The research productivity of Australian academics – and what determines it

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One of the defining characteristics of a university is its commitment to those scholarly activities that lead to the production of knowledge and ideas. Perhaps the most critical indicator of research commitment and productivity – widely regarded as the main source of esteem, as a requirement for individual promotion, as evidence of institutional excellence, and as a sine qua non for obtaining competitive research funds – is publication. The centrality of publications to scholarly activity and recognition can hardly be overestimated. It has been argued that research work only becomes "a work" in the academic world when it takes on the conventional, physical form of a published paper or its equivalent, and that the most fundamental social processes of science are the communication and exchange of research findings and results (Fox, 1983). It is not easy to accept the contrary assertion that numbers of publications are not very important in gaining scholarly prestige (see, for example, O'Neill, 1990): it does not fit with the facts of academic life. Consider the time and effort that prestigious universities expend in publicising the quantity of their members' books and articles; the growing use of numbers of publications as an indicator of an department's performance; the chief topics of conversation on any tenure, appointments and promotions committee. In the culture of the university, it seems, academic distinction and publications go together.

Our purpose in this paper is not to enter into a debate about the advisability or validity of publications as a measure of research output, or to consider the arguments for and against other quantitative measures of research quality and quantity such as citation counts, impressionistic peer review, and value of research grants. The article has two main objects. It estimates and reports the rate of productivity (as measured chiefly by scholarly publication) of Australian academics; secondly, it considers some factors which are associated with different levels of productivity in the Australian system. Both these objects relate to matters of pivotal importance in contemporary Australian and British higher education policies. These include a deep concern with the quality of higher education provision across the system, greater emphasis on the regular assessment of individual academics' proficiency, attempts to link resource allocation to research output using performance indicators, and pressures on those institutions which until recently have had little commitment to research to become productive.

These issues translate into practical questions such as the kind of environment that might facilitate – or inhibit – high levels of research output, the possible differences in productivity between academics who are orientated towards different scholarly activities (research versus teaching, for example), the feasibility of transforming institutions focused on teaching into ones focused on research and teaching, and the level of publication that might be regarded as evidence of a staff member's, or department's, satisfactory performance in different subject areas. On a more theoretical level, they raise questions about the interpretation of apparently "objective" data about research output, in particular the problem of whether and how to correct for contextual factors such as the academic's position or the department's institutional location prior to making personnel or resource allocation decisions (see Elsworth, 1992). They touch, also, on the even wider question of whether the development of a theory of research and teaching productivity is a realistic goal.

Previous studies of research productivity

The study of academic research output and the factors associated with it has itself brought into existence an enormous quantity of literature. Several hundred articles together address the questions of how many publications are produced in different parts of higher education, by different types of faculty, and in different subject areas; and of what characteristics of departments and persons are associated with publication.

Taking first the issue of the quantity of output, a small number of regularities have emerged. The first of these is a negative result: it is evident that the number of publications produced and research grants gained by the "average" faculty member is hard to estimate accurately. This is so for several reasons, some of which interact with each other. The first problem concerns the unit of publication: are books to be counted as well as journal articles, for example? Must articles be published in refereed journals if they are to be counted? Are conference papers and reports to be counted? How is joint authorship to be allowed for, if at all? Should journal articles be weighted by the prestige of the journal? Should performances, exhibitions, letters to the editor, be counted? The next difficulty relates to different publishing modes characterising different subject areas. If only refereed journal articles are admitted, for example, then fields of study where monographs and books are the usual form of publication (in many arts subjects, for example) will be unfairly disadvantaged in any overall average. But there is little agreement on how to weight different forms of publication to produce a single index (Creswell, 1985; Feldman, 1987). A third problem concerns how to collect the information:

issues such as over what number of years the data should be averaged, and what type of information (self-report or counts from research reports, for example) is to be regarded as valid, are not easy to decide. Fourthly, the meaningfulness of a general average is doubtful when the range of output is so great. The final problem mentioned in the previous paragraph touches on the second regularity in the literature on research output: the twin facts that most publications are produced by a small number of academics and that many faculty produce little or nothing. In other words, the distribution of publications is heavily and negatively skewed, a regularity that has been noted repeatedly since at least 1926 (see Daniel, 1990, p.358). This leads to the third main theme of this area: the fact that, although average output is impossible to estimate exactly, it is certainly not high. This is, perhaps, a paradoxical result. Even though research is manifestly important in the academic reward system, most academics are far from being fertile publishers.
Evidence of low productivity abounds. Halsey (1980) reported that 23 percent of his UK university staff sample, and 68 per cent of his polytechnic sample, had published nothing at all in the previous two years. The Australian review of science and mathematics teacher education found that 34 percent of staff had not published in the last five years. Boyes, Happel and Hogan (quoted in O'Neill, 1990) maintain that the average number of articles needed for promotion to full professor in US universities is five. Ladd and Lipset's survey of American academics (Ladd and Lipset, 1978) showed that 31 per cent published from zero to four articles during their entire careers. West, Hore and Boon (1980) calculated a median output of three articles in five years for staff in one (unnamed) university faculty. Fox (1992) estimated a mean of 2.4 among social scientists in three years. Bentley and Blackburn (1990) give a general average of about eight articles in five years, a rather higher figure than most other North American studies suggest.

Fox quotes other studies that indicate a five-year median of about 5 for biochemistry and 3 for physics; on the other hand, Blume and Sinclair (1973) reported mean numbers of papers from 13 to 26 in different fields of chemistry in British universities. (It seems that the British university system – as it was in 1970, at any rate – resembles the elite US research university sector. The Australian system seems to fall somewhere in between). Cole (1979) and Reskin (1977) (quoted in Fox, 1983) separately report that 15 percent of American academics produce about half the total publications.

Explaining productivity
The classic review of the correlates of productivity levels is Fox's (1983). She distinguishes among individual level

variables, environmental variables, and feedback processes. The first group include the academic's motivation, inner compulsion, attitudes and interests, cognitive style, ability, work habits, and age. The environmental variables that correlate positively with productivity include graduate school background, the prestige of the department, degree of collegiality within the unit, and the amount of freedom it provides to pursue individual interests. A particularly interesting finding is that the effect of productivity on the prestige of the department seems to be weak, while the effect of prestige on productivity is strong (Long, 1978). In other words, selection effects are less important than environmental ones. Fox discusses theories of reinforcement and "cumulative advantage" ("to those that have...") theories under a separate heading of feedback processes, suggesting that there is cyclical process linking individual and environmental level variables, such that early productivity becomes the source of advantage, advantage leads to increased facilities, which in their turn lead to more advantage and higher continuing productivity.

Most of the results of the studies that attempt to explain research productivity are unsurprising, but neither are they easy to interpret. The majority of these studies are correlational; their task seems to have been to search for as many predictors as possible. Few of them, with the notable exceptions of Elsworth (1992) and Blackburn et al (1991), have started from any kind of theoretical perspective.

Among the multitude of investigations, Long and McGinnis (1981) establish the effect of different types of institution on productivity, while Blackburn et al (1978) stress the key role of the departmental environment on output. Blackburn et al also found that interest in research was the best individual level predictor of high output, while rank and frequency of academic communication also correlated with productivity. Gender does not appear to influence research output after other influences such as rank and discipline are controlled (Blackburn et al 1978, 1991). Both Baird (1986) and Bentley and Blackburn (1990) examine aggregate (departmental level) data only, and conclude inter alia that the correlates of productivity may differ in different disciplines, that graduate students' perceptions of the quality of instruction are unrelated to average output, and that type of institution differences remain after controlling for discipline differences.

Blackburn et al (1991) use a theory of cognitive motivation to argue that academics assess their personal abilities in different ways, and that these assessments interact with their perceptions of the environment to produce variation in the activities that lead to higher and lower levels of research output. Elsworth (1992) and Ramsden and Moses (1992) begin from the hypothesis that teaching effectiveness and scholarly productivity are closely coupled. Elsworth uses data from Australian accountancy

departments to establish that students' and graduates' perceptions of the quality of teaching and learning are not

associated with average output. Ramsden and Moses found negative or zero relations between self-reports of commitment to teaching and productivity, at both unit level and individual level.

Theoretical model

The theoretical assumptions underlying the results presented in this paper derive from several sources. First, we assume (following Blackburn et al (1991) and Fox (1992)) that any sensible explanation of research output must take into account personal and structural (environmental) factors, and preferably also the interaction between them.

Second, we maintain that there is no simple association between scholarly productivity and other desired outcomes, such as teaching excellence.

Third, it would seem important to look particularly at structural variables that might be amenable to change, such as the departmental environment, in order to learn about optimal conditions for high levels of output. We are mindful of the theoretical implications of studies of student learning which suggest that students' perceptions of academic environments are critical influences on the effectiveness of the learning strategies they adopt, and ultimately on the quality of the learning outcomes they reach (see Biggs, 1991; Entwistle and Ramsden, 1983; Ramsden, 1992). In this respect the seminal research is that reported by Entwistle and Ramsden (1983) and Ramsden and Entwistle (1981), which showed that there were aggregate level relations between perceived environments and approaches to studying. Might a similar relationship occur between academics' research output and their perceptions of the departmental environment? There are some

suggestions in the previous work that it may: Blackburn and his colleagues found some relationships between staff perceptions (measured at individual level) and productivity, and Baird (1986) reported a similar association with "compatibility of the work environment", though only for the chemistry academics in his sample.

Data sources and methods of analysis

The results to be described here are based on a 1989 survey of full time staff working in 18 Australian higher education institutions, of which 8 were universities established prior to 1987. The remaining institutions were part of the former advanced education sector, and comprised 4 large technological

institutions and 6 colleges of advanced education. The subject areas covered included humanities, commerce, science, health science and engineering. Further details of the sample appeared in Ramsden and Moses (1992). Thirty members of staff at a subsample of institutions in Melbourne, all of whom had previously completed questionnaires, were interviewed during 1991.

Dependent variables

In Ramsden and Moses (1992), two indicators of individual research performance were used. An index of research productivity (IP) was defined as the five year sum of (3 x the number of single or multi-authored books) + (the number of papers published in refereed journals) + (the number of edited books) + (the number of chapters in refereed books). In the results that follow, the number of books, refereed papers, conference papers, edited books, and chapters reported as having been produced over the five year period will also be separately described.

An index of research activity (IA) was calculated from answers to a question about whether the respondent had or had not undertaken each of a series of academic activities during the past two years such as receiving a competitive research grant, reviewing a funding proposal, and supervising doctoral candidates.

The IP and IA measures were also used, in certain analyses, at aggregate (department) level. Aggregate IP was defined as the ratio of total IP to the number of staff responding, or more simply stated the average IP or number of publications per capita over a five year period. If it is assumed that the respondents are a representative sample of the population in each department, and further that aggregate IP is mediated by expert review in the way that refereed journal articles are (both rather dubious assumptions in the present case), then average IP is a true performance indicator, since it accurately measures amount of output per unit of input, where each input unit is an employee on the payroll (see Gillett, 1989, p.27).

Similarly, aggregate IA is the ratio of total IA to the number of respondents. The two aggregate measures are closely associated in our sample (see Figure 1).

Background and independent variables

The first section of the academics' questionnaire supplied information about each respondent's gender, department, subject area, institution type, academic rank, and age. Respondents were asked to assess their own capacity as a teacher and as a researcher on a scale of 1 to 5 (from 'below average' to 'outstanding'), and from these answers a typology of academic quality was derived (see Ramsden and Moses, 1992). The typology is reproduced as Figure 2: it identifies groups of academics labelled respectively as "Low" (on both self-rating quality measures), "Researchers", "Teachers" and "Teacher-researchers". Respondents also indicated in this section of the questionnaire whether their early academic interests lay primarily in teaching

or research.

Figure 1: Association between departmental research activity and departmental publication rate

Figure 2: A typology of academic quality groups

Self-rating of teaching quality

Self-rating of research quality	Low	High
Low	Group 1 Low Teachers (N=135)	Group 3 (N=159)
High	Group 2 Researchers (N=211)	Group 4 Teacher-researchers (N=361)

Another section contained items about attitudes to promotion and tenure (see Moses and Ramsden, 1991). Respondents were asked their opinion of the extent to which certain activities were currently taken into account in decisions about promotion and tenure in their institutions; and about the extent to which they thought these activities should be taken into account; again using a five point scale. The sum of the absolute differences between the corresponding 'is' and 'should be' responses for two of these activities (teaching undergraduates; research and publication) was used to provide an indication of the staff member's satisfaction with his or her institution's promotions system. The greater the discrepancy between 'is' and 'should be', we assume, the greater the dissatisfaction.

The final section of the questionnaire comprised a series of items which formed five attitude scales. The scales of interest in this article are:

1. Commitment to teaching (Cronbach alpha = 0.81). This measures the respondents' interest in teaching

undergraduates and improving his or her teaching. Sample item: "I go out of my way to help students with their study problems".

2. Student independence (alpha = 0.68). This measures interest in helping students to become autonomous learners. Sample item: "I aim to provide students with the capacity to learn new ideas and information for themselves".

3. Intrinsic academic motivation (alpha = 0.69). This measures interest in the subject matter for its own sake, and corresponds to measures of "interest in research" (Blackburn, Behymer and Hall, 1978) or "deep motivation" (in students) (Biggs, 1991). Sample item: "I become increasingly absorbed in my academic work the more I do"

4. Cooperative departmental environment (alpha = 0.76) This measures respondents' perceptions of the degree to which their department is managed fairly and supportively, and the extent to which there is mutual cooperation between colleagues. The average value for a department is defined as an indicator of the quality of the unit's research environment (c.f. Ramsden and Entwistle, 1981). We hypothesise that more cooperative environments will encourage higher individual outputs. Because this dimension forms a key independent variable in our model, the items are listed in full in Table 1.

Table 1: Items forming the Cooperative Departmental Environment scale

In my department, staff are consulted on matters of policy even when they are not directly affected

Staff in this department often discuss research issues together

Teaching loads in my department are negotiated cooperatively among staff

There is not much discussion on teaching and curriculum issues among academic staff in this department

There is a considerable amount of professional jealousy among academic staff in this department

Good teachers are highly respected in this department

Interviews

A series of interviews of a subsample of staff from the original survey were carried out in 1991 and 1992. These interviews explored respondents' perceptions of the relations between teaching and research, their views about the correlates of

productivity, and their perceptions of the effects of departmental and institutional environments on their own research activity and output. Details of the results, which broadly coincide with the main findings of the survey results reported below, will be reported in a subsequent version of this paper.

Results and discussion

Levels of productivity

Tables 2 and 3 provide details of the median numbers of books, edited books, edited book chapters, conference papers, and refereed journal articles published by the sample during the period from 1985 to 1989. Median rather than mean values are shown because of the highly skewed distribution of output, a phenomenon which is discussed below. The percentage of academics in each of the categories publishing nothing at all during the period is also given. Table 2 shows productivity by sector; table 3, productivity by subject area.

Table 2: Research productivity by sector, five year period 1985-1989

Sector	Books	Edited books	Chapters	Conference papers	Refereed articles
Pre-1987 universities (N=557)					
Median number of publications	0	0	0	0	0
Percentage of staff producing no publications	68%	83%			

0

57%

2

33%

5

19%

CAEs
(N=119)
Median number of publications
Percentage of staff producing no publications

0

71%

0

90%

0

73%

1

42%

0

58%

Large techs.
(N=185)
Median number of publications
Percentage of staff producing no publications

0

78%

0

92%

0

84%

1

35%

1

48%

Table 3: Research productivity by subject area, five year period 1985- 1989

Subject area

Books
Edited books
Chapters
Conference
papers
Refereed
articles

Social science
(N=122)

Median number of publications
Percentage of staff producing no publications

0

54%

0

81%

1

44%

2

33%

3

25%

Arts
(N=125)
Median number of publications
Percentage of staff producing no publications

0

58%

0

74%

0

52%

0

53%

2

33%

Natural sciences
(N=242)
Median number of publications
Percentage of staff producing no publications

0

88%

0

93%

0

75%

2

32%

8

20%

Engineering
(N=132)
Median number of publications
Percentage of staff producing no publications

0

73%

0

86%

0

76%

4

15%

1

40%

Health
science
(N=79)

Median number of publications

Percentage of staff producing no publications

0

77%

0

90%

0

82%

1

35%

1

49%

Commerce/
Law
(N=147)

Median number of publications
Percentage of staff producing no publications

0

57%

0

83%

0

56%

1

40%

2

32%

These self-report data are subject to qualifications. There was an obvious temptation to inflate one's own publication rate in the self-report, anonymous questionnaire (including 'in press' articles as publications and non-published conference papers as published ones, for example). No distinction has been made between single-author and multi-author works, so double-counting may have occurred. The respondent sample was biased towards senior staff (professors and readers) in comparison with the population; and seniority of rank, as we shall see below, is a strong predictor of research output.

All these factors suggest that the numbers are probably over-estimates of actual productivity. Even if we regard them as accurate, by no means do they suggest that the average Australian academic is a very prolific publisher (although he or she is probably not less productive than his or her colleagues in the USA and UK). The staff of the former CAEs and large technological colleges are notably less productive than their colleagues in the older universities. This may be no surprise; but even in the prestigious pre-1987 universities, geared strongly towards research, nearly 2 out of every 10 staff reported that they had not produced a single journal article, even as a co-author, in five years. An average of more than one article a year is enough to place an academic in one of the older universities in the upper half of the distribution of producers.

The second important point is that our results show that the productivity of Australian academics is just as variable as that of American and British ones. Most publications, in other words, are the work of a minority of staff. Table 4 illustrates the phenomenon for the pre-1987 university staff. Using the composite measure of productivity (IP) previously described, it shows that half the sample produce 87 percent of the total output, and that 14 percent of the sample produce half of it. These figures resemble very closely those of the US studies previously mentioned (see Fox, 1983). Equivalent distributions for the CAEs and large technological institutions are even more skewed. In the CAEs, 10 percent of staff produced 51 percent of the output; in the large technological institutions, 10 percent produced 49 percent of it. Twelve percent of university staff reported that they published nothing in the 5 year period. The equivalent figures for in the CAEs and the technological institutions were 38 and 36 percent respectively. Across the whole sample, an average of 20 percent did not publish during the period.

Table 4: Percentage of publications produced by percentage of staff (pre-1987 universities)

	Percentage of staff			
	10	14	40	50
Percentage of total output (all publications)	87	36	50	80

Figure 3 illustrates the effects of sector on individual productivity after controlling for subject area. Standardised IP scores were created for each of the subject areas separately, summed across them, and a new standardised score was then created from the sum of scores (see Bentley and Blackburn, 1990, for details of the technique). It is clear that the different mix of subjects in the different sectors does not account for the sector differences.

Figure 3: Research productivity by sector, compensated for subject area differences

The correlates of productivity

We begin by examining personal and structural correlates separately. Tables 5 and 6 list the mean IP scores for different groups of staff, and show effect sizes in order to illustrate differences between the predictors.

The strongest personal correlates are early interest in research, involvement in research activity, and seniority of academic rank. The research activity association is unsurprising. Staff who report an early interest in research rather than teaching are three times more productive than those who report an early interest mainly in teaching. Professors and readers are about four times more productive than lecturers. Age is not significantly related to research output across the whole sample, although the mean values suggest, as other studies have shown, the existence of peak output in the middle years. The smaller (negative) effect of commitment to teaching on output reproduces findings previously reported (Ramsden and Moses, 1992). The negative effect of female gender on output is mainly attributable to the different distribution of sexes in different academic ranks (see below).

By far the best structural predictor of individual output is the academic's membership of a highly active research department (Table 6). This is of course congruent with the aggregate level association described in Figure 1; active departments produce

more publications for their size than less active ones. In turn these departments are more often pre-1987 university ones, more often teach science, more often provide a cooperative environment, and are less likely to have staff who are strongly committed to teaching.

Table 5: Personal correlates of research productivity

Personal characteristic	Mean IP	SD	P <	Effect size
Gender - female	5.8	7.4	.000	Medium
Gender - male	10.4	12.8		
Early interest - primarily in teaching	5.1	8.0		
Early interest - more in teaching	6.3	9.7		
Early interest - equal	10.3	10.4	.000	Very large
Early interest - more in research	12.1	14.6		
Early interest - primarily in research	15.6	14.1		
Intrinsic academic motivation - low	5.8	11.4		
Intrinsic academic motivation - medium	8.6	11.3	.000	Large
Intrinsic academic motivation - high	12.8	12.1		
Research activity index - low	3.0	6.8		
Research activity index - medium	6.5	7.3	.000	Very large
Research activity index - high	16.7	14.1		
Appointment - professor or reader	16.2	15.9		
Appointment - senior lecturer	8.2	9.4	.000	Very large
Appointment - tenured lecturer	3.7	6.5		
Appointment - untenured lecturer	4.5	5.7		

Table 5 continued

Personal characteristic	Mean IP	SD	P <	Effect size

Commitment to teaching - low 11.6 13.6
Commitment to teaching - medium 8.8 11.6 .001
Medium
Commitment to teaching - high 7.5 10.0

Satisfaction with promotions system
- high 12.8 13.9
Satisfaction with promotions system
- medium 8.7 11.24 .000
Large
Satisfaction with promotions system
- low 6.0 8.2

Age - 31 or younger 4.9 7.3
Age - 31-40 9.7 11.9
n.s.

Age - 41-50 9.7 12.4
Age - 51 or older 9.0 11.5

Table 6: Structural correlates of research productivity

Structural characteristic Mean IP1 SD P <
Effect size

Sector - pre-87 university 11.5 12.5
Sector - CAE 3.6 6.3 .000
Large
Sector - large technological college 4.6 7.5

Field of study - social science 11.0 12.4
Field of study - arts 6.3 6.7
Field of study - science 13.0 14.7
.000 Large
Field of study - engineering 5.8 8.7
Field of study - health science 4.7 8.8
Field of study - commerce or law 8.4 9.3

Cooperative departmental environment
- low 6.4 7.4
Cooperative departmental environment
- medium 10.1 12.9 .01 Medium
Cooperative departmental environment
- high 10.8 13.5

Departmental mean research activity index - low	4.0	5.8		
Departmental mean research activity index - medium	9.2	10.0	.000	Very large
Departmental mean research activity index - high	16.4	15.1		
Departmental mean commitment to teaching - low	13.1	14.4		
Departmental mean commitment to teaching - medium	9.3	11.3	.000	Large
Departmental mean commitment to teaching - high	6.7	10.2		

A series of analyses of variance and multiple regression analyses was undertaken to establish the relative influence of these different factors. Most independent variables maintained some statistically significant connection with output after controlling for one or more other correlates, with the exception of gender. In this case, the association is almost entirely accounted for by the fact that females are less likely to hold more senior posts. Figures 4 and 5 illustrate some other joint effects of theoretical interest. Dissatisfaction with the promotions system, unlike gender, maintains a negative influence on output across different levels of seniority (Figure 4). Cooperative environments are associated with higher individual outputs in both pre-1987 universities and the other institutions (Figure 5; CAEs and the large technological colleges are here combined because of small cell sizes).

Figure 4: Research productivity by academic rank and dissatisfaction with promotions system

Figure 5: Research productivity by sector and departmental environment

Variable reduction

The next stage of the analysis involved reducing the number of

variables through factor analysis of a combination of personal and structural characteristics suggested by the preliminary work. Research activity was included at departmental level only so that both individual IA and individual IP could be related to the independent variables of the reduced model. Dummy variables were used for subject area (science departments = 1, non-science = 0) and for sector (pre-1987 university departments =1, others = 0). In the case of level of appointment, a distinction was made between professors and readers (1) and the rest (0).

Table 7 shows the results of a factor analysis (after oblique rotation) using the eigenvalues-greater-than-one criterion for the number of factors to be extracted. The four factors represent latent constructs consisting of clusters of similar independent variables. The first construct is readily interpretable. It brings together three structural variables: institution type, departmental research activity (mean IA), and cooperative departmental environment. There are is also a small loading on the personal variable described as early interest in research rather than teaching. Seen from the point of view of the individual academic, the construct defines membership of an active research department with a cooperative management structure. As our previous analyses have shown, these departments are mainly to be found in the older universities.

The second latent construct relates high scores on three personal variables measured by the questionnaire attitude scales. Two of these are directly concerned with teaching (commitment to teaching and student independence). The third variable measures intrinsic academic motivation, or liking for one's subject for its own sake. The factor suggests an orientation towards teaching subject matter in which the staff member has an inherent interest.

The third latent construct brings together more junior academic status (below reader level), dissatisfaction with the promotions system, low scores on intrinsic academic motivation, and early interest in teaching rather than research. It is possible to interpret this factor as one of discontent with or alienation from the academic environment.

The fourth latent construct is easily understood but of less interest. It records the fact that women are most likely to be found in non-science departments, and that early interest in teaching is slightly more common among these groups.

Table 7: Factor analysis of selected structural and personal correlates of research productivity

	I	II	III	IV
Pre-1987 University	83			
Departmental mean IA	77			

Mean cooperative environment	65				
Early interest in research		35			-31
-30					
‘Commitment to teaching’			80		
‘Student independence’			80		
‘Intrinsic academic motivation’				65	-46
Academic position below reader					76
Dissatisfied with promotions system				64	
Non-science subject area					
78					
Female					75

Notes
1. Loadings <0.30 and decimals omitted.
2. Structural variables shown in italic; personal variables in roman.
3. The four factors are described in the text as the latent constructs (LCs) 1 to 4, viz. LC1 Supportive environment; LC2 Teaching orientation + interest in subject; LC3 More junior + alienated; LC4 Non-science females.

Our preliminary analysis and our theoretical model now suggest the following hypotheses:

1. High scores on construct 1 should be positively associated with research productivity, since they indicate a combination of structural and personal characteristics (working in a supportive, active research environment in an older university; together with an early interest in research) favourable to high output. In terms of our typology of academic quality groups (Figure 2), “Teacher-researchers” and “Researchers” are most likely to be found in these environments and to have an early interest in research, and so they are likely to have the highest scores on this construct.

2. Scores on construct 2 would not be expected be associated with research productivity. This factor combines two individual variables that are either distinct from research productivity or negatively related to it (see Ramsden and Moses, 1992) with one variable that is positively related to it. “Teachers”, and possibly “Teacher-researchers”, ought to have the highest scores on this construct.

3. High scores on construct 3 should be negatively associated with research productivity. Academic position was among the strongest predictors of publication output in the preliminary analyses. Dissatisfied junior staff who express low intrinsic interest in their subjects seem unlikely to be high producers. It is probable that staff who score low on both self-ratings (i.e those who rate both their research and their teaching below average) will score highest on this variable.

4. High scores on construct 4 should also be negatively associated with research productivity, since staff in non-science departments with early interest in teaching are on average less productive. The preliminary analyses showed that the apparent gender effect disappears, or at any rate is much attenuated, when controls for level of appointment and subject area are introduced.

These hypotheses were examined in the following ways. Factor scores were calculated for each latent construct. Mean values were broken down by level of research activity and productivity, and by academic quality group. We then estimated regression equations with the latent constructs as independent variables and the two research measures as dependent variables.

Table 8 gives a summary of the regression results. They offer some support for each of the four hypotheses. The best predictor of both IA and IP is construct 3 (low activity and productivity is predicted by junior rank combined with dissatisfaction and low intrinsic motivation), followed by construct 1 (high activity and productivity is predicted by membership of a supportive research environment), construct 4 (low activity is associated with female gender and being in a non-science subject area). Construct 2 is not related to productivity and only marginally related to activity.

Figure 6 illustrates the relationship between levels of output (IP) and staff members' scores on three of the latent constructs (LCs 1,3, and 4). Staff are categorised into low producers (the lowest quarter of the sample) medium (the middle half) and high (the top quarter). The graph show the factor scores for each of the three groups. We see that the lowest scores on LC1 occur for the low output group and the highest for the high output group; the reverse is the case for LC3. The pattern for LC4 is less clear, though the group with the highest output has the lowest score, in accordance with our prediction.

Figure 7 shows the association between membership of the four quality groups ("low", "researchers", "teachers", and "Teacher-researchers") and the factor scores on the first three constructs (the differences between the groups on the fourth construct were not significant). The results are broadly as expected, with the

"low" group and the "teachers" scoring low on the supportive environment factor (LC1) and high on the alienation factor (LC3), and the "teacher-researchers" scoring high on the teaching orientation/intrinsic interest factor (LC2).

Table 8: Regression of latent constructs on IA and IP

	IA			IP		
	B	SEB	R2	B	SEB	R2
LC1 (Supportive environment)	1.55	0.07	0.33	3.63	0.35	0.11
LC2 (Teaching orientation + interest in subject)	0.16	0.07	0.00			n.s.
LC3 (More junior + alienated)	-1.60	0.07	0.34	-5.04	0.35	0.21
LC4 (Non-science females)	-0.72	0.07	0.07	-2.91	0.35	0.07
Multiple R		0.70			0.51	

Figure 6 : Factor scores on three latent constructs for academics classified as low, medium, and high research output

Figure 7 : Factor scores on three latent constructs for the four academic quality groups

Conclusions

Taken together, these results suggest several conclusions and policy implications. We have seen that the average Australian academic is not a prolific publisher, and that most publications are produced by a small proportion of the total number of staff. This is true both within the sectors and across them. The image of the university teacher as a highly productive writer of books and articles bears little relation to reality. These findings are consistent with those from other countries.

If we ask how productivity might be increased, a question arises as to whether the best strategy consists in more rigorous selection of staff with characteristics known to be associated

with high output, or in more selective support of those who are already highly productive, or in changing the environment in which academics work in order to encourage greater research activity and output – or in some combination of these strategies. There is no support in our results for general exhortations to do research, and financial support for such research, among those staff and departments that do not already carry it out. Lack of early interest in research, dissatisfaction with promotions systems, and a high level of commitment to teaching either cannot be affected or are unlikely to be touched by such approaches. They are more likely to further alienate already dissatisfied staff at the same time as inefficiently allocating resources. It seems from our results that, if the goal is to maximise total research output, the "anti-Mathew" principle of an equitable distribution of research support across already productive and non-productive academics cannot be a practical policy option.
On a more positive note, it appears that certain kinds of departmental environment may conduce to high individual output: and here may lie a key to increasing the level of publication among Australian academics. The consequences, however, may be politically unacceptable in a period of consolidation following major changes in the structure of Australian higher education. A

staff member who works in a very active research department whose personnel are not particularly committed to teaching is more likely to be a productive academic. The departmental characteristics associated with high individual output perhaps indicate tentative endorsement of a rather traditional view of the academic department – a collegial structure with much research and scholarly activity, and a fairly low sense of responsibility to undergraduate students. Especially when taken together with the strong association between early interest in research and research productivity, these factors might even be thought to provide evidence to support a policy of separation between departments (and institutions?) whose main focus is research and graduate study on one hand, and undergraduate teaching on the other.
A less extreme picture emerges if we accept that explaining research productivity requires careful consideration of the contextual mechanisms that account for the relation between higher output and the older university departments (see Fox, 1992, p. 109). The effects of sector on output are not uniform, and our own results suggest that collaborative management structures and cooperative leadership patterns may be the keys to understanding how to enhance individual performance across the different types of university that comprise the unified national system.

Notes

(1) The record appears to be held by the American entomologist Theodore Cockerell, who is reported to have published a total of 3,904 papers (Zuckerman, 1970, quoted in Cresswell, 1985).

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