APPENDIX C

MEAN PUBLICATION TRENDS AMONG UNIVERSITY PROFESSORS BETWEEN 1960 AND 2000

During late 2001 and early 2002, Bozeman and Lee (2003) conducted a survey of careers of scientists and engineers. The survey was sent to 997 university faculty members who were not retired professors or industrial researchers. The response was 44%, which meant 443 returns. Among the respondents, 41% (181) were engineering professors; 15% (66) were bioscience professors; 5.6% (25) were computer science professors; 10.61% (47) were chemistry professors; 9.7% (43) were physics professors; and the remaining 12.9% (57) were other science field professors. By group, 62.8% (278) were tenured faculty; 37.3% (165) were non-tenured faculty; 86.5% (383) were male; 13.1% (58) were female; 68.4% (303) were native scientists; and 31.4% (139) were immigrants. The average age of the sample was 46 in year 2000. It should be noted that the gender ratio and the native/immigrant ratio in this sample are very close to the national levels.

The results are presented in Fig. C.1 and C.2. The "normal count" measures the total number of published refereed scientific articles and books. For "fractional count," Bozeman and Lee (2003) divided by the number of authors.

The explosion of publications first noted by De Solla Price (1963) is underscored by Fig. C.1. While there are relatively few 1950s-era Ph.D.s in the Bozeman and Lee sample, there are several from the 1960s era. By cohort, their data show that the publication rate is much greater for the later years, and, starting with 1980s, the difference between fractional count and normal count sharpened.

Fig. C.2 provides the mean number of publications after researchers have received their doctoral degree, with the lower line representing fractional count and the upper line normal count. A "0" means that less than one year has passed since receiving the degree, and a "44" means that 44 years have passed since the individual received the doctoral degree. Thus, the figure gives insight into the productivity levels during the course of a researcher's career.

The normal count data suggest that productivity peaks between the 23rd and 28th year, averaging nearly five publications per year. After that period, the researcher has four publications for about five years or so, and then the average drops to a little more than two after forty years. The average is less than three publications for the first eight years—the time during which many researchers are struggling to be awarded tenure. There are some cohort effects after six to eight years due to "drop outs" among persons who did not receive tenure. That is, the 0-8 cohorts presumably include some people who will not receive tenure, and the cohorts after eight probably include very few people who did not receive tenure.

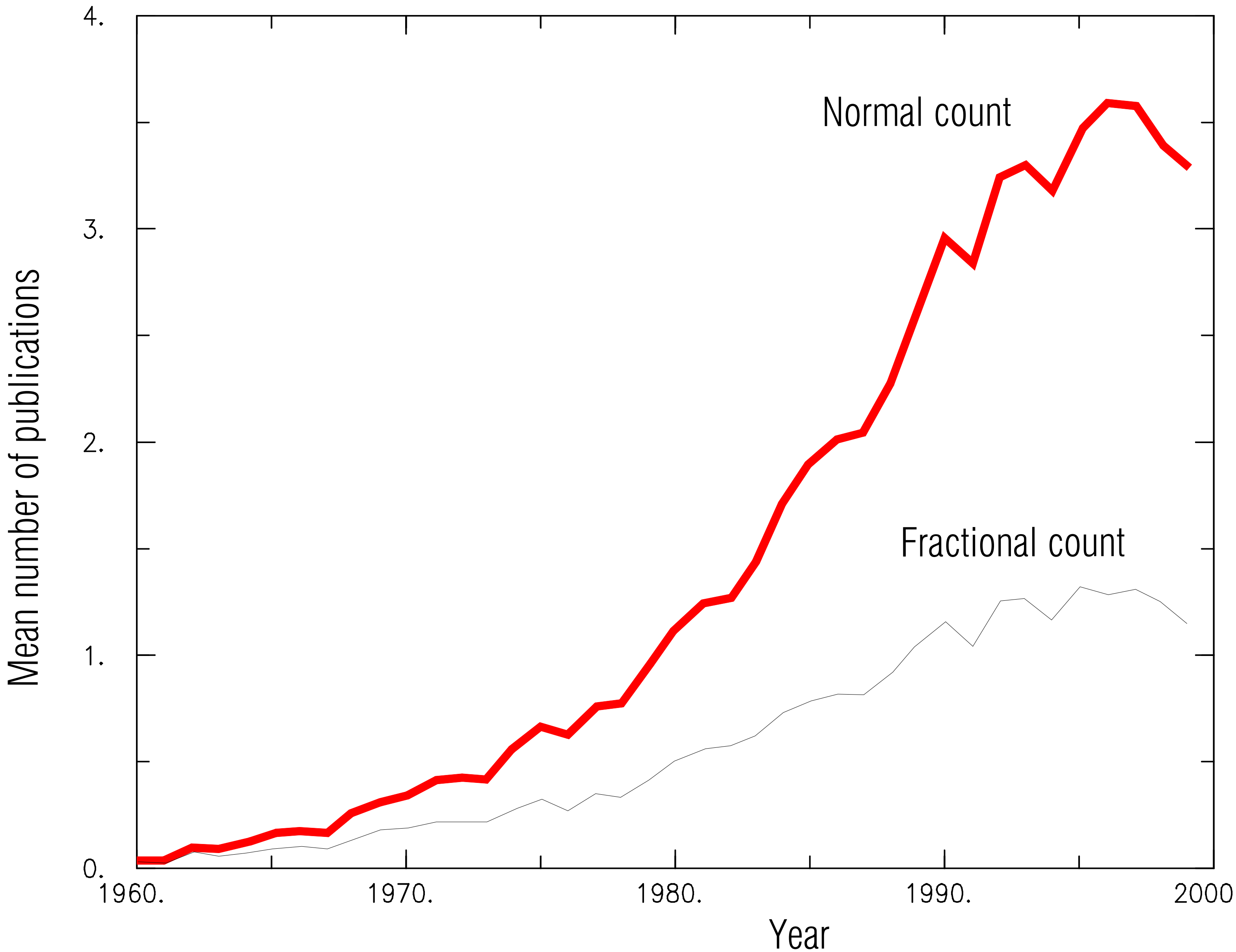

Fig. C.1: Mean number of publications between 1960 and 2000.

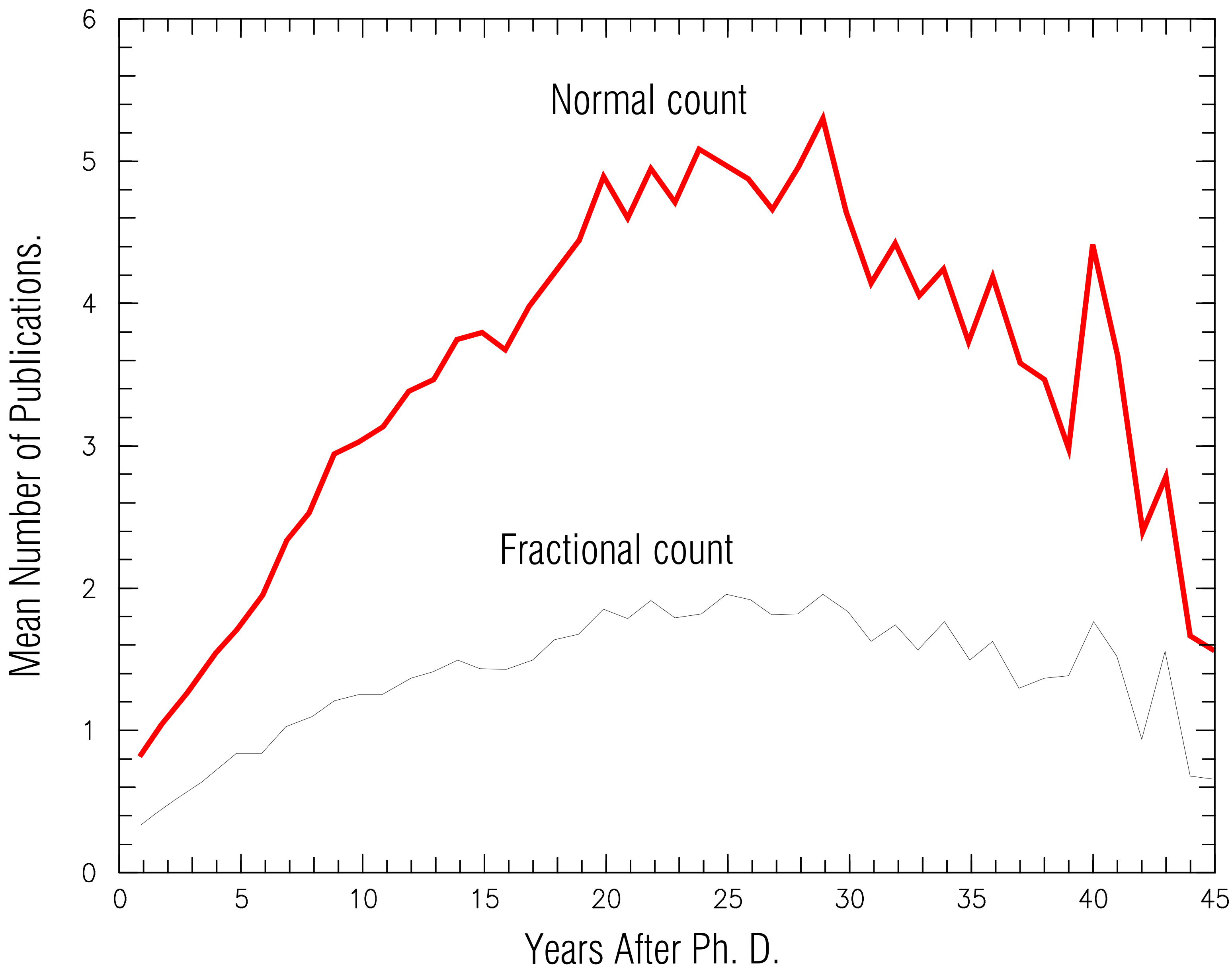

Fig. C.2: Mean number of publication versus years after Ph.D.

With respect to fractional count, Fig. C.2 shows that there are fewer peaks and the curve is somewhat smoother. The effect of using a fractional count is to make the data more closely approximate a normal distribution, perhaps indicating that later years' productivity is related to the scientific and technical human capital and the collaborative arrangements that develop. As before, the early years and the later years are less productive, but there is less of a sharp peak from years 8 to 40 (though the most productive period appears to be from about 19 to 29 years after the doctoral degree).

Bozeman and Lee (2003) further show that there are considerable disciplinary differences in numbers of publications during the researchers' life course. Chemistry is the highest-producing discipline, and computer science has the fewest publications. The data also indicate that whereas chemistry researchers peak between 28 and 30 years after the dissertation, physics researchers peak at 37 years after the degree. Productivity by gender is examined in Figures C.3 and C.4. These figures indicate that the level of normal count productivity of the males is higher than that of the females until the 18^{th} year, at which time females have a somewhat higher productivity rate. Bozeman and Lee (2003) note that the data must be treated with caution because the relatively small percentage of females (13.1%, n = 58) in the sample makes the trend data highly subject to individual cases and small cohorts.

Table C.1 shows productivity by rank for both the fractional and the normal count. To make the figures comparable, the measure is median publications during period 1996 – 2000, dropping individuals who did not have doctoral degrees by 1996. By normal count, the discrepancy between full, associate, and assistant professors is considerable, with more than five per year for full professors and less than three for assistants. A similar pattern holds for the fractional count, with the numbers for the full professors being twice that for the assistant professors.

Using the same indicator—productivity since 1996—Bozeman and Lee (2003) found that other demographic factors are importantly related to productivity. As Tables C.2, C.3, and C.4 show, married researchers, non-native researchers, and males are more productive in terms of both fractional and normal count. Using the t-test of significance, rank, gender, native status, and marital status are all significantly associated with both productivity measures. Finally, Bozeman and Lee (2003) noted that other variables positively and significantly associated with both normal and fractional counts of productivity include total number of doctoral students currently supported, self-reported job satisfaction, and a perception that department colleagues appreciate one's work.

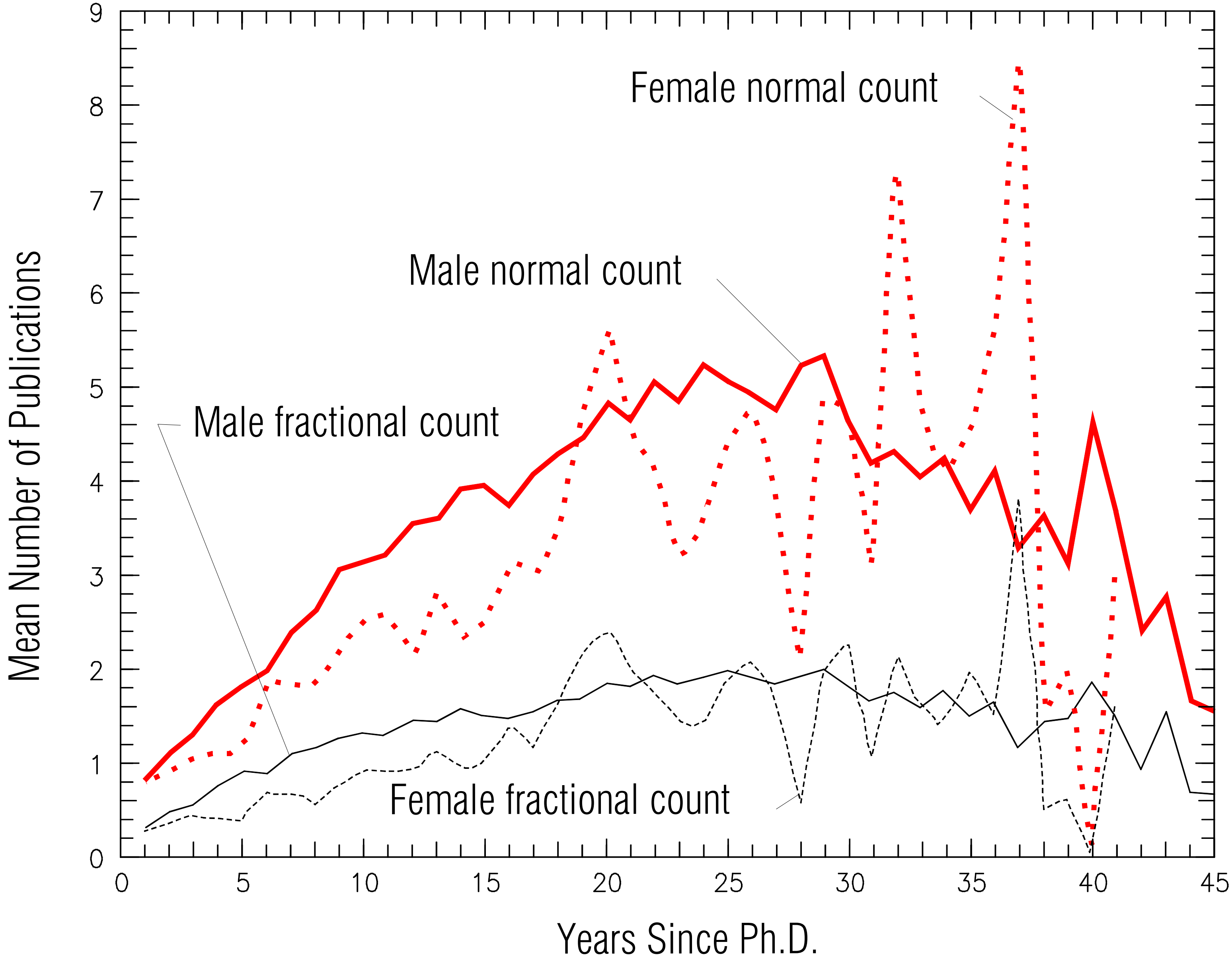

Fig. C.3: Comparison of mean number of publication for male and female faculty plotted versus years after award of Ph.D.

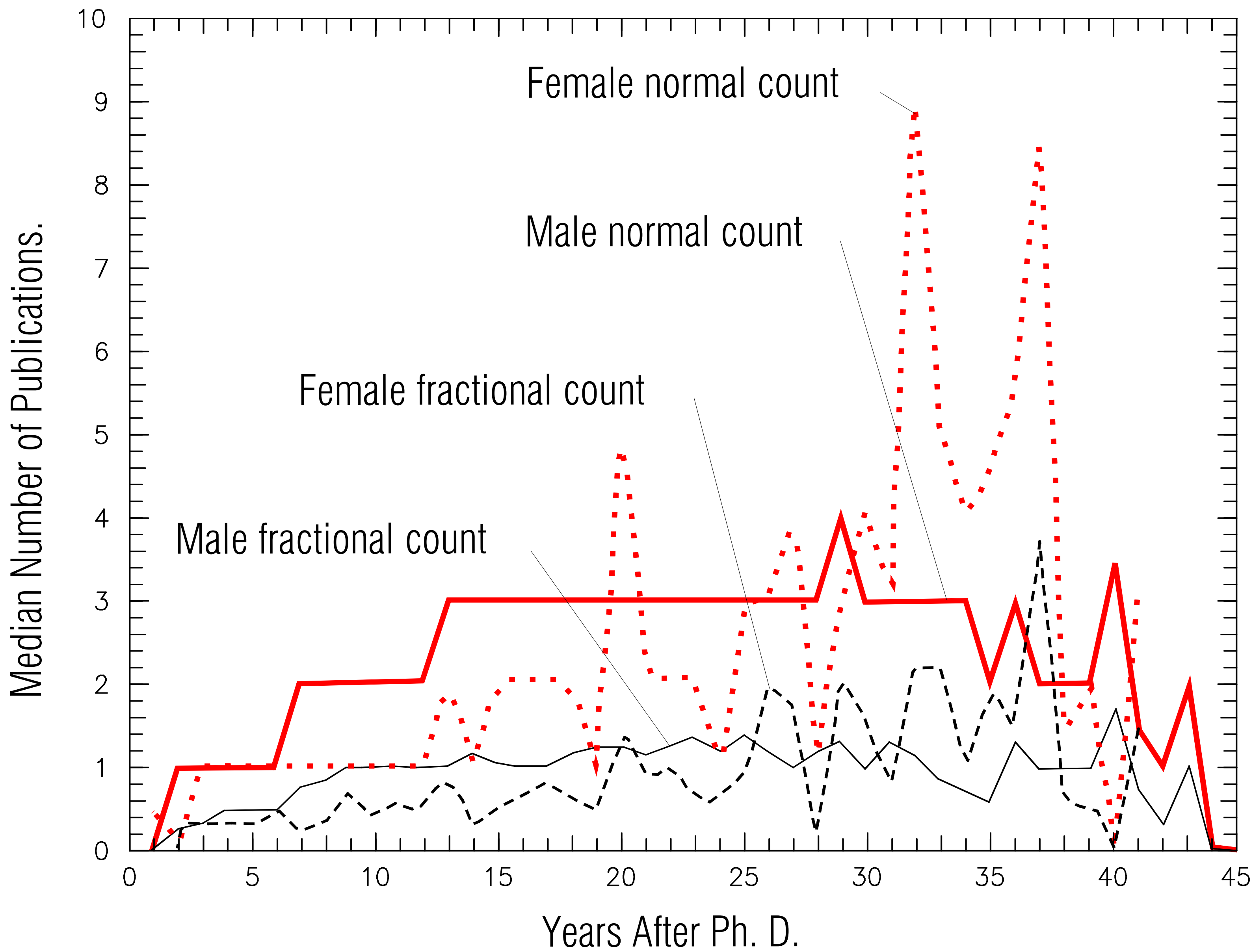

Fig. C.4: Comparison of the median number of publications for male and female faculty plotted versus years after award of Ph.D.

Table C.1. Productivity by Rank[*]

Count		Full professor (Valid N:168)	Associate (Valid N: 72)	**Assistant (Valid N: 114)**
Normal Count	Mean	5.15	3.25	2.82
	Median	3.9	2.60	2.20
Fractional Count	Mean	1.87	1.22	1.04
	Median	1.51	0.99	0.78

Table C.2. Productivity by Marital Status*

Count		Married (Valid N:371)	Single (Valid N:36	**Difference**
Normal Count	Mean	3.91	2.59	Sig; < 0.05
	Median	2.60	2.30	
Fractional Count	Mean	1.41	.97	Sig; < 0.05
	Median	(1.44)	(1.00)	

Table C.3. Productivity by Citizenship*

Count		Native (Valid N:>280)	Non-native (Valid N:130)	**Difference**
Normal Count	Mean	3.55	4.34	Sig; < 0.05
	Median	(2.40)	3.20	
Fractional Count	Mean	1.29	1.55	Sig; < 0.05
	Median	(.93)	(1.26)	

Table C.4. Productivity by Gender*

Count		Male (Valid N:356)	Female (Valid N: 53)	**Difference**
Normal Count	Mean	3.96	2.75	Sig; < 0.1
	Median	2.60	(2.40)	
Fractional Count	Mean	1.42	1.08	Sig; < 0.05
	Median	(1.06)	(.89)	

[*] From Bozeman and Lee (2003).

REFERENCES

1. Bozeman, B., and Lee, S. (2003). The impact of research collaboration on scientific productivity, Paper presented at the Annual Meeting of the American Association for the Advancement of Science, Denver, CO.

2. DeSolla Price, D. (1963). *Little Science Big Science*, New York: Columbia University Press.