

## What kind of faculty are motivated to perform research by the desire for promotion?

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Received: 3 August 2004 / Accepted: 31 July 2006 / Published online: 2 September 2006  
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**Abstract** A policy of adding a new rank to the faculty career ladder was implemented in Taiwan in 1994. It was believed that structural changes of the incentive system would change faculty research behavior. This paper explores the question: Who are motivated to perform research by the desire for promotion? A mail survey investigating Taiwanese faculty members was conducted. The results show that the answer varies by different performance measures. Those who publish for the promotion reward tend also to be motivated by other external and internal rewards. Among all rewards, the most important to many faculty is an increase in personal income. Holding one's valence score on promotion constant, faculty with better research performance tends to be those who possess doctoral degrees. The results show that faculty in public institutions perform better than their private-institution counterparts, regardless of promotion valence. Finally, alternative policies to improve faculty research performance are recommended.

**Keywords** Higher education policy · Faculty research productivity · Promotion · Motivation · Faculty rank system

### Introduction

Research is one of the most important functions of universities throughout the world. Faculty members, the primary producers of academic research, play crucial roles in producing knowledge. Today, under the pressures of budget constraints, higher education leaders face the challenge of encouraging research vitality of their faculty to perform research. Different strategies, such as adding a new rank into the faculty rank hierarchy, establishing post-tenure review, providing sabbatical, offering travel funds, and holding workshops to overcome faculty writing blocks, have taken to assuring faculty research and career growth (Boice, 1983, 1984, 1992; Boice

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& Johnson, 1984; Licata, 1986; Creswell & Brown, 1992; Sorcinelli & Austin, 1992; Hekelman, Zyzanski, & Flocke, 1995; Tien, 2000; Bazeley, 2003). Among the different strategies, many scholars and policy makers believe that structural changes of the incentive system—for example, changes of the faculty rank hierarchy—would be an effective way to influence faculty behavior (Tuckman, 1976, p118, 1979; Fox, 1985; Legislative Yuan, 1989a; Pan & Hsieh, 1989; Brewer, Brewer, & Hilton, 1990; Diamond & Adam, 1993; Kwiek, 2003; Smolentseva, 2003).

The idea of adding a new rank to the faculty career ladder assumes that the desire for promotion should have a motivating effect on faculty research productivity. Some higher education studies devote themselves to examining whether or not the desire for promotion motivates faculty to publish. Studies have indicated that motivation for promotion does have an impact on faculty research behavior for both American faculty and Taiwanese faculty. For instance, Tien and Blackburn (1996) use the Carnegie survey of American faculty to demonstrate that the introduction and removal of promotion rewards influence publication rates and the shape of faculty productivity curves. Based on the rationale of expectancy theory, Tien (2000) found that Taiwanese faculty who are more highly motivated by the possibility of promotion display better research performance than their less-motivated colleagues. Lawrence and Blackburn (1985) and Lawrence et al. (1989) reported that the desire for promotion influenced some, but not all, faculty members. They found that some individuals adjusted their efforts (e.g., increasing publications versus adding administrative tasks) in response to perceived promotion requirements; some faculty exhibited definite “spurts of productivity” around promotion decisions, and some faculty members’ productivity fell after achieving the full professorship (Lawrence & Blackburn, 1985). Due to the small sample size in their study, however, the common personal characteristics shared by this specific group of faculty—if any—were not identified.

Although the presence of a research-linked promotion system is a significant predictor of better research performance among faculty members, we do not know, for instance, what are characteristics of faculty members who perform research and are motivated by the desire for promotion? How do these faculty members differ from their colleagues who do not publish despite their high desire for promotion? How do they distinguish from nonproductive faculty with low-promotion motivation? And how do they differ from other productive faculty members who say they care less about promotion? An inquiry into the common characteristics of faculty who do research because of the anticipated promotion reward may add to our knowledge of faculty motivation and of research productivity. By utilizing Taiwanese faculty data, this paper aims at exploring what kind of faculty are motivated to perform research by the desire for promotion.

### Conceptual framework and research hypothesis

Since few studies have inquired into the research question proposed in the study, the abundant literatures on inquiring the correlates of faculty research productivity are briefly reviewed. When Tuckman (1976, p118, 1979) suggested adding a new rank level to the American faculty rank hierarchy, the effect of aging on research productivity is a major concern. Therefore, age is first selected to examine faculty members’ motivation-productivity patterns. The second one would be gender. Why male scientists are more prolific researchers than females remains a puzzle

(Cole & Singer, 1991). Some scholars have argued that marriage and child care are barriers to a female's research career (Hargens, McCann, & Reskin, 1978). Others dispute such a claim (Cole & Zuckerman, 1987; Sax, Hagedorn, Arredondo, & Dicrisi, 2002). Gender differences in resource acquisition (Zuckerman, 1987; Bentley, 1990) and collegial isolation which reduces the opportunities to exchange research information and ideas (O'Leary & Mitchell, 1990) are also invoked to explain women's relatively low productivity. According to Fox and Faver (1981), men have significantly stronger aspirations for promotion than do women. Since college students instead of faculty are the subjects of their study, whether or not male faculty show stronger motivation for promotion than female faculty and hence have different productivity patterns from female faculty needs to be examined. Third, academic field is selected as a correlate. Faculty members with different specialties are socialized in different academic cultures and develop different publishing norms (Creswell, 1985; Bayer & Smart, 1991). In general, engineering and the natural sciences faculty tend to publish articles, humanities faculty tend to publish books, while the social sciences faculty fall somewhere in between (Ma, 1985; Tien, 2000). Faculty members in engineering and the natural sciences may be more or less motivated to publish by the desire for promotion—this difference also needs to be investigated. Fourth, productive faculty often are those who hold a doctoral degree (Finkelstein, 1984; Ma, 1985). However, we do not know whether or not possessing a doctoral degree makes a difference in the motivation-productivity patterns. Fifth, in Taiwan, possessing a foreign degree not only has a certain prestige value but also serves as one significant predictor of faculty research productivity (Ma, 1985; Altbach, 1989). It is reasonable to assume that faculty trained abroad have been socialized toward different research norms and values than domestically trained faculty. The impact of this difference is a question that needs to be answered. Sixth, institutional affiliation may play a substantial role in shaping individual valuation of research and conceptions of the scholarly role. In Taiwan, public institutions are superior to their private counterparts not only in terms of facilities and faculty quality (e.g., proportion of PhDs), but also in research resources owned, among others (Lin, 1984; Gai, 1985; Ma, 1985; Huang, 1986; Ministry of Education, 2001). Whether faculty members in public universities display different motivation-publishing patterns from their colleagues in private universities needs to be examined. Finally, faculty members' desire for other kinds of rewards may reflect their personal values and may have some implications for their promotion-motivation/productivity patterns. These desires include increases in personal income, peer recognition, respect from students, upward mobility into administration, satisfaction of curiosity, the challenge of responding, the sense of mastery, and the joy of involvement (Vroom, 1964; Csikszentmihalyi, 1988; Tuckman, 1976; Hunter & Kuh, 1987; Butler & Cantrell, 1989; Tien, 2000). Do these characteristics distinguish among faculty who publish because of the promotion reward, faculty who do not publish regardless of their desire level for promotion, and faculty who publish but care less about the promotion reward demands an investigation? In short, as an exploratory study, I propose the following research hypothesis to answer this main question: What kind of faculty are motivated to perform research by the desire for promotion?

Hypothesis: Age, gender, academic field, doctoral degree, country in which training was received, institutional affiliation, and personal value system for different rewards are significant predictors of one's promotion motivation-research performance patterns.

Before moving to the next section, a rough picture of faculty rank system in Taiwan needs to be mentioned. In Taiwan, the old faculty rank system was reformed in 1994. The old system was composed of four career ladders: teaching assistants, lectures, associate professors, and professors. Many people with doctoral degrees could be hired directly as associate professors prior to 1994. The Ministry of Education took several years of effort to rewrite the University Act, which regulates hierarchies of the faculty rank system. When the Ministry of Education proposed its new rank policy of adding the assistant professorship, the policy makers claimed that the policy was specially targeted in order to lengthen the research careers of associate professors who are young and possess doctoral degrees. Otherwise, the policy makers argued, “once these young faculty (who hold doctoral degrees) advance to full professor, they may not do research” (Legislative Yuan, 1989b). In 1994, the government did add a new rank of assistant professorship to the Taiwanese faculty career ladder (University Act, 1994). This change was made possible by the centralized nature of the Taiwanese higher education system, in which the government has control over personnel policies and practices. In practice, however, most universities did not hire their first assistant professor until 1997 since related regulations made by various universities and other related laws need to be modified according to the new Act (Ministry of Education, 2004c). Since the policy assumes that the desire for promotion motivates faculty to publish, it is important to explore what kind of faculty are motivated to perform research by the desire for promotion.

## Methods and data

### Subjects

The subjects of the study are instructors and associate professors employed in nine institutions in Taiwan. They are selected from 14 different fields including disciplines in natural science, engineering, humanities, and social sciences. All selected institutions are 4-year universities with graduate programs. They vary in terms of institutional control (six public universities versus three private ones), institutional orientation (comprehensive universities, humanities and social science-oriented, engineering and technology-oriented), and geographic location (North, Central, and Southern Taiwan).

The data analyzed were collected by a mail survey and from publication material (Tien, 2000). The survey response rate is 52% (1,017 full-time faculty members complete cases). The survey was done before Taiwan’s parliament passed the University Act, which added a new rank of assistant professorship. In the study, teaching assistants are not investigated since they are expected not to conduct research. Full professors are excluded from the survey data because there is no further step on the career ladder to which they can be promoted and therefore no need to examine their promotion motivation-productivity patterns.

### Variables

In addition to demographic, educational, and institutional variables, the mail survey also collects data on a set of valence variables. Subjects are asked to use 0–100 scores to represent their evaluation of the importance of internal and external rewards to

them. The internal rewards include: satisfaction of curiosity, sense of mastery over subject matter, responding to challenges, and joy of involvement. The external rewards which come from other people and the outside environment are: recognition from peers, love and esteem from students, increases in income, and administrative mobility. The more important the reward to the subject, the higher points he or she scores.

There are three measures of research performance: publishing articles or not, publishing books or not, and whether or not the faculty member received a National Science Foundation (NSC) Research Outcome Award. Among the 1,017 subjects in the study, about 48% of them published no articles at all in 1992. Another 28% published one article only. And another one-fourth of them published two or more articles. With regard to the book publishing, more than 90% of faculty published zero books, about 8% of our subjects published one book, and less than 2% of them published two or three books. Also, among all subjects about two-fifth of them won the NSC Research Outcome Award in 1992 while the other three-fifth did not receive the award. Previous research indicates that the dichotomous variables perform better as a measure of research performance than do raw number of publications when analyzing the relationship between the desire for promotion and faculty research performance (Tien, 1994). Therefore, the dichotomous measures of faculty research performance are utilized.

In this paper, the NSC Research Outcome Award serves as a quality indicator of research productivity (Ma, 1985). In Taiwan, faculty members can apply for the award by submitting their research publications for peer review. Only faculty members who pass the review process will receive the Research Outcome Award. Those who win the award receive up to 144,000 N.T. dollars, or about \$4,200 US at current exchange rates. Faculty may apply for the award year after year. Receipt of the Research Outcome Award is taken as evidence of superior research.

### Group classification and statistical techniques

For each measure of research performance, these subjects were divided into four groups based on two criteria: (1) a promotion valence score above or below the mean promotion valence score of the subjects selected, and (2) publishing (versus not publishing) articles or books or receiving (versus not receiving) the NSC Research Outcome Award in the year 1992.

For each measure, four groups were identified. I characterize the first group as an aggressive-belief/consistent-action group. This group of faculty tends to think promotion is important and exhibits good research performance. The second group consists of faculty who desire promotion but do not produce publications or compete for awards. The third group consists of those who have lower promotion valence scores but still perform research. The fourth group contains faculty members who care less about promotion and who do not act on research (for percentages of group membership see Table 1).

The research goal is to identify how characteristics of the first group of faculty who exhibit high-promotion valence scores and who produce publications or awards differ from those of the other three groups. Therefore, discriminant analysis is utilized to distinguish group membership. Discriminant analysis is a statistical technique in which linear combinations of variables are used to distinguish between two

**Table 1** Membership description for discriminant analysis

| Measures                  | Description  | N   | (%)    |
|---------------------------|--|-----|--------|
| Article-V <sub>prom</sub> |  |     |        |
| Group 1                   | Faculty who have above-average promotion valence scores and who publish articles         | 145 | 31.45  |
| Group 2                   | Faculty who have above-average promotion valence scores and who do not publish articles  | 107 | 23.21  |
| Group 3                   | Faculty who have below-average promotion valence scores and who publish articles         | 95  | 20.61  |
| Group 4                   | Faculty who have below-average promotion valence scores and who do not publish articles  | 114 | 24.73  |
| Total                     |  | 461 | 100.00 |
| Book-V <sub>prom</sub>    |  |     |        |
| Group 1                   | Faculty who have above-average promotion valence scores and who publish books            | 24  | 5.20   |
| Group 2                   | Faculty who have above-average promotion valence scores and who do not publish books     | 228 | 49.46  |
| Group 3                   | Faculty who have below-average promotion valence scores and who publish books            | 20  | 4.34   |
| Group 4                   | Faculty who have below-average promotion valence scores and who do not publish books     | 189 | 41.00  |
| Total                     |  | 461 | 100.00 |
| NSC-V <sub>prom</sub>     |  |     |        |
| Group 1                   | Faculty who have above-average promotion valence scores and who get the NSC grant        | 133 | 25.68  |
| Group 2                   | Faculty who have above-average promotion valence scores and who do not get the NSC grant | 148 | 28.57  |
| Group 3                   | Faculty who have below-average promotion valence scores and who get the NSC grant        | 97  | 18.73  |
| Group 4                   | Faculty who have below-average promotion valence scores and who do not get the NSC grant | 140 | 27.02  |
| Total                     |  | 518 | 100.00 |

or more categories of cases. It helps to find the linear combination of variables that best discriminates between, or separates, groups.

## Results

Table 2 reports bivariate group means and significance tests for 14 independent variables. As can be seen, most group differences reach the 0.05 significance level, and different sets of predictor variables achieve significance for different outcomes.

**Table 2** Means, Chi-square Tests and F Tests for Article-Vprom, Book-Vprom, and NSC-Vprom

| Variables            | Group means or % <sup>a</sup> |         |         |         | F or Chi-square <sup>b</sup> | df       | P      |
|----------------------|-------------------------------|---------|---------|---------|------------------------------|----------|--------|
|                      | Group 1                       | Group 2 | Group 3 | Group 4 |                              |          |        |
| <b>Article-Vprom</b> |                               |         |         |         |                              |          |        |
| Gender               | 0.87                          | 0.68    | 0.82    | 0.80    | 13.75                        | 3        | 0.0033 |
| Age                  | 37.59                         | 37.59   | 39.14   | 41.54   | 11.14                        | 3        | 0.0000 |
| Field                | 0.60                          | 0.45    | 0.53    | 0.48    | 6.56                         | 3        | 0.0861 |
| Degree               | 0.90                          | 0.59    | 0.80    | 0.60    | 45.95                        | 3        | 0.0000 |
| Country              | 0.68                          | 0.53    | 0.59    | 0.57    | 5.95                         | 3        | 0.1140 |
| Institution          | 0.75                          | 0.60    | 0.82    | 0.69    | 13.67                        | 3        | 0.0034 |
| Vpeer                | 77.81                         | 78.01   | 65.85   | 65.39   | 20.54                        | (3, 457) | 0.0000 |
| Vstudent             | 80.86                         | 81.92   | 72.42   | 74.11   | 10.92                        | (3, 457) | 0.0000 |
| Vincome              | 62.64                         | 61.86   | 44.97   | 43.62   | 21.95                        | (3, 457) | 0.0000 |
| Vadministration      | 34.21                         | 31.50   | 20.26   | 20.83   | 8.98                         | (3, 457) | 0.0000 |
| Vcuriosity           | 75.90                         | 71.13   | 69.20   | 65.80   | 5.99                         | (3, 457) | 0.0005 |
| Vmastery             | 76.39                         | 75.38   | 70.35   | 70.25   | 4.49                         | (3, 457) | 0.0040 |
| Vchallenge           | 75.92                         | 75.40   | 69.12   | 67.14   | 6.72                         | (3, 457) | 0.0002 |
| Vjoy                 | 76.34                         | 77.32   | 69.36   | 69.50   | 5.65                         | (3, 457) | 0.0008 |
| <b>Book-Vprom</b>    |                               |         |         |         |                              |          |        |
| Gender               | 0.83                          | 0.79    | 0.95    | 0.79    | 3.31                         | 3        | 0.3458 |
| Age                  | 38.96                         | 37.45   | 41.05   | 40.39   | 8.82                         | 3        | 0.0000 |
| Field                | 0.29                          | 0.56    | 0.20    | 0.53    | 14.94                        | 3        | 0.0019 |
| Degree               | 0.75                          | 0.77    | 0.55    | 0.70    | 6.05                         | 3        | 0.1090 |
| Country              | 0.63                          | 0.61    | 0.50    | 0.59    | 1.21                         | 3        | 0.7517 |
| Institution          | 0.83                          | 0.67    | 0.75    | 0.75    | 5.16                         | 3        | 0.1603 |
| Vpeer                | 76.42                         | 78.05   | 67.50   | 65.40   | 20.71                        | (3, 457) | 0.0000 |
| Vstudent             | 85.54                         | 80.76   | 78.15   | 72.83   | 12.54                        | (3, 457) | 0.0000 |
| Vincome              | 65.67                         | 61.96   | 41.75   | 44.50   | 22.15                        | (3, 457) | 0.0000 |
| Vadministration      | 29.17                         | 33.46   | 21.50   | 20.48   | 8.95                         | (3, 457) | 0.0000 |
| Vcuriosity           | 74.83                         | 73.78   | 69.40   | 67.13   | 4.30                         | (3, 457) | 0.0052 |
| Vmastery             | 83.17                         | 75.20   | 71.40   | 70.17   | 6.17                         | (3, 457) | 0.0004 |
| Vchallenge           | 79.92                         | 75.26   | 66.15   | 66.24   | 7.06                         | (3, 457) | 0.0001 |
| Vjoy                 | 80.38                         | 76.38   | 66.65   | 69.73   | 6.08                         | (3, 457) | 0.0005 |
| <b>NSC-Vprom</b>     |                               |         |         |         |                              |          |        |
| Gender               | 0.81                          | 0.73    | 0.85    | 0.76    | 5.81                         | 3        | 0.1210 |
| Age                  | 36.54                         | 38.97   | 37.86   | 43.20   | 27.91                        | 3        | 0.0000 |
| Field                | 0.62                          | 0.43    | 0.61    | 0.40    | 20.97                        | 3        | 0.0001 |
| Degree               | 0.88                          | 0.63    | 0.87    | 0.51    | 62.08                        | 3        | 0.0000 |
| Country              | 0.67                          | 0.59    | 0.68    | 0.47    | 14.87                        | 3        | 0.0019 |
| Institution          | 0.80                          | 0.61    | 0.86    | 0.68    | 24.12                        | 3        | 0.0000 |
| Vpeer                | 78.26                         | 77.57   | 65.39   | 65.11   | 24.05                        | (3, 514) | 0.0000 |
| Vstudent             | 81.15                         | 81.51   | 72.29   | 74.21   | 11.82                        | (3, 514) | 0.0000 |
| Vincome              | 65.12                         | 58.57   | 44.35   | 43.65   | 25.09                        | (3, 514) | 0.0000 |
| Vadministration      | 34.96                         | 30.81   | 20.82   | 19.43   | 11.01                        | (3, 514) | 0.0000 |
| Vcuriosity           | 75.15                         | 73.27   | 69.05   | 64.19   | 8.07                         | (3, 514) | 0.0000 |
| Vmastery             | 75.67                         | 76.28   | 68.13   | 70.75   | 6.63                         | (3, 514) | 0.0002 |
| Vchallenge           | 75.96                         | 75.78   | 70.23   | 66.51   | 8.72                         | (3, 514) | 0.0000 |
| Vjoy                 | 77.80                         | 75.93   | 69.16   | 69.39   | 6.72                         | (3, 514) | 0.0002 |

<sup>a</sup> For dummy variables such as gender, field, degree, country, and institutional type, the group mean is the proportion of faculty coded as 1 in the corresponding variables

<sup>b</sup> Instead of *F* statistics, a Chi-square test is utilized to test group differences for the dummy independent variables

However, common characteristics for the first group of faculty are still visible. Compared to other three groups, faculty who highly value promotion and who produce research tend to be younger. Also, they tend to think both internal rewards

**Table 3** Discriminant analysis results for article-Vprom, book-Vprom, and NSC-Vprom

| Measure       | Function | Eigenvalue | Relative percentage | Canonical correlation | Wilks' lambda | Chi-square | df | P      |
|---------------|----------|------------|---------------------|-----------------------|---------------|------------|----|--------|
| Article-Vprom | 0        |            |                     |                       | 0.64          | 201.39     | 30 | 0.0000 |
|               | 1        | 0.33       | 66.87               | 0.50                  | 0.86          | 70.56      | 18 | 0.0000 |
|               | 2        | 0.15       | 29.46               | 0.36                  | 0.98          | 8.24       | 8  | 0.4107 |
|               | 3        | 0.02       | 3.67                | 0.13                  |               |            |    |        |
| Book-Vprom    | 0        |            |                     |                       | 0.67          | 178.68     | 33 | 0.0000 |
|               | 1        | 0.33       | 74.58               | 0.50                  | 0.90          | 49.28      | 20 | 0.0003 |
|               | 2        | 0.09       | 19.63               | 0.28                  | 0.97          | 11.48      | 9  | 0.2442 |
|               | 3        | 0.03       | 5.79                | 0.16                  |               |            |    |        |
| NSC-Vprom     | 0        |            |                     |                       | 0.60          | 257.30     | 30 | 0.0000 |
|               | 1        | 0.41       | 69.94               | 0.54                  | 0.85          | 83.49      | 18 | 0.0000 |
|               | 2        | 0.15       | 26.27               | 0.36                  | 0.98          | 11.09      | 8  | 0.1969 |
|               | 3        | 0.02       | 3.78                | 0.15                  |               |            |    |        |

(e.g., the satisfaction of curiosity, the sense of mastery over subject matter, responding to challenges, the joy of involvement) and external rewards (e.g., recognition from peer, love and esteem from students, increases in income, administrative mobility) are important.

In order to eliminate weak or redundant variables, I further utilized stepwise discriminant analysis. As indicated in Table 3, stepwise discriminant analysis shows that two of three discriminant functions derived for each performance measure are statistically significant.

At each step of stepwise discriminant analysis, the variable that results in the smallest Wilks' lambda for the discriminant function is selected for entry. For different measures of faculty research performance, the predictors selected vary. Table 4 reports the standardized discriminant function coefficients and the structural coefficients for the selected variables. The absolute value of a standardized coefficient indicates the relative contribution of a variable in determining the discriminant score after taking into consideration the simultaneous contributions of all other variables.

For function 1, the valence measure for increase in income makes the greatest contribution for all three dependent variables. For function 2, holding a doctoral degree is the most important discriminant for the article-Vprom measure; field is the dominant predictor for the book-Vprom measure; and institutional type has the largest standardized coefficient for the NSC award-Vprom measure.

The structural coefficient in Table 4 is a bivariate correlation, which measures the similarity between an independent variable and a discriminant function. It is helpful in interpreting the meaning of the canonical discriminant function (Klecka, 1980). Only coefficients of 0.25 or greater are interpreted in Table 5.

The group centroids, which are the mean discriminant scores for different groups, are listed in Table 6. By looking at the relative percentage of discriminatory ability explained for every function in Table 3, the function description in Table 5, and the group centroids in Table 6, I interpreted how the discriminant functions separate different groups for each measure below.



**Table 4** Standardized and structural coefficients for article-Vprom, book-Vprom, and NSC-Vprom

| Measures      | Variables   | Standard coefficient |       |       | Structural coefficient |       |       |      |
|---------------|-------------|----------------------|-------|-------|------------------------|-------|-------|------|
|               |             | F1                   | F2    | F3    | F1                     | F2    | F3    |      |
| Article-Vprom | Vincome     | 0.55                 | -0.04 | 0.12  | 0.65                   | -0.01 | 0.19  |      |
|               | Vpeer       | 0.37                 | -0.01 | 0.05  | 0.63                   | -0.06 | 0.19  |      |
|               | Vstudent    | 0.22                 | -0.16 | 0.23  | 0.45                   | -0.15 | 0.34  |      |
|               | Vcuriosity  | -0.06                | 0.39  | -0.10 | 0.30                   | 0.25  | 0.05  |      |
|               | Vjoy        | 0.25                 | -0.20 | 0.23  | 0.33                   | -0.08 | 0.09  |      |
|               | Degree      | 0.25                 | 0.83  | -0.05 | 0.20                   | 0.81  | -0.04 |      |
|               | Institution | -0.24                | 0.33  | -0.23 | -0.10                  | 0.42  | -0.24 |      |
|               | Age         | -0.37                | 0.14  | 0.68  | -0.43                  | -0.12 | 0.70  |      |
|               | Gender      | -0.16                | 0.28  | 0.42  | -0.03                  | 0.42  | 0.46  |      |
| Book-Vprom    | Country     | 0.04                 | -0.18 | 0.48  | 0.07                   | 0.26  | 0.31  |      |
|               | Vincome     | 0.56                 | 0.11  | 0.39  | 0.66                   | 0.12  | 0.15  |      |
|               | Vpeer       | 0.38                 | -0.29 | -0.49 | 0.63                   | 0.08  | -0.29 |      |
|               | Vstudent    | 0.22                 | 0.44  | 0.09  | 0.45                   | 0.43  | -0.05 |      |
|               | Vjoy        | 0.27                 | -0.20 | 0.39  | 0.33                   | 0.09  | 0.29  |      |
|               | Vcuriosity  | -0.07                | -0.06 | -0.73 | 0.28                   | 0.12  | -0.10 |      |
|               | Age         | -0.35                | -0.05 | 0.31  | -0.41                  | 0.13  | 0.18  |      |
|               | Field       | 0.02                 | -0.83 | 0.26  | 0.08                   | -0.60 | 0.13  |      |
|               | Vmastery    | -0.04                | 0.44  | 0.59  | 0.29                   | 0.34  | 0.32  |      |
|               | Institution | -0.27                | 0.33  | 0.42  | -0.13                  | 0.18  | 0.35  |      |
|               | Degree      | 0.26                 | -0.08 | 0.38  | 0.17                   | -0.16 | 0.26  |      |
|               | Gender      | -0.19                | 0.58  | -0.38 | -0.05                  | 0.23  | -0.25 |      |
|               | NSC-Vprom   | Age                  | -0.50 | -0.16 | 0.51                   | -0.60 | -0.27 | 0.44 |
|               |             | Vincome              | 0.41  | -0.16 | 0.52                   | 0.54  | -0.41 | 0.45 |
|               |             | Vadministration      | 0.18  | -0.05 | 0.09                   | 0.36  | -0.26 | 0.21 |
| Vchallenge    |             | 0.09                 | 0.01  | -0.80 | 0.32                   | -0.20 | -0.29 |      |
| Vjoy          |             | 0.20                 | -0.05 | 0.54  | 0.27                   | -0.25 | 0.18  |      |
| Degree        |             | 0.43                 | 0.37  | 0.11  | 0.46                   | 0.57  | -0.02 |      |
| Institution   |             | 0.02                 | 0.47  | 0.40  | 0.12                   | 0.52  | 0.33  |      |
| Vmastery      |             | -0.11                | -0.22 | 0.22  | 0.20                   | -0.39 | 0.12  |      |
| Vpeer         |             | 0.31                 | -0.45 | -0.16 | 0.49                   | -0.53 | 0.01  |      |
| Field         | 0.03        | 0.26                 | 0.21  | 0.23  | 0.36                   | 0.17  |       |      |

### Article-Vprom

Function 1 is a 'value system' dimension discriminating groups, which publish articles and which think promotion is important (group 1) from groups which place low valence on promotion and which do not publish articles (group 4). In general, group 1 has higher overall valence scores on both external rewards (e.g., income increase, peer recognition, love and esteem from students) and internal rewards (e.g., the joy of involvement, and the satisfaction of curiosity).

Function 2 accounts for almost 30% of the discriminatory ability of the selected variables (see Table 5). It best differentiates between the two groups with high-promotion valences (groups 1 and 2). Group 1 is a belief-action consistent group, which thinks promotion is important and publishes articles in order to achieve it. Group 2 consists of those for whom the spirit is willing but the flesh is weak. According to the data, males publish more articles than females do. Receiving doctoral training aimed at the cultivation of research ability and working in public institutions where research resources are more available both have positive influences on one's research performance. Thus, members in group 2 may not produce at

the level adequate to match their desire for promotion because they generally lack doctoral degrees and are predominantly employed in private institutions.

**Table 5** Function interpretation

| Measures/function   | Relatives (%) | Positive end  | Negative end   |
|---------------------|---------------|---|--|
| Article-Vprom<br>F1 | 66.87         | Higher valence score on income increase<br>Higher valence score on peer recognition<br>Higher valence score on obtaining love & esteem from students<br>Higher valence score on the joy of involvement  | Younger faculty  |
| F2                  | 29.46         | More likely to be doctoral degree holder<br>More likely to be in public institutions<br>More likely to be male  |  |
| Book-Vprom<br>F1    | 74.58         | Higher valence score on income increase<br>Higher valence score on peer recognition<br>Higher valence score on obtaining love & esteem from students<br>Higher valence score on the joy of involvement<br>Higher valence score on the satisfaction of curiosity | Older faculty  |
| F2                  | 19.63         | Higher valence score on the sense of mastery<br>Higher valence score on obtaining love & esteem from students<br>More likely to be male   | More likely to be in the natural sciences & engineering                                  |
| NSC-Vprom<br>F1     | 69.94         | Higher valence score on income increase<br>Higher valence score on administrative mobility<br>Higher valence score on responding to challenges<br>Higher valence score on the joy of involvement  | Older faculty  |
| F2                  | 26.27         | More likely to be doctoral degree holder<br>More likely to be in public institutions<br>More likely to be in the natural sciences & engineering   | Higher valence score on peer recognition<br>Higher valence score on the sense of mastery |

**Table 6** Centroids of groups in reduced space for article-Vprom, book-Vprom, and NSC-Vprom

| Group   | Arfide-Vnrom |       |       | Book-Vprom |       |       | NSC-Vprom |       |       |
|---------|--------------|-------|-------|------------|-------|-------|-----------|-------|-------|
|         | F1           | F2    | F3    | F1         | F2    | F3    | F1        | F2    | F3    |
| Group 1 | 0.53         | 0.37  | 0.09  | 0.47       | 0.93  | 0.44  | 0.81      | 0.07  | 0.16  |
| Group 2 | 0.51         | -0.55 | -0.09 | 0.53       | -0.08 | -0.05 | 0.17      | -0.45 | -0.15 |
| Group 3 | -0.52        | 0.32  | -0.21 | -0.82      | 0.86  | -0.54 | -0.06     | 0.69  | -0.16 |
| Group 4 | -0.72        | -0.22 | 0.15  | -0.61      | -0.11 | 0.06  | -0.91     | -0.06 | 0.11  |

**Book-Vprom**

Function 1 is the most powerful function, accounting for almost 75% of the discriminatory ability of the selected variables. It separates groups 2 and 3 based on their age and value systems. In general, faculty who publish but place a lower valence on promotion (group 3) tend to be older. They also tend to place less importance on external rewards such as increases in income and peer recognition, and on internal rewards such as the satisfaction of curiosity.

Function 2 distinguishes between the two groups which publish (groups 1 and 3) and those which do not (groups 2 and 4). Members in the former category have higher valence scores on the sense of mastery while those in the latter tend to work in natural sciences and engineering. In addition, compared to their female colleagues, male faculty members publish more books.

**NSC-Vprom**

Function 1 best discriminates between groups 1 and 4, accounting for almost 70% of the discriminatory power. In general, faculty who think promotion is important and who get the NSC Research Outcome Award (those in group 1) tend to be younger, to have comparatively higher valence on increases in income, administrative

**Table 7** Classification results for the discriminant analysis of article-Vprom, book-Vprom, and NSC-Vprom

| Dependent Vars | N   | Predicted group membership (%) |      |      |      | Grouped cases correctly classified (%) | Tau (%) |
|----------------|-----|--------------------------------|------|------|------|--|---------|
|                |     | G1                             | G2   | G3   | G4   |  |         |
| Article-Vprom  | 145 | 60.0                           | 13.1 | 20.7 | 6.2  | 47.07                                  | 29.16   |
|                | 107 | 34.6                           | 44.9 | 8.4  | 12.1 |  |         |
|                | 95  | 26.3                           | 10.5 | 37.9 | 25.3 |  |         |
|                | 114 | 17.4                           | 11.3 | 31.3 | 40.0 |  |         |
| Book-Vprom     | 24  | 62.5                           | 12.5 | 12.5 | 12.5 | 50.98                                  | 34.49   |
|                | 228 | 19.3                           | 53.5 | 11.4 | 15.8 |  |         |
|                | 20  | 20.0                           | 5.0  | 55.0 | 20.0 |  |         |
|                | 189 | 7.4                            | 24.3 | 22.2 | 46.0 |  |         |
| NSC-Vprom      | 133 | 60.9                           | 12.8 | 18.0 | 8.3  | 48.65                                  | 31.53   |
|                | 148 | 26.4                           | 40.5 | 13.5 | 19.6 |  |         |
|                | 97  | 28.9                           | 7.2  | 48.5 | 15.5 |  |         |
|                | 140 | 8.6                            | 20.0 | 25.7 | 45.7 |  |         |

mobility, the joy of involvement, and responding to challenges than those who neither get the grant nor think of promotion as important.

Function 2 distinguishes the award-receiving groups (groups 1 and 3) from the nonaward-receiving groups (groups 2 and 4). Again, doctoral degree, employment in public institutions, and work in natural sciences and engineering appear to be significant predictors of winning a grant.

Table 7 summarizes the classification results. For each measure, the number underlined indicates the percentage of correctly classified cases based on the discriminant function. The overall classification score illustrates the accuracy of the procedure and confirms the degree of group separation. The *tau* value indicates how much the discriminant function improves on chance alone in classifying cases. It can be interpreted as a standardized measure of improvement regardless of the number of groups classified. If the *tau* value is 0, no improvement is made compared to random assignment. If the *tau* value is 1, no prediction error occurs.

When predicting article publication, the group most accurately classified is the group, which publishes and has high-valence scores on promotion (60 % of group 1 cases were correctly classified). Overall, 47.07% of the 461 cases were correctly predicted. This represents a roughly 30% improvement over a random-assignment of cases to groups.

The book measure has the highest correct classification rate of the three dependent variables. In total, 50.98% of the 461 cases were correctly classified. The *tau* value is 34.49%. The majority of the improvement in correct classification, however, comes in groups 2–4: group 1's correct-classification rate is essentially the same as for the article publication measure.

On the NSC award measure, the discriminant function performs about the same as for article publication. It classifies group 1 most accurately (roughly 60%), and has approximately the same rates of correct classification and *tau* overall as for the first two dependent variables. Overall, nearly 50% of cases were grouped correctly (48.65%), and the discriminant function makes 31.53% fewer errors than would be made by random assignment.

## Conclusion and policy recommendations

### Summary of findings

Who are motivated to perform research by the desire for promotion? Compared to the other three groups, faculty who highly value promotion and who produce research tend to be younger. Faculty who publish for promotion rewards tend to be motivated to obtain other kinds of external and internal rewards. That is, they tend to think both internal rewards and external rewards are important. Among different kinds of rewards, many faculty members consider the most important reward to be a pay raise. The study finds that possessing a doctoral degree enhances the chances that a faculty member performs research. Faculty in public institutions perform research more successfully than their private-institution counterparts, regardless of promotion valence. In addition, males publish more articles and books than female faculty. Faculty who work in natural sciences and engineering produce significantly fewer books than faculty in humanities and social sciences. However, the natural

sciences and engineering faculty are more likely to receive the NSC Research Outcome Award than faculty in humanities and social sciences.

### Policy implications

Based on the results above, a policy which adds a new rank should be effective in motivating young scholars who still have several steps to climb in their academic careers. In other words, the rank policy, which targeted at young faculty who need to climb several years in order to obtain the full professorship would be appropriate.

The finding indicates that productive faculty members who are motivated by the desire for promotion are multi-dimensional achievement-oriented people. They pursue rewards from the outside environment as well as self-fulfillment. This result offers policy-makers insights into creating an atmosphere in which productivity is valued, perhaps by establishing an incentive system of prizes and honors, which will recognize and encourage faculty research work.

The findings regarding the importance of personal income as an incentive offer an important message to Taiwan's government regarding its uniform pay policy. In Taiwan, faculty members' salaries, especially those in public institutions, have for decades been determined according to a standardized pay schedule based on rank level and seniority (Ministry of Education, 2004a). The results of this study suggest that if a policy of adding a new rank is going to be effective, it may be because the new rank increases a ladder of promotion; promotion offers a new pay-level, and thus motivates those who strive to increase their incomes. But if promotion is only a proxy for a salary increase, then a merit pay system based on faculty research performance probably would serve well to enhance faculty research performance. In American experience, where merit-pay system has a long history, the fact that female faculty members are paid less than their male colleagues should serve as a cautionary lesson to Asian countries (Sosin, Rives, & West, 1998; Carlin & Partick, 2000; Becker & Toutkoushian, 2003). In many of the East Asian societies, with their tradition of deference to senior figures and of male dominance, implementing a merit-pay system, which is fair to disadvantaged faculty groups such as young and female faculty is particularly problematic.

The results show that faculty with doctoral degrees tend to be productive faculty. According to the Ministry of Education (2004b), about 50% of university faculty in Taiwan possess doctoral degrees. Since doctoral training has positive effects on one's research productivity, I suggest that policy makers should consider two ways of improving faculty research performance: (1) Providing faculty who do not possess a doctoral degree, especially for those who are young, resources to receive doctoral training. (2) Requiring all newly recruited faculty members to possess doctoral degrees.

The results concerning the public-private disparity in research performance raise questions about resources. In practice, private institutions lack research equipment, have smaller library holdings, require heavier teaching loads, etc. If encouraging research within private universities is the primary goal, policy makers could distribute grants to improve research facilities in private institutions. In addition, the government could encourage greater research cooperation between faculty in public institutions and private institutions.

The phenomenon that males publish more articles and books than female faculty is similar to findings in the United States (Cole & Zuckerman, 1984; Bentley, 1990). According to Tien (1999), female faculty in Taiwan have the same aspiration for promotion as do male faculty. However, female faculty tend to work in private universities and have less doctoral degrees. Although it is not the primary purpose of this paper to investigate factors contributing to gender difference in productivity, the results obtained here suggest further exploration of the reasons behind gender differences in research productivity among Taiwanese faculty is needed.

The Taiwanese faculty data in this study were collected from the end of 1992 to 1993. In 1994, the government in Taiwan did add a new rank of assistant professorship to the Taiwanese faculty career ladder (University Act, 1994). As mentioned before, most people who possess doctoral degrees are hired as assistant professors instead of associate professors after 1997. There is no follow up study yet available to determine the actual effectiveness of the new rank policy. Future research exploring the effects of the reform is suggested.

Although employing faculty data in Taiwan, the findings of the paper have implications for the general issue of incentives and academic productivity. With the ultimate aim of promoting research excellence, which has become the primary goal for higher education development in Taiwan as well as other countries in the world, more research on exchanging experiences and ideas among different countries is needed and should be encouraged. By doing so, we are more likely to be a vital force in fighting inertia and moving toward a more optimal process for higher education development in the future.

## References

- Altbach, P. G. (1989). Higher education and scientific development: the promise of newly industrializing countries. In P. G. Altbach, et al. (Eds.), *Scientific development and higher education: the case of newly industrializing nations*. New York: Praeger.
- Bayer, A. E., & Smart, J. C. (1991). Career publication patterns and collaborative Style in American academic science. *Journal of Higher Education*, 62(6), 613–636.
- Bazeley, P. (2003). Defining early career in research. *Higher Education*, 45, 257–279.
- Becker, W., & Toutkoushian, R. K. (2003). *Measuring gender bias in the salaries of tenured faculty members*. *New Directions for Institutional Research*, no. 117. DE, USA: Wiley Periodicals Inc.
- Bentley, R. J. (1990). Faculty research performance over time and its relationship to sources of grant support. Ph.D Dissertation, University of Michigan.
- Boice, R., & Johnson, K. (1984). Perception and practice of writing for publication by faculty at a doctoral-granting university. *Research in Higher Education*, 21, 195–209.
- Boice, R. (1983). Contingency management in writing and the appearance of creative ideas: implications for the treatment of writing blocks. *Behavior Research and Therapy*, 21, 537–543.
- Boice, R. (1984). Reexamination of traditional emphases in faculty development. *Research in Higher Education*, 21, 33–43.
- Boice, R. (1992). Combining writing block treatments: theory and research. *Behavior Research and Therapy*, 30, 107–116.
- Boyer, E. L. (1990). *Scholarship reconsidered: priorities of the professoriate*. Princeton, NJ: The Carnegie Foundation for the Advancement of Teaching.
- Brewer, P. D., Brewer, V. L., & Hilton, C. H. (1990). Promoting research productivity in colleges of business. *Journal of Education for Business*, 66(1), 52–56.
- Butler, J. K., & Cantrell, R. S. (1989). Extrinsic reward valences and productivity of business faculty: a within- and between-subjects decision modeling experiment. *Psychological Reports*, 64, 343–353.
- Carlin, P., & Partick, R. (2000). Am I paid fairly? *Change*, 32, 40–50.

- Cole, J. R., & Singer, B. (1991). A theory of limited differences: explaining the productivity puzzle in science. In H. Zuckerman, J. R. Cole, & J. T. Bruer (Eds.), *The outer circle: women in the scientific community*. New York: Norton.
- Cole, J. R., & Zuckerman, H. (1984). The productivity puzzle: persistence and change in patterns of publication of men, women scientists. In M. W. Steinkamp, & M. L. Maehr (Eds.), *Advances in motivation and achievement* (Vol. 2). Greenwich, CT: JAI Press.
- Creswell, J. W., & Brown, M. (1992). How chairpersons enhance faculty research: a grounded theory study. *The Review of Higher Education*, 16, 41–62.
- Creswell, J. W. (1985). *Faculty research performance: lessons from the sciences and the social sciences. ASHE-ERIC Higher Education Report No. 4*. Washington: Association of the study of Higher Education.
- Csikszentmihalyi, M. (1988). The flow experience and its significance for human psychology. In I. S. Csikszentmihalyi (Ed.), *Optimal experience: psychological studies of flow in consciousness*. Cambridge, England: Cambridge University Press.
- Diamond R. M., & Adam B. E. (Eds.) (1993). *Recognizing faculty work: reward systems for the year 2000. New directions for institutional research. No.81*. San Francisco, CA: Jossey-Bass.
- Finkelstein, M. J. (1984). *The American academic profession: a synthesis of social scientific inquiry since World War II*. Columbus: Ohio State University Press.
- Fox, M. F. (1985). Publication, performance, and reward in science, scholarship. In J. C. Smart (Ed.), *Higher education: handbook of theory and research* (Vol. 1) (pp. 255–282). New York: Agathon Press.
- Fox, M. F., & Faver, C. A. (1981). Achievement and aspiration: patterns among male and female academic-career aspirants. *Sociology of Work and Occupations*, 8, 439–463.
- Gai, K. C. S. (1985). The development of higher education in the Republic of China. *Asian Thought and Society*, 5, 157–164.
- Hargens, L., McCann, J., & Reskin, B. (1978). Productivity and reproductivity: marital fertility and professional achievement among research scientists. *Social Forces*, 52, 129–146.
- Hekelman, F. P., Zyzanski, S.J., & Flocke, S. A. (1995). Successful and less-successful research performance of junior faculty. *Research in Higher Education*, 36(2), 235–255.
- Huang, P. H. (1986). *The correlates of faculty research productivity in Taiwan, R. O. C. Masters thesis*. Taipei, Taiwan: National Chengchi University (in Chinese).
- Hunter, D. E., & Kuh, G. D. (1987). The write wing: characteristics of prolific contributors to the higher education literature. *Journal of Higher Education*, 58, 43–462.
- Kwiek, M. (2003). Academe in transition: transformations in the Polish academic profession. *Higher Education*, 45, 455–476.
- Lawrence, J. H., & Blackburn, R. T. (1985). Faculty careers: maturation, demographic, and historical effects. *Research in Higher Education*, 22, 135–154.
- Lawrence, J. H., Bieber, J. P., Blackburn, R. T., Saulsberry, K., Trautvetter, L. C., Hart, K., & Frank, K. (1989). Predicting individual change in faculty research productivity. Paper presented at the Annual Conference of the American Educational Research Association in San Francisco.
- Legislative, Yuan (1989a). *Meeting record of the Legislative Yuan on January 7th of 1989*. Taipei, Taiwan: Legislative Yuan (in Chinese).
- Legislative, Yuan (1989b). *Joint meeting records for the educational committee and the legal affairs committee on March 18th of 1989*. Taipei, Taiwan: Legislative Yuan (in Chinese).
- Licata, C. M. (1986). *Post-tenure faculty evaluation: threat or opportunity. ASHE-ERIC Higher Education Report No.1*. Washington, D.C.: Association for the Study of Higher Education.
- Lin, Wen-Da. (1984). The quality of 4-year colleges and universities and their contributions to economics. *Academic Journal of the National Chengchi University*, 50, 111–139 (in Chinese).
- Ma, S. S. (1985). *A study of correlates of Taiwanese faculty research productivity*. Taipei: Kua-Kuang (in Chinese).
- Ministry of Education (2001). White paper on higher education. Retrieved July, 26, 2004, from [http://www.high.edu.tw/white\\_paper/indexc.htm](http://www.high.edu.tw/white_paper/indexc.htm).
- Ministry of Education (2004a). Pay schedule for teachers. Retrieved July, 26, 2004, from [http://www.edu.tw/EDU\\_WEB/EDU\\_MGT/STATISTICS/EDU7220001/temp1/doc/48-49.PDF](http://www.edu.tw/EDU_WEB/EDU_MGT/STATISTICS/EDU7220001/temp1/doc/48-49.PDF).
- Ministry of Education (2004b). Percentage of university faculty possessing doctoral degrees. Retrieved July, 26, 2004, from [http://www.edu.tw/EDU\\_WEB/EDU\\_MGT/STATISTICS/EDU7220001/user1/index04.xls](http://www.edu.tw/EDU_WEB/EDU_MGT/STATISTICS/EDU7220001/user1/index04.xls).
- Ministry of Education (2004c). The numbers of full-time faculty in colleges and universities (Academic Year of 1992 to Academic Year of 2001). Retrieved November 2, 2004, from [http://www.edu.tw/EDU\\_WEB/EDU\\_MGT/STATISTICS/EDU7220001/service/s110181-90.htm](http://www.edu.tw/EDU_WEB/EDU_MGT/STATISTICS/EDU7220001/service/s110181-90.htm).

- O'Leary, V. E., & Mitchell, J. M. (1990). Women connecting with women: networks and mentors. In S. Lie, & V. E. O'Leary (Eds.), *Storming the tower: women in the academic world*. London: Kogan Page.
- Pan, H., & Hsieh, H. S. (1989). The scientific research environment in Taiwan. In P. G. Altbach, et al. (Eds.), *Scientific development and higher education: the case of newly industrializing nations*. New York: Praeger.
- Sax, L. J., Hagedorn, L. S., Arredondo, M., & Dicrisi III, F. A. (2002). Faculty research productivity: exploring the role of gender and family-related factors. *Research in Higher Education*, 43(4), 423–447.
- Smolentseva, A. (2003). Challenges to the Russian academic profession. *Higher Education*, 45, 391–424.
- Sorcinelli M. D. & Austin A. E. (Eds.) (1992). *Developing new and junior faculty. new directions for institutional research* (No. 50). San Francisco: Jossey-Bass.
- Sosin, K., Rives, J., & West, J. (1998). Unions and gender pay equity in academe: a study of U.S. institutions. *Feminist Economics*, 4, 25–46.
- Tien, F. F., & Blackburn, R. T. (1996). Faculty rank system, research motivation, and faculty research productivity: Measure refinement and theory testing. *Journal of Higher Education*, 67, 2–11.
- Tien, F. F. (2000). To what degree does the desire for promotion motivate faculty to perform research? Testing the Expectancy theory. *Research in Higher Education*, 41(6), 723–752.
- Tien, F. F. (1999). The impact of research productivity on promotion of college faculty in Taiwan: an application of event history analysis. *Journal of Humanities and Social Sciences*, 11(3), 359–394 (in Chinese).
- Tien, F. F. (1994). Promotion, motivation, and faculty research productivity: theory testing and model construction for a Taiwanese setting. Ph.D. dissertation. University of Michigan.
- Tuckman, H. P. (1976). *Publication, teaching, and the academic reward structure*. Lexington, MA: Lexington Books.
- Tuckman, H. P. (1979). The academic reward structure in American higher education. In D. Lewis (Ed.), *Academic rewards in higher education*. Cambridge, MA: Ballinger.
- University Act (1994). Taipei, Taiwan (in Chinese).
- Vroom, V. H. (1964). *Work and motivation*. New York: Wiley.
- Zuckerman, H. (1987). The careers of men and women scientists: a review of current research. In L. S. Dix (Ed.), *Women: Their underrepresentation and career differentials in science and engineering*. Washington DC: National Academy of Science.



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