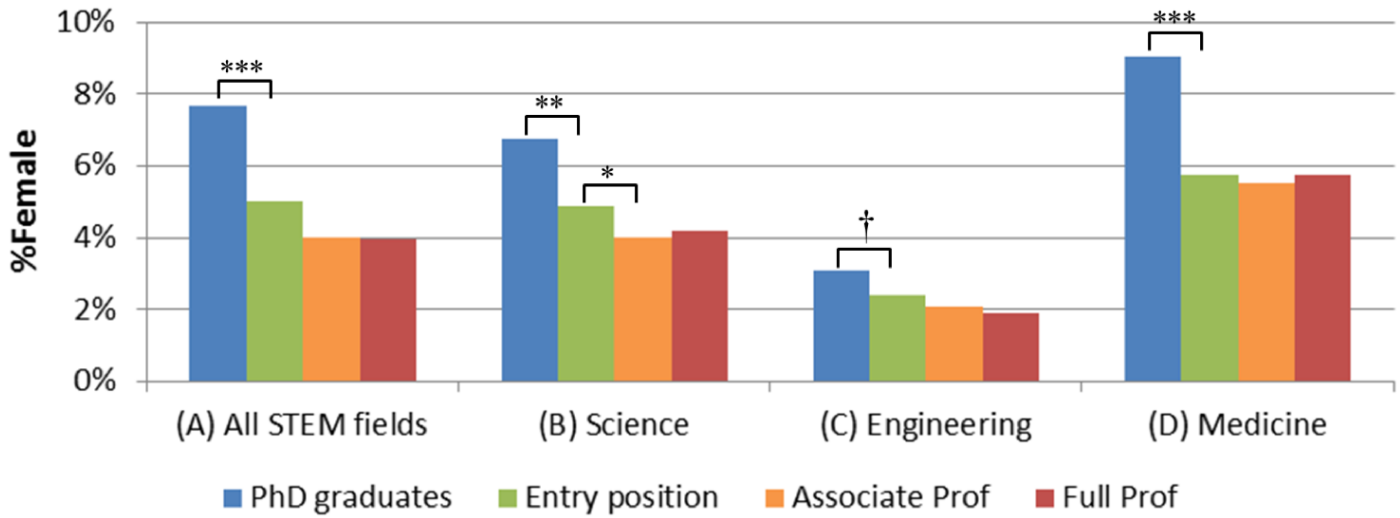
- For the cohort 1985-1989, we analyze the sample of researcher that got at least one grant and study their exit from the database.
- We estimated the likelihood of exit by survival analysis, drawing on a duration model.
- We draw on a discrete approach based on the complementary log-log (*cloglog*) model (similar results for continuous model).
- A set of time dummy variables is included in order to capture the unobserved time-varying effect on the likelihood of exit.

Prediction of Post-employment Exit
Cohort 1985-1989

	Complementary log-log model				Cox semi-parametric model			
	Model 1		Model 2		Model 3		Model 4	
female	,045	(,087)			,065	(,087)		
pre-tenure (base group)								
associate prof	-,370 ***	(,058)	-,355 ***	(,059)	-,319 ***	(,058)	-,303 ***	(,059)
full prof	-,704 ***	(,078)	-,690 ***	(,079)	-,624 ***	(,079)	-,611 ***	(,080)
*female * pre-tenure*			,137	(,098)			,159	(,098)
*female * associate prof*			-,262	(,246)			-,265	(,246)
*female * full prof*			-,261	(,321)			-,219	(,321)
pub stock	-,041 ***	(,005)	-,040 ***	(,005)	-,040 ***	(,005)	-,040 ***	(,005)
fund stock	-,015 **	(,005)	-,016 **	(,005)	-,017 ***	(,005)	-,017 ***	(,005)
mobility	-,134 *	(,054)	-,136 *	(,054)	-,073	(,054)	-,075	(,054)
job tenure	-,011 †	(,006)	-,011 †	(,006)	-,007	(,006)	-,007	(,006)
ln(*#co-grantees*)	,231 ***	(,023)	,230 ***	(,023)	,223 ***	(,024)	,223 ***	(,024)
Top 7	-,272 ***	(,072)	-,269 ***	(,072)	-,257 ***	(,071)	-,254 ***	(,071)
%univ fund	-,001	(,012)	-,001	(,012)	-,007	(,012)	-,007	(,012)
ln(*#researcher*)	-,245 ***	(,028)	-,247 ***	(,028)	-,195 ***	(,028)	-,197 ***	(,028)
field growth	-,601 *	(,239)	-,603 *	(,239)	-,468 †	(,248)	-,468 †	(,248)
field dummies	YES		YES		YES		YES	
ln(*#national univ employment*)	-,568 ***	(,045)	-,567 ***	(,045)	-,047	(,060)	-,044	(,060)
ln(*#private univ employment*)	,066 **	(,023)	,067 **	(,023)	,013	(,023)	,013	(,023)
ln(*#industrial employment*)	-,429 ***	(,038)	-,430 ***	(,038)	-,066	(,049)	-,067	(,049)
ln(*#PhD graduate*)	,504 ***	(,042)	,503 ***	(,042)	,073	(,051)	,072	(,051)

Exit by career stages

Figure 2 **Exit by Career Stage (1985-89 Cohort)**



Career trajectory – cohort 1985-1989

- Promotion is generally slower for females than for males; for example, it took 12 years after graduation for half the male researchers to be appointed to associate professors and 15 years for the female counterpart.
- Females also tend to exit an academic career at a lower rank; among females who were active researchers for 20 years, 29% were still in an entry position, compared to 13% for males.

Conclusions

Conclusions: gender bias at what stage of the career

- Female academics tend to exit research more easily. This effect is especially strong immediately after graduation, less so during the junior stage, and is reversed during the senior career stage (however only 4.4% of profs were females in the cohort 1985-1989).

Conclusions: gender bias and prestige

- Female researchers in more-prestigious top 7 imperial universities tend to have a higher probability of exit compared to female gradates from other universities.

Conclusions: gender bias and scientific field

- The % of females is higher in MEDICINE, but their probability of abandoning the academic career is also the highest among the field analysed (though decreasing in time).
- In SCIENCE female participation has doubled in 20 years (both at the PhD and AP level), but the odds-ratio has also increased.
- Female participation in ENGINEERING is extremely low, due to low share of PhDs, with only a weak evidence of bias at the entry level.