# The Remuneration of British Academics

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## Abstract

This paper examines both pay relativities and mechanisms for pay determination within the UK academic labour market drawing upon a particularly detailed data set of 635 academics from five traditional Scottish Universities. In the existing literature, the fact that in many occupations, employees are paid according to explicitly determined wage scales is mostly ignored. We employ salary, grade and spinal point information to incorporate the fixed framework of academic salaries into analysis. Our results outline the importance of individual productivity, measured through publication, grant receipt and teaching skill, in attracting financial reward. We find a large penalty associated with time out of the profession and evidence for the deregulation of established pay and promotion structures. In order to identify those academics most likely to leave the profession, analysis also considers the determinants of individuals' reservation and deserved salary. Controlling for individual characteristics we find that lecturers hold the lowest reservation salaries in relation to their current salary level. The academic profession is therefore most at risk from loosing its staff at this grade. We find however no (self-)selection on the basis of the productivity of individuals.

KEYWORDS: Academic labour market, Salary, Salary Scales

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## 1. Introduction

The Hay report (1997) revealed that over the previous 10 years, university pay dropped by as much as 20% in real terms, falling behind comparable professions in the public sector. Dearing (1997) confirmed this trend, advising that although academic remuneration should be sufficient to recruit, retain and motivate staff of the required quality, the majority of staff in higher education were in fact paid substantially below comparable private and public sector rates. Although one might argue that academics are interested in more than mere pecuniary reward,[2] long-term underpayment may spark the drain of high quality individuals from academia into more lucrative positions in the private sector, or to academic positions abroad. Strikes over pay during 1996 and 1999 were suggestive of a profession on the edge of their salary threshold.

Within the context of the academic underpayment debate, the adequacy of the remuneration structure currently in place has been held to question. Establishment level academic salaries, at least below professorial grades, remain formally set through a nationally negotiated fixed salary structure agreed between the Association of University Teachers (AUT) and the University and College's Employers Association (UCEA). Within this formal framework, staff progression is largely automatic and dependent on years of work. With the emergence of the research and teaching assessment exercises and the dramatic increase in student numbers over recent years, the importance of publication and administrative responsibility within the academic job has been consolidated. It is unclear, however, whether the current reward system adequately recognises individual productivity.

This paper examines both pay relativities and mechanisms for pay determination within the UK academic profession and aims to provide some visibility into academic reward. We utilise a unique cross sectional dataset, which includes detailed information on salary and grade of the academic staff of five old established universities. An important feature of the data is that it includes measures for individual research productivity. Such detailed data is scarce in the existing literature in this area. In the first step of our analysis, we employ salary, grade and spinal point information to incorporate the fixed framework of salary scales into analysis. Although

[2] Academics have after all undertaken periods of extended study relative to the general labour force at an opportunity cost of perhaps considerable foregone earnings. For further discussion of non pecuniary reward see Ward and Sloane (1999).

there exists an extensive literature on pay schemes, the fact that in many occupations employees are paid according to explicitly determined wage scales is mostly ignored. Our framework allows us to consider the effect of policy-changes to the current system of academic reward, such as changing the wage rates within the fixed framework, or the effect of changing the fixed framework itself. In the second step of our analysis, we investigate the determinants of academics' deserved and reservation salary with the aim of identifying the most mobile and/or most dissatisfied staff within the profession. Although the mobility of staff in and out of the academic sector might be beneficial to some extent, the profession should ensure its capability to retain the best and most productive individuals. We will try to identify those who are most at risk from being lost to the profession.

The remainder of the paper is structured as follows: Section 2 summarizes previous literature relevant to our analysis and section 3 outlines the main characteristics of the dataset used in this paper. Section 4 introduces our model, which incorporates the fixed framework of salary scales, for the analysis of the determinants of actual academic salary. Section 5 considers a model of deserved and reservation salary. Section 6 concludes.

## 2. Previous literature

Until recently there had been virtually no work written on pay within the British academic profession. The lack of detailed data on academics in the UK has provided a hurdle for potential researchers. National statistics, collected by the Universities Statistical Record and the Higher Educational Statistics Agency, contain only very limited information. The census of academic salaries collected data on gender, age, date of recruitment, rank, faculty and salary, but ceased in 1993. Baimbridge and Simpson (1996) model the financial remuneration of vice chancellors and principals at UK higher institutions using a Times Higher Education Supplement survey. The individual statistical significance of relatively few of their independent variables, together with a large, highly significant, constant term leads them to conclude that managerial and performance indicators fail to offer any explanation for reward levels. They instead establish an idea of a 'going rate' for vice-chancellors. McNabb and Wass (1997) use the census of academic salaries to consider the gender salary gap in academia in 1975, 1985 and 1992. They conclude that women are less successful in achieving promotions from the lecturer scale than their male

counterparts, and receive lower remuneration. Their data, however, lacks variables on individual research productivity.

In contrast the US literature on academic pay, where salary is not determined by a formal pay framework, is extensive, with the main emphasis lying in the investigation of the gender salary gap. Work on the wage tenure profile in academia has been undertaken by Ransom (1993), Brown and Woodbury (1995) and Hallock (1995) who provide some evidence of a negative return to tenure. Ransom (1993) claims that the negative return to tenure is induced by the monopsony power of universities. Johnson and Stafford (1974) and McDowell (1982) consider the effect of career interruption on salary and reveal evidence of negative effects to career breaks within some subjects. US research, however, also generally suffers from the lack of detailed productivity variables. One notable exception is the work by Tuckman, Gapinski and Hagemann (1977) who use cross sectional data from 1972–73 to consider reward to teaching ability, research productivity, public service and administrative skill. They find that research productivity is the most rewarded component of academic's ability, followed by administrative skill. Teaching ability and public service receive small and negligible reward respectively.

Consideration of reservation and deserved wage data has become more usual in economics in recent years. For example, work using data on reservation wages exists in the job-search literature. The most well known of such studies is by Lancaster and Chesher (1983) who use respondent's reservation wages to deduce the structural parameters of the standard optimal job search model. This and many other studies lack a test of the true informational content of data on reservation wages however. One notable exception is provided by Schmidt and Winkelmann (1993), who using a German survey on employed and unemployed individuals and a stationary job search model, compare the stated reservation wages of the unemployed to the predicted reservation wages of the unemployed, based on the accepted wages of the employed. They find that the two types of reservation wages are consistent with each other, in other words that data on reservation wages are consistent with job search theory. While most previous studies use data on the reservation wages of the unemployed, we use reservation wages of employed. Van den Berg (1992) also uses such data, the major conclusion from his analysis being that moving costs have a substantial impact on the reservation wage.

Work on deserved wages can be found in the job satisfaction literature, where a group of papers have studied comparison effects (see for example, Cappelli and Sherer, 1988; Clark and Oswald, 1996; Hamermesh 1977; Hampton and Heywood, 1999; Sloane and Williams 1996a). Here, workers perceptions of relative or 'comparison' income enters their utility function. Individual job satisfaction is therefore not only affected by a worker's own absolute income level, but also by their income relative to some expected level or comparison group. Hamermesh (1977) concludes that much of the differential in (dis)satisfaction across workers is due to individuals' comparison of their present job with the benchmark opportunities open to them. Although in these studies deserved wage is used as a right-hand-side variable and in our analysis as the left-hand-side variable, this work emphasizes the important informational content of this variable.

## 3. Data

The data used in this paper come from a unique cross section study of five Scottish Universities: Aberdeen, Dundee, Glasgow, Heriot-Watt and St. Andrews undertaken in 1995/6. The data incorporates detailed information on the personal background, working history, productivity and job satisfaction of 878 academics, collected by means of postal questionnaires.[3] Academic staff includes professors, senior lecturers and readers, lecturers and research assistants. The overwhelming advantage of this dataset is its uniqueness and detail. It allows us to undertake the first detailed analysis of salary within the UK academic profession. Its comparative disadvantage is it's cross sectional nature. We are only able to analyze a snap-shot of the academic profession at one point in time without the ability to correct for selection in and out of the profession. This restriction is an important caveat to our analysis. Nevertheless the analysis of the cross sectional picture introduces some interesting propositions, to be challenged by future research.

Of the 878 academics from whom information was collected, we select fulltime academics (dropping 48 who work part time), those paid on the non-clinical scale (dropping 51 paid on the clinical scale) and those academics who are under the age of 64 (dropping 3 individuals). The part-time academics are deleted from our sample as we do not have good information on their working hours, which makes the comparison of their wages to the wages of fulltime academics

[3] The average response rate achieved was 30%, reasonably high for this type of study. Data were weighted for non-response at a faculty level by sex allowing for non-response at the level of rank by sex.

problematic. The academics paid on the clinical scale are dropped due to the difficulty of incorporating this additional, higher paid, scale in our analysis. From our original sample we also loose 106 observations due to incomplete data and another 35 observations due to intractability of spinal salary point. We are therefore left with 635 observations.

The dataset contains information on an individual's actual, reservation and deserved salary. Actual salary is defined as a respondents's response to the question 'What is your annual salary, that is before any deductions for tax, national insurance, pension contributions, union dues and so on?'. Staff are asked to report this annual salary together with the payment scale of this remuneration. Actual salary therefore refers to pay received on the university payment scale only, that is, it makes unlikely any additional salary attracted from consultancy etc. Reservation salary is questioned though 'What is the lowest salary that you would accept in order to move jobs?'. This question attempts to capture the minimum incentive required for academic mobility, whether it be mobility to another job within the academic profession, or outside. Finally deserved salary information is gathered in response to the question 'In your view, what salary do you deserve to get per annum?' and is questioned in relation to an individuals' current annual salary.

In an attempt to measure the non-pecuniary advantages of an academic position, the dataset also contains detailed information on the advantages and disadvantages of an academic job. Individuals are asked to identify the advantages and disadvantages of an academic career relative to any career alternatives feasible with an individual's present qualifications and experience. Suggested advantages included the flexibility of working timetable, interesting work, the opportunity to travel, a relaxed working environment, the opportunity to teach, geographical mobility and job security. Suggested disadvantages included less supervision/guidance, a closed environment removed from the real world, smaller promotional opportunity, and more limited promotion path. Respondents answer questions on advantages or disadvantage with 'yes' or 'no'.

The definitions of the variables used in our analysis are given in Table 1. Table 2 presents summary statistics for our sample. The first column in table 1 gives the summary statistics for the full sample of 635 observations.[4] We see that the majority of Scottish academics are male and are UK citizens. Academics hold on average around 17 years of experience, nearly 10 years

[4] Descriptive statistics for the complete dataset can be found in Ward (1999).

of which have been spent with their current university. Over 70% of academics hold a PhD and 36% are on short-term contracts. About 31% of our academics are researchers, 34% are lecturers, 21% are senior lecturers or readers and 14% are professors. The science faculty is largest in terms of its staff numbers within the five universities – nearly 40% of academic considered staff work here and Dundee and Glasgow are the largest universities, employing 26% and 32% of our academics respectively. About one out of five respondents are evaluated by their students as a skilled teacher.

Table 2 also presents average statistics on research productivity variables. The average academic has published 20 refereed papers and one book. As research traditions vary substantially by scientific field, table 3 presents these statistics broken down by the faculty that the respondent is working in. The table shows that in the Arts and Social Sciences it is relatively common to write books or chapters in books. On the other hand, the number of published papers is on average substantially higher in Science. The following analysis we take the differences between scientific fields into account by including the number of books, chapters in books, refereed papers, and grants, divided by their averages of the field in which the respondent is working, as explanatory variables.

Table 4 presents the average actual, reservation and deserved salary statistics for academics by rank. We observe that academics across ranks report significantly higher deserved salaries than they actually receive. Staff report underpayment within their current position to the order of 16% for researchers, and around 20% for lecturers, senior lecturers and professors. For researchers and lecturers we observe that the average reservation salary lies between average actual and deserved. Staff in these grades would therefore accept a salary lower that that they felt they deserved in order to move jobs. For senior lecturers, readers and professors, however, average reservation salary is higher than deserved. The staff in these grades are therefore less mobile and would need to be rewarded above the salary they believe they deserve in order to move jobs.

Table 5 gives a matrix representing the number of individuals reporting each of the various combinations between actual, reservation and deserved salary. Points to notice from this table are firstly that the vast majority of respondents report a deserved salary that is greater than that they actually receive. The vast majority also report a reservation salary greater than that they actually receive. This pattern of reports is perhaps what we might expect and might be argued to hold true

for a wider population of workers than academics. There are two interesting, and arguably more unusual, groups that emerge from this matrix however: Academics with low reported deserved salary, that is individuals who report a deserved salary that is either lower or equal to their current salary, and individuals with a low reservation salary, that is individuals who would accept a salary less or equal to their current salary in order to move jobs. Comparison of the majority or 'reference group' and these low deserved and low reservation groups in table 2 reveal more about the average characteristics of these groups. We see that individuals with a low reservation salary are younger than our reference group – they are more likely to be female, in the lower rungs of an academic career and on a short-term contract. We might characterize these workers as the most likely to be mobile. Our low deserved salary individuals are in contrast older, with a higher experience and tenure with current employer. They have had slightly longer periods out of the labour market, and are more likely to be working in St Andrews, in the faculty of arts or engineering and less likely to work as a lecturer.

Table 6 reports the average response to questions concerning the relative advantages and disadvantages of an academic career. Interesting work and the flexibility of an academic career are the most frequently cited advantages of an academic career over feasible career alternatives. Promotion changes and a less structured promotion path are the most frequently cited disadvantages of academia. Our low reservation academics are more likely to consider academia as removed from the real world. Our low deserved academics value in particular the working environment, interesting work, the flexibility and opportunity to teach within an academic career and are less likely to report promotion related disadvantages of an academic career.

## 4. The academic salary scale

In the U.K. academic sector, all academic and research staff up to professorial level are paid according to a nationally agreed pay scale. Figure 1 presents the 1994/1995 salary scale.[5] Academics are placed onto a particular spinal point within a specific scale, such as Lecturer A, by their university and then rise automatically up the rungs or points of a scale, one point each year, until the maximum for that scale is reached. An academic will seek promotion from one

[5] For a part of our sample the 1994/1995 scale is relevant scale, while for another part the 1995/1996 scale is the relevant scale. Compared to 1994/1995 scale, the salaries of the 1995/1996 scale were increased by 2.7 percent. This fact is taken into account in our analysis.

grade to the next. Accelerated progression up the points of a scale or through the grades and additional salary payments in the form of discretionary awards are possible. There exists however a minimum point at spinal point 4 for those staff with a PhD and a minimum point for individuals aged 27 at spinal point 6. This framework allows us to calculate a minimum spinal point for each academic, on the basis of age, tenure and time-out-of-labour-force. For instance, an academic at age 29 with a tenure of 2 years has to be at least in spinal point 8.

One of the aims of our analysis is to provide some visibility into academic reward through estimates of the returns to individual productivity. In this section we start with the analysis of the determinants of academic salary. The traditional approach is to apply linear regression to a wage equation. However, this approach ignores the data we have on academic positions, and ignores the fact that salaries are not contineously distributed. Furthermore, a wage equation does not allow for policy analysis with respect to changes in the wages within salary scales, or with respect to changes of the salary scale system itself. In order to take account of these problems, we explicitly model the UK academic system of salary scales. Still as a comparison we report and discuss wage regression results.

We observe annual salary and payment scale, such as Lecturer A or B, for all respondents in our sample. Only 26 respondents gave their exact spinal point on the scale. But as several respondents gave an annual salary which fits exactly to a certain point on the salary scale, we can identify a spinal point for an additional 165 respondents. Since there is no formal spinal point system for professors, we model the position of a professor as being spinal point 28. Table 7 outlines the distribution of academics across pay scales. To model the scales and salaries simultaneously, one has to understand that these are outcomes of the same underlying process. As neither of these two kinds of information is perfect, it makes sense to incorporate both pieces of information in a model. To recapulate: the data on the salary scales in not perfect as for the largest part of our sample we only know the respondents' academic position; the data on the wages is not perfect as it clearly contains measurement error.

We model the spinal points and salary scales as an ordered probit, defining $x_i$ as a vector of explanatory variables, $\beta$ as a parameter vector, and $\varepsilon_i^s$ an individual disturbance term. The minimum spinal point that an academic can be in is represented by the point $m$ and the threshold value $T^m$, which is determined by age, tenure and the time being out of the job.

$$
\begin{aligned}
(1a)\quad s_i^* &= x_i'\beta + \varepsilon_i^s \\
s_i &= j \qquad \text{if } T^m \le T^j < s_i^* \le T^{j+1} \\
&= m \qquad \text{if } s_i^* < T^m
\end{aligned}
$$

Next we define $w_i$ as the natural logarithm of the salary of individual i. We model the salaries according to the salary scales of figure 1 with salary $w^j$ for the spinal points j from 4 to 27, with $\varepsilon_i$ a individual disturbance term, and $I(s_i = j)$ an indicator function for being on point j.

$$
(1b)\quad w_i = \Sigma_{j=4,..,27}\ w^j I(s_i = j) + \varepsilon_i
$$

Note that due to the fact that our information on spinal points is imperfect – for most respondents we only observe the salary scale – the salaries contain additional information to estimate the model. In case we would know the exact spinal point for all respondents, equation (1b) would only identify the variance of the error term $\varepsilon_i$ – which could be interpreted as measurement error.

Professors are not paid according to the salary scale, and therefore we model their salaries separately. As there is a minimum wage for professors, we model their wages with a censored regression model, with $z_i$ as a vector of explanatory variables, $\gamma$ as a parameter vector, and $\varepsilon_i^*$ as a disturbance term.

$$
\begin{aligned}
(1c)\quad w_i^* &= z_i'\gamma + \varepsilon_i^* \\
w_i^p &= w_i^* \qquad \text{if } w_i^* > w_i^m \\
&= w_i^m \qquad \text{if } w_i^m = w_i^*
\end{aligned}
$$

Note that the data on the salaries of the professors do not add information to the model of the spinal points, and could be left out of the model. As the salaries of the professors are of interest by themselves however, we include them in our model. For estimation we assume the disturbance terms $(\varepsilon_i^s \varepsilon_i \varepsilon_i^*)$ to be independent of the explanatory variables $(x_i, z_i)$, and to be identically and independently trivariate normally distributed. Our model can be interpreted as an extended version of the switching regression or the Tobit Type 5 model, see Amemiya (1984), in which the switching part of the model is replaced by an ordered probit.

In total, we find that 69 respondents report an annual salary that is below their minimum salary. Although several of these cases might be due to rounding errors in salary, 39 respondents report a wage which is in line with a lower spinal point. Of these 39 respondents, 16 respondents aged 27 or older report a salary that is consistent with a point below the minimal spinal point at age 27. The question is whether this is due to measurement error in our background variables, or whether these individuals really accepted too low a wage. The problem also occurs among the professors – 3 out of 91 professors report a salary that is below the professional minimum of £31,158 in 1994. So although there is an official minimum point, it is an open question whether it is really effective in practice. For the purpose of our analysis, we estimate two models, a model with, and a model without restrictions. In the model with restrictions, we exclude the 39 academics that are paid on, we argue, too low a salary point. Results for this analysis are presented in table 8. Only the constant term differs in significance between the two models.

Table 8 displays the estimation results. We do not include variables such as having a short-term contract and having administrative responsibility among the explanatory variables, since we judge that they are mostly a result of the rank that someone has. This means that they cannot be considered as being exogenous in our model. The model reveals some interesting results. First, we find evidence for some deregulation of established pay and promotion structures; we find that in Heriot-Watt University and in the social sciences academics are put on significantly higher spinal points. This is in line with McNabb and Wass (1997), although contrary to their results we find no significant difference in rewards to full time academics across gender. Second, progression along spinal points is driven almost solely by individual productivity variables. We reveal a positive reward to experience, number of books published, number of refereed papers published, number of grants awarded and high teaching ability[6]. Third, we find evidence of negative effects to career breaks, possibly due to the depreciation effects of career breaks as subject-specific skills and knowledge become obsolete.

Our results are in contrast to most of the earlier literature on the gender wage-gap in the academic labour market since the gender-dummy is significant at all conventional significance levels. The reason for this contrasting result might be the fact that we are able to correct for

[6] We recognize that there might be some causal effect the other way around – from salary to productivity. None of the papers on this topic mentions this potential problem. And also with our data at hand we see no way to correct for this endogeneity.

productivity. Excluding the productivity variables (books, chapters, papers, grants, having PhD, and teaching skills) from our analysis reveals a significant gender wage-gap at a 10 percent significance level. Most interesting in this respect is the variable out-of-labour-force. Not only are women more likely to have had a out-of-labour-force spell (in our sample 40 percent of women against 10 percent of men), if they have had such a spell the duration is also longer (in our sample 2.5 years on average for women against 1.5 years on average for men). Including an interaction term between gender and the out-of-labour-force time variable reveals that men are not 'punished' significantly differently for such spells to women. The variables experience and tenure do not include the out-of-labour-force time, so the results indicate that mothers, and also fathers, who decide to take maternity leave are disadvantaged in the academic labour market. McDowell (1982) argues that durability of knowledge differs significantly per research field. We tested his hypothesis by interacting the out-of-labour-force variable with the faculty variables. We find however no significant differences between the fields of research, which might be due to the fact that the number of observations is small for such a detailed analysis.

Our model of professorial pay is interesting in that none of the explanatory variables included in the model are significant. This suggests that once the position of professor has been attained factors such as experience, publication record and teaching skills are no longer important to reward. Instead one might argue that factors such as negotiation skill, outside offers and costs of moving may be important determinants of professorial pay, which are not captured within our model. This result is in line with Baimbridge and Simpson (1996), who find very few significant variables in their model of the financial remuneration of vice chancellors and principals at UK higher institutions, and instead establish an idea of a 'going rate' for vice-chancellors.

Appendix B presents simulations with respect to productivity and gender-related issues for two reference academics. Although the variables on research productivity is highly significant in our model, the size of their impact turns out to be modest. Remarkle is the impact of teaching skills, for the expected salary the reward to good teaching skills equals the reward to 12 to 15 refereed papers! An explanation for this effect might be that our teaching skill variable picks up other skills, such as presentation skills. Also remarkeble is the impact of out-of-labour-force time; in expected salary a one-year spell has to be compensated with 4 to 5 refereed papers. Although the gender-variable itself is not significant, our simulations show that the impact of gender-related issues might be considerable. Changing our male reference academics without an out-of-labour-

force spell into a woman with a one year out-of-labour-time spell decreases, ceteris paribus, the expected salary by 2.8 to 3.8 percent.

As a comparison of our results, we also run a human capital regression of salary against individual characteristics. The detailed results of this are discussed in appendix C. The main finding is that the overall conclusions from this exercise are very much in line with the results from our spinal point and salary scale model.

## 5. Reservation and deserved salary

In this section we investigate the underlying determinants of academics' reservation and deserved salary. In doing so we hoped to determine those academics most at risk from being lost to the profession. Although mobility in itself is not a bad thing for academics, one would hope that the profession is able to retain the best and most productive academics. We define $W_i$ as an academic's actual annual salary, $W_i^r$ as his/her reservation salary, and $W_i^d$ as his/her deserved salary. $x_i$ is a vector of explanatory variables, $\beta$ a parameter vector, and $\varepsilon_i$ an individual disturbance term. We assume actual salary to be exogenous, and we analyse the deviation of reservation and deserved salary from actual salary using seemingly unrelated regression:

$$(2a) \quad 100\,(W_i^r - W_i)/W_i = x_i'\beta^r + \varepsilon^r$$

$$(2b) \quad 100\,(W_i^d - W_i)/W_i = x_i'\beta^d + \varepsilon^d$$

We regress the percentage deviation of reservation and deserved salary from actual salary on the same set of explanatory variables utilised in section 4. One could also argue that non-pecuniary advantages and disadvantages of the job may be important in the determination of reservation and deserved wages. This information is therefore also included as a series of dummy variables. Results are presented in table 9. The significance of the correlation coefficient suggests that there are unobserved variables that determinate both academic's reservation and deserved salary.

Considering reservation wages first, we see that ceteris paribus the impact of salary is u-shaped with the minimum at the top of the Lecturer B scale with an annual salary of £26,574. Although

hardly significant, experience is n-shaped with the maximum at 2.3 years of experience. The insignificant results on the productivity variables in table 9 provide a neutral answer to our question concerning whether academia can retain its most productive staff. It appears that good academics are at least not setting low reservation wages for themselves in order to leave the profession. On the other hand, this is also true of the less productive academics. A surprising result is the impact of the number of chapters, which has a significantly negative impact! In combination with the insignificant impact of the number of chapters in the salary scale model, a reasonable explanation seems to be that publishing chapters in books is under-valued in British academia. Finally we find only weakly significant impacts of the non-pecuniary factors of geographical mobility and being removed from reality. Overall, therefore, pecuniary considerations dominate the determination of academic's reservation wage.

Turning to the results for deserved salary again reveals a seniority effect of higher wages on the percentage deviation of deserved salary from actual salary. This time the impact of wages is insignificant but the minimum point of the wage-squared function lies at £38.571 – within the professorial grade. The effect of experience is significant and n-shaped with the maximum at an experience of 23 years. Those with less experience are increasingly discontented with their appointed salary point. Alternatively, this result may reflect a selection effect. Those with a lot of experience within the profession may be those who have achieved their best match. Staff with less experience may not yet have done so, and it is possible that some of these less satisfied individuals leave the profession. The 'correct' interpretation may also dependent on the reference group referred to by the respondent within the assessment of deserved salary. For young, more recently qualified academics the relevant reference group may be more likely to be other young workers, including those working in the private sector who hold a comparative wage advantage. On the other hand, older academics holding mainly specialised human capital may compare themselves with their peers within the profession.

Also striking within this analysis are the results on the skilled teacher variable, the size of which is considerable at 6.7 percent. Thus, although we find evidence of a significant reward to teaching skill in the analysis of actual salary, this reward is insufficient in the eyes of the academics themselves. We find no evidence of academics perceiving penalties to time out of labour force. The effect of this variable on deserved wage is insignificant. Finally, the results concerning the (dis-)advantages of academia identify more about the grievances of our most

dissatisfied academics than any evidence of positive compensating effects. Dissatisfaction with promotional prospects increases deserved salary demands substantially. This result suggests the interdependence between salary and position within the formal academic reward system. Perceptions of academia as being removed from the real world reduces deserved salary.

## 6. Conclusion.

Our analysis of actual, reservation and deserved salary within the UK academic profession has uncovered a number of interesting effects. Firstly, our results outline the importance of publication, grant receipt and teaching skill in attracting financial reward within the current payment system. With the inclusion of the salary framework into analysis the relationship between productivity and individual reward is reinforced. Our model therefore provides some evidence to ease concerns that the current reward system does not adequately recognise individual productivity. Perhaps surprising in this respect is the importance of teaching skills, which are revealed to have a sizable impact on pay in our simulations. Secondly, we find some suggestion of a negative reward to time out of the profession – career breaks carry an associated penalty, perhaps due to depreciation effects as subject specific skills and knowledge become obsolete. Simulations show that this effect is sizable; the salary loss associated with a one-year out-of-labour-force spell would require compensation equivalent to 4 to 5 additional refereed papers. Third, none of the explanatory variables included in our model of professorial pay are significant. This suggests that once the position of professor has been attained factors such as experience, publication record and teaching skills are no longer important to reward. Instead factors such as negotiation skill, outside offers and costs of moving may be important determinants of professorial pay.

Analysis of deserved and reservation salary suggests that controlling for individual characteristics, lecturers hold the lowest reservation salaries in relation to their current salary level. The Profession is therefore most at risk from loosing its youngest staff – presumably those who will also find it easiest to attract job offers from outside academia. We find that highly paid professors are most at ease with their salary position. In contrast, lower rung academics are the least content. Analysis also reveals some evidence of dissatisfaction with actual pay for those with high teaching ability.

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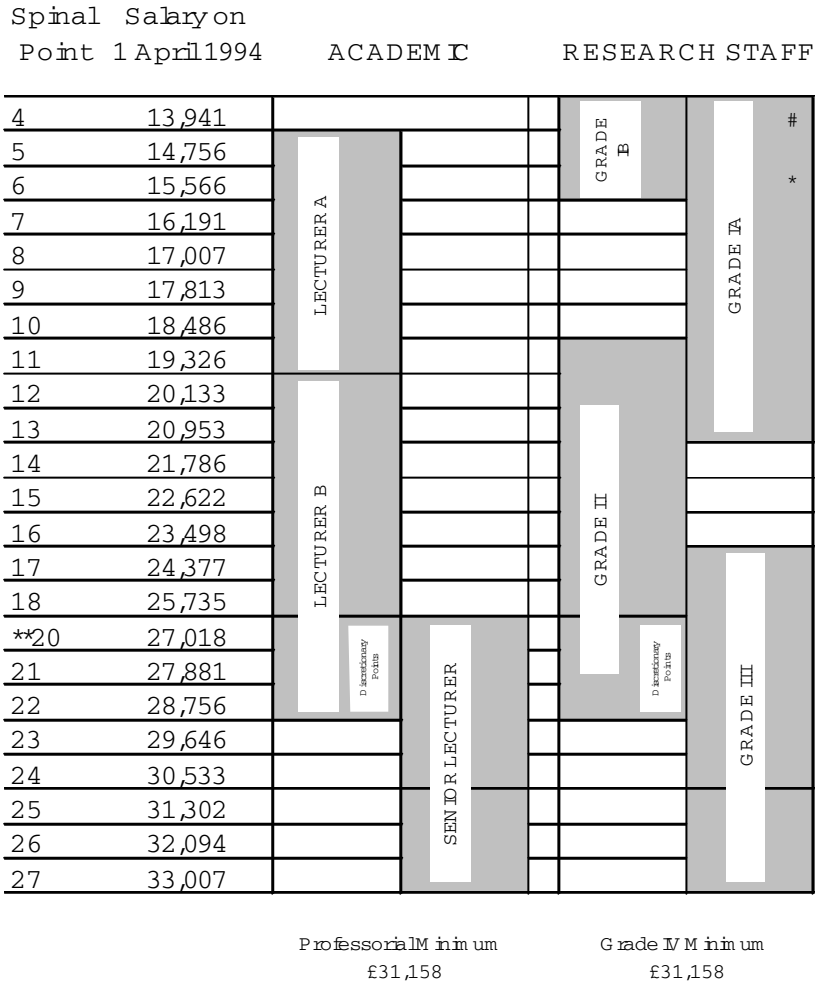
Figure 1

# SALARY SCALES 1994/1995

Joint Negotiating Committee for Non-Clinical Academic and Academic Related Staff




Notes: *Age 27 point

# Minimum appointment level for staff with PhD

** Point 19 was deleted with effect from 1.4.91

Table 1: list of variables

| Name | Definition |
|---|---|
| Individual char. | |
| Gender | = 1 if male, = 0 if female |
| Citizen | = 1 if UK citizen, = 0 otherwise |
| Job char. | |
| Experience | Lenght total labour market experience, measured in years[1] |
| Job tenure | Lenght of time with current employer, measured in years[1] |
| Time-out | Lenght of time out of labour force, measured in years |
| Short-term | = 1 if contract for 3 or less years, = 0 otherwise |
| Job position | |
| Researcher | = 1 if researcher, = 0 otherwise |
| Lecturer | = 1 if lecturer A or lecturer B, = 0 otherwise |
| Sen.Lec./Reader | = 1 if senior lecturer or reader, = 0 otherwise |
| Professor | = 1 if professor, = 0 otherwise |
| University | Dummies for the five universities from which the data are sampled from |
| Faculty | Dummies for the five faculties from which the data are sampled from |
| Publications | |
| Books | Total number of books published |
| Chapters | Total number of chapters published in books |
| Papers | Total number of refereed publications published |
| Other | |
| Grants | Total number of grants received |
| Having PhD | = 1 if holds a PhD, = 0 otherwise |
| Teach.skill | = 1 if skilled teacher (based on student's evaluations), = 0 otherwise |
| Advantages | Advantages of present career over feasible alternatives according to respondent's opinion |
| Environment | = 1 if relaxed working environment is an advantage, = 0 otherwise |
| Interesting work | = 1 if interesting work is an advantage, = 0 otherwise |
| Responsibility | = 1 if opportunity to hold responsibility is an advantage, = 0 otherwise |
| Job Security | = 1 if job safety is an advantage, = 0 otherwise |
| Flexibility | = 1 if flexible working timetable is an advantage, = 0 otherwise |
| Traveling | = 1 if opportunity to travel is an advantage, = 0 otherwise |
| Mobility | = 1 if geographical mobility is an advantage, = 0 otherwise |
| Teaching | = 1 if opportunity to teach is an advantage, = 0 otherwise |
| Disadvantages | Disadvantages of present career over feasible alternatives according to respondent's opinion |
| Supervision | = 1 if less supervision is a disadvantage, = 0 otherwise |
| Prom. Chances | = 1 if smaller opportunity for promotion is a disadvantage, = 0 otherwise |
| Prom. Path | = 1 if more limited promotion path is a disadvantage, = 0 otherwise |
| Reality | = 1 if removal from real world is a disadvantage, = 0 otherwise |

[1] experience and tenure do not include the time being out of the labour force.

Table 2: sample statistics

| | Full sample | | Reference group $w^r > w, w^d > w$ | | Low res. wage $w^r <= w$ | | Low des. Wage $w^d <= w$ | |
|---|---|---|---|---|---|---|---|---|
| | (635 obs.) | | (282 obs.) | | (175 obs.) | | (97 obs.) | |
| Individual char. | | | | | | | | |
| Age -29 | 0.213 | | 0.202 | | 0.303 | | 0.216 | |
| Age 30-39 | 0.312 | | 0.319 | | 0.367 | | 0.247 | |
| Age 40-49 | 0.265 | | 0.270 | | 0.240 | | 0.289 | |
| Age 50- | 0.211 | | 0.209 | | 0.091 | | 0.247 | |
| Gender | 0.691 | | 0.734 | | 0.611 | | 0.701 | |
| Citizen | 0.882 | | 0.862 | | 0.903 | | 0.928 | |
| Job char. | | | | | | | | |
| Experience | 16.731 | (10.854) | 16.668 | (10.379) | 13.243 | (9.978) | 17.856 | (11.150) |
| Job tenure | 9.700 | (9.997) | 9.790 | (10.052) | 6.864 | (7.696) | 10.077 | (10.473) |
| Time-out | 0.422 | (1.646) | 0.341 | (1.302) | 0.471 | (1.457) | 0.672 | (2.869) |
| Short-term | 0.361 | | 0.323 | | 0.571 | | 0.351 | |
| Job position | | | | | | | | |
| Researcher | 0.312 | | 0.284 | | 0.474 | | 0.351 | |
| Lecturer | 0.340 | | 0.355 | | 0.326 | | 0.206 | |
| Sen.Lec./Reader | 0.205 | | 0.202 | | 0.114 | | 0.258 | |
| Professor | 0.143 | | 0.160 | | 0.086 | | 0.186 | |
| University | | | | | | | | |
| Aberdeen | 0.162 | | 0.167 | | 0.120 | | 0.103 | |
| Dundee | 0.260 | | 0.241 | | 0.263 | | 0.299 | |
| Heriot-Watts | 0.068 | | 0.078 | | 0.069 | | 0.041 | |
| St Andrews | 0.192 | | 0.184 | | 0.223 | | 0.237 | |
| Glasgow | 0.318 | | 0.330 | | 0.326 | | 0.320 | |
| Faculty | | | | | | | | |
| Arts | 0.170 | | 0.131 | | 0.166 | | 0.237 | |
| Engineer | 0.139 | | 0.145 | | 0.086 | | 0.175 | |
| Medicine | 0.143 | | 0.160 | | 0.154 | | 0.144 | |
| Science | 0.387 | | 0.404 | | 0.457 | | 0.320 | |
| Soc.science | 0.161 | | 0.160 | | 0.137 | | 0.124 | |
| Publications | | | | | | | | |
| Books | 1.074 | (2.418) | 1.043 | (2.559) | 0.783 | (2.122) | 1.051 | (1.856) |
| Chapters | 2.805 | (6.515) | 2.691 | (4.982) | 1.800 | (3.883) | 2.278 | (4.361) |
| Papers | 20.109 | (28.292) | 20.411 | (25.966) | 14.720 | (28.317) | 20.422 | (30.367) |
| Other | | | | | | | | |
| Grants | 4.951 | (8.151) | 5.557 | (8.069) | 3.589 | (7.309) | 4.463 | (8.713) |
| Having PhD | 0.728 | | 0.748 | | 0.709 | | 0.701 | |
| Teach.skill | 0.198 | | 0.209 | | 0.149 | | 0.175 | |

Note: the first column presents the statistics of the full sample, the second column represents the statistics of the reference group (both reservation salary $w^r$ and deserved salary $w^r$ are larger than the actual salary $w$). Between parentheses the standard deviations.

Table 3: research productivity statistics

| Faculty | number of obs. | age | | books | | chapters | | papers | | grants | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Arts | 107 | 45.73 | (9.84) | 2.28 | (3.39) | 3.89 | (5.22) | 13.03 | (15.89) | 2.54 | (4.49) |
| Engineer | 88 | 39.00 | (10.49) | 0.28 | (0.80) | 2.05 | (10.90) | 16.68 | (24.26) | 4.48 | (6.57) |
| Medicine | 91 | 36.85 | (9.13) | 0.46 | (1.11) | 2.22 | (4.51) | 19.68 | (26.27) | 6.12 | (10.86) |
| Science | 246 | 39.42 | (10.50) | 0.60 | (1.38) | 2.13 | (5.06) | 26.50 | (34.58) | 6.13 | (9.39) |
| Soc.Science | 103 | 40.80 | (10.35) | 2.17 | (3.74) | 4.49 | (6.74) | 15.50 | (23.40) | 4.02 | (5.28) |

Note: Standard deviations between parentheses.

Table 4: salary statistics

| | number of observations | Actual salary | | Reservation salary | | Deserved salary | |
|---|---|---|---|---|---|---|---|
| Researcher | 162 | 17.24 | (2.66) | 18.04 | (5.02) | 19.97 | (4.57) |
| Lecturer | 154 | 22.20 | (3.55) | 25.36 | (7.33) | 26.85 | (5.53) |
| Sen.Lec/Reader | 84 | 29.98 | (1.83) | 37.02 | (11.43) | 35.63 | (5.11) |
| Professor | 66 | 37.30 | (4.01) | 47.56 | (18.96) | 44.61 | (8.47) |

Note: only observations with actual, reservation, and deserved salary observed are included. Salary in 1,000 BP per year, and comparable to the 1994/1995 salary scale. Standard deviations between parentheses.

Table 5: observations on salary

| | $w^d$ missing | $w^d < w$ | $w^d = w$ | $w^d > w$ | Total |
|---|---|---|---|---|---|
| $w^r$ missing | 34 | 8 | 20 | 53 | 115 |
| $w^r < w$ | 11 | 18 | 17 | 76 | 122 |
| $w^r = w$ | 6 | 3 | 5 | 39 | 53 |
| $w^r > w$ | 37 | 5 | 21 | 282 | 345 |
| Total | 88 | 34 | 63 | 450 | 635 |

Table 6: (dis-)advantages statistics

| | Full sample (635 obs.) | Reference group $w^r > w^a, w^d > w^a$ (282 obs.) | Low res.wage $w^r <= w^a$ (175 obs.) | Low des.wage $w^d <= w^a$ (97 obs.) |
|---|---|---|---|---|
| Advantages | | | | |
| Environment | 0.516 | 0.475 | 0.549 | 0.598 |
| Interesting work | 0.885 | 0.922 | 0.817 | 0.928 |
| Responsibility | 0.403 | 0.422 | 0.326 | 0.381 |
| Job Security | 0.313 | 0.305 | 0.269 | 0.278 |
| Flexibility | 0.789 | 0.805 | 0.783 | 0.814 |
| Travelling | 0.529 | 0.589 | 0.497 | 0.526 |
| Mobility | 0.100 | 0.106 | 0.126 | 0.113 |
| Teaching | 0.498 | 0.493 | 0.451 | 0.536 |
| Disadv. | | | | |
| Supervision | 0.081 | 0.064 | 0.131 | 0.103 |
| Prom. Chances | 0.457 | 0.532 | 0.463 | 0.299 |
| Prom. Path | 0.469 | 0.514 | 0.497 | 0.278 |
| Reality | 0.170 | 0.128 | 0.280 | 0.237 |

Note: the first column presents the statistics of the full sample, the second column represents the statistics of the reference group (both reservation salary $w^r$ and deserved salary $w^d$ are larger than the actual salary $w$). Between parentheses the standard deviations.

Table 7: observations on spinal points and salary scales

| Spinal point | | Academic staff | Research staff |
|---|---|---|---|
| 4 | (3 obs.) | | Grade IB |
| 5 | (12 obs.) | | Points 4-6 |
| 6 | (18 obs.) | | (26 obs.) |
| 7 | (9 obs.) | Lecturer A | |
| 8 | (9 obs.) | Points 5-11 | Grade IA |
| 9 | (14 obs.) | (58 obs.) | Points 4 -13 |
| 10 | (7 obs.) | | (77 obs.) |
| 11 | (11 obs.) | | |
| 12 | (9 obs.) | | |
| 13 | (10 obs.) | | |
| 14 | (2 obs.) | | |
| 15 | (7 obs.) | Lecturer B | Grade II |
| 16 | (3 obs.) | Points 12-22 | Points 11-22 |
| 17 | (6 obs.) | (88 obs.) | (13 obs.) |
| 18 | (18 obs.) | | |
| 20 | (11 obs.) | | |
| 21 | (7 obs.) | | |
| 22 | (3 obs.) | | |
| 23 | (2 obs.) | Sen.Lec./Reader | Grade III |
| 24 | (15 obs.) | Points 20-27 | Points 17-27 |
| 25 | (8 obs.) | (89 obs.) | (2 obs.) |
| 26 | (4 obs.) | | |
| 27 | (3 obs.) | | |
| | | Professor | |
| | | (91 obs.) | |

Table 8: Estimation results on spinal point and salary scale

| | Model without restrictions | | | | Model with restrictions | | | |
|---|---|---|---|---|---|---|---|---|
| | Spinal Point | | Ln (Salary Prof.) | | Spinal Point | | Ln (Salary Prof.) | |
| | Par. | s.e. | par | s.e. | par. | s.e. | par. | s.e |
| Individual char. | | | | | | | | |
| Intercept | 0.4076 | (0.3799) | 10.597 | ***(0.1312) | -0.4523 | (0.5174) | 10.5917 | ***(0.1085) |
| Sex | 0.1109 | (0.1385) | | | 0.1362 | (0.1794) | | |
| Citizen | 0.1266 | (0.1763) | | | 0.2781 | (0.2313) | | |
| Job Char. | | | | | | | | |
| Experience | 0.1929 | ***(0.0271) | | | 0.2405 | ***(0.0345) | | |
| Experience²/10 | -0.0274 | ***(0.0068) | | | -0.0358 | ***(0.0081) | | |
| Tenure | 0.0201 | (0.0268) | 0.0036 | (0.0058) | -0.0288 | (0.0323) | 0.0038 | (0.0056) |
| Tenure²/10 | -0.0054 | (0.0086) | -0.0018 | (0.0017) | 0.0075 | (0.0100) | -0.0018 | (0.0017) |
| Time-out | -0.0952 | ***(0.0351) | | | -0.1201 | **(0.0485) | | |
| University | | | | | | | | |
| Aberdeen | 0.1704 | (0.1768) | -0.0188 | (0.0446) | 0.1981 | (0.2030) | -0.0194 | (0.0437) |
| Dundee | 0.0445 | (0.1526) | -0.0044 | (0.0575) | 0.0899 | (0.1962) | -0.0054 | (0.0565) |
| Heriot-Watts | 0.5524 | ***(0.2579) | -0.0614 | (0.0587) | 0.6011 | **(0.2973) | -0.0607 | (0.0574) |
| St Andrews | -0.0655 | (0.1709) | 0.0612 | (0.0460) | -0.0395 | (0.2109) | 0.0621 | (0.0451) |
| Faculty | | | | | | | | |
| Arts | 0.1021 | (0.1749) | -0.0102 | (0.0487) | 0.1064 | (0.2052) | -0.0112 | (0.0478) |
| Engineer | -0.2895 | (0.1905) | 0.0470 | (0.0578) | -0.3974 | (0.2423) | 0.0502 | (0.0567) |
| Medicine | -0.0207 | (0.1904) | 0.0768 | (0.0613) | -0.0758 | (0.2362) | 0.0076 | (0.0602) |
| Soc.Science | 0.3611 | **(0.1859) | -0.0143 | (0.0505) | 0.3070 | (0.2224) | -0.0131 | (0.0485) |
| Publications | | | | | | | | |
| Books /average by fac. | 0.1165 | ***(0.0369) | -0.0060 | (0.0059) | 0.1223 | ***(0.0397) | -0.0056 | (0.0059) |
| Chapt. /average by fac. | -0.0216 | (0.0254) | -0.0048 | (0.0055) | -0.0240 | (0.0268) | -0.0050 | (0.0054) |
| Papers /average by fac. | 0.3614 | ***(0.0747) | 0.0009 | (0.0114) | 0.3933 | ***(0.0815) | 0.0008 | (0.0108) |
| Other | | | | | | | | |
| Grants /average by fac. | 0.1333 | ***(0.0462) | 0.0064 | (0.0101) | 0.1616 | ***(0.0502) | 0.0060 | (0.0100) |
| Having PhD | 0.2323 | (0.1423) | -0.0434 | (0.0441) | -0.0279 | (0.1788) | -0.0390 | (0.0414) |
| Teach.skill | 0.3229 | **(0.1527) | 0.0384 | (0.0359) | 0.3208 | *(0.1717) | 0.0374 | (0.0351) |
| Distr. parameters | | | | | | | | |
| Standard dev. | 0.0728 | (0.0047) | 0.0928 | (0.0122) | 0.0721 | (0.0047) | 0.0908 | (0.0116) |
| Correlation | -0.5043 | (0.0717) | -0.0213 | (0.5083) | -0.4487 | (0.0896) | -0.2134 | (0.4729) |

Table 9: Estimation results on reservation and desired salary

| | Reservation salary $100(W^r-W)/W$ | | Deserved salary $100(W^d-W)/W$ | |
|---|---|---|---|---|
| | par. | s.e. | par. | s.e. |
| Individual char. | | | | |
| Intercept | 46.0216 | ***(19.8374) | 28.7897 | ***(11.0619) |
| Gender | -0.7159 | (3.4582) | -0.5066 | (1.9284) |
| Citizen | -2.6702 | (4.2539) | -0.1478 | (2.3721) |
| Job char. | | | | |
| (W/10,000) | -37.2322 | ***(15.6570) | -13.5078 | (8.7308) |
| (W/10,000)² | 7.0052 | ***(2.5820) | 1.7516 | (1.4398) |
| Experience | 1.1957 | *(0.6868) | 0.7518 | **(0.3830) |
| Experience²/10 | -0.2621 | (0.1767) | -0.1577 | (0.0985) |
| Tenure | 0.3020 | (0.6604) | 0.0478 | (0.3683) |
| Tenure²/10 | 0.1234 | (0.2139) | 0.0452 | (0.1193) |
| Time-out | -1.0188 | (1.0803) | -0.7616 | (0.6024) |
| University | | | | |
| Aberdeen | 1.5043 | (4.4223) | 2.1708 | (2.4660) |
| Dundee | 1.0357 | (3.7018) | -2.0651 | (2.0642) |
| Heriot-Watts | -0.0763 | (5.9366) | 0.8174 | (3.3104) |
| St Andrews | 4.0506 | (4.0109) | -0.2100 | (2.2366) |
| Faculty | | | | |
| Arts | -6.7891 | (4.3780) | -3.3358 | (2.4413) |
| Engineer | 5.3442 | (4.6596) | -1.2326 | (2.5983) |
| Medicine | -0.5462 | (4.3939) | -1.0640 | (2.4502) |
| Soc.Science | -0.8213 | (4.4326) | -1.9342 | (2.4717) |
| Publications | | | | |
| Books /average by fac. | 0.6081 | (0.7685) | 0.0474 | (0.4286) |
| Chapt. /average by fac. | -2.0800 | **(0.9370) | -0.9156 | *(0.5225) |
| Papers /average by fac. | 2.2234 | (1.4724) | 0.9480 | (0.8210) |
| Other | | | | |
| Grant/average by fac. | -1.1425 | (1.2726) | 0.3022 | (0.7097) |
| Having PhD | -1.2046 | (3.4186) | 3.4236 | *(1.9063) |
| Teach.skill | 1.9112 | (3.7400) | 6.6908 | ***(2.0855) |
| Advantages | | | | |
| Environment | 0.2705 | (2.9771) | -1.3194 | (1.6601) |
| Interesting work | 5.9962 | (4.7202) | 0.9330 | (2.6321) |
| Responsibility | 2.3727 | (3.0073) | 2.4883 | (1.6769) |
| Job Security | 0.0771 | (3.3258) | 0.7457 | (1.8545) |
| Flexibility | -5.2465 | (3.7554) | -1.4879 | (2.0941) |
| Traveling | 4.0951 | (2.9156) | 0.2794 | (1.6258) |
| Mobility | -8.1788 | *(4.4352) | -0.1649 | (2.4732) |
| Teaching | 1.0688 | (3.0293) | -2.2623 | (1.6892) |
| Disadvantages | | | | |
| Supervision | -7.7305 | (4.9172) | -3.1455 | (2.7420) |
| Prom. Chances | 3.1738 | (3.1769) | 4.0241 | **(1.7715) |
| Prom. Path | -2.9296 | (3.0845) | 3.4224 | **(1.7200) |
| Reality | -6.5586 | *(3.6697) | -4.6591 | **(2.0463) |
| Correlation coeff. | | 0.2664*** | | |

Appendix A: Estimation of spinal point and salary scale model

We model the spinal points and salary scales as an ordered probit. Define $x_i$ as a vector of explanatory variables, $\beta$ as a parameter vector, and $\varepsilon_i^s$ an individual disturbance term. The minimum spinal point that an academic can be in is represented by the point m and the treshold value $T^m$, which is determined by age, tenure and the time being out of the job.

$$
\begin{aligned}
(1a)\quad s_i^* &= x_i'\beta + \varepsilon_i^s \\
s_i &= j \qquad \text{if } T^m \le T^j < s_i^* \le T^{j+1} \\
&= m \qquad \text{if } s_i^* < T^m
\end{aligned}
$$

Next define $w_i$ as the natural logarithm of the salary of individual i. We model the salaries according to the salary scales of figure 1 with salary $w^j$ for the scales j from 4 to 27, with $\varepsilon_i$ a individual disturbance term, and $I(s_i = j)$ an indicator function for being in scale j.

$$(1b)\quad w_i = \Sigma_{j=4,..,27}\ w^j I(s_i = j) + \varepsilon_i$$

Note that due to the fact that our information on spinal points is imperfect – for most respondents we only observe the salary scale – the salaries contain additional information to estimate the model. In case we would know the exact spinal point for all respondents, equation (1b) would only identify the variance of the error term $\varepsilon_i$ – which could be interpreted as measurement error.

Professors are not paid according to the salary scale, and therefore we model their salaries separately. As there is a minimum wage for professors, we model their wages with a censored regression model, with $z_i$ as a vector of explanatory variables, $\gamma$ as a parameter vector, and $\varepsilon_i^*$ as a disturbance term.

$$
\begin{aligned}
(1c)\quad w_i^* &= z_i'\gamma + \varepsilon_i^* \\
w_i^p &= w_i^* \qquad \text{if } w_i^* > w_i^m \\
&= w_i^m \qquad \text{if } w_i^m = w_i^*
\end{aligned}
$$

Note that the data on the salaries of the professors do actually not add information to the model of the spinal points, and could be left out of the model. As the salary equation of the professors is interesting in itself, we include it in our model. For estimation we assume that the disturbance terms $(\varepsilon_i^s, \varepsilon_i, \varepsilon_i^*)$ to be independent of the explanatory variables $(x_i, z_i)$ and to be identically and independently trivariate normally distributed. Our model can be interpreted as an extended version of the switching regression or the Tobit Type 5 model, see Amimiya (1984), in which the switching part of the model is replaced by an ordered probit. As from the data it is not clear whether the restrictions on the scales and the professional salaries hold in practice, we decide to estimate one model without restrictions, and one model with restrictions. We first discuss the estimation of the model without the restrictions.

Model without restrictions

The likelihood contribution for an academic i in scale j and wage $w_i$ is:

$$P(s_i=j, w_i) = P(s_i^* = T^{j+1}, w_i) - P(s_i^* = T^j, w_i)$$
$$= [P(s_i^* = T^{j+1} | w_i) - P(s_i^* = T^j | w_i)]\, P(w_i)$$

with for non-professors (j=27):

$$P(s_i^* = T^j | w_i) = F\left( (T^j - x_i'\beta - (\rho/\sigma)(w_i - w^j)) / \sqrt{(1-\rho^2)} \right)$$
$$P(w_i) = f\left( (w_i - w^j)/\sigma \right)$$

and for professors (j=28):

$$P(s_i^* = T^j | w_i) = F\left( (T^j - x_i'\beta - (\rho^*/\sigma^*)(w_i - z_i'\gamma)) / \sqrt{(1-\rho^{*2})} \right)$$
$$P(w_i) = f\left( (w_i - z_i'\gamma)/\sigma^* \right)$$

Note that the standard deviation of $\varepsilon_i^s$ is set to one. Note also that for this model the correlation between the error-terms of the wages for the non-professors and professors is not identified. For a comparable result, see the Tobit Type 5 model of Amemiya (1984).

Model with restrictions

The likelihood contribution for a non-professor i in scale j and wage $w_i$ is:

$$P(s_i=j, w_i \mid s_i=m) = P(s_i=j, w_i)/P(s_i=m) \qquad (j=m)$$

As the nominator is the same as for the model without restrictions, the derivation of the likelihood contribution is furthermore straightforward. For estimation we deleted the 39 individuals with j<m from the data. The likelihood contribution for a professor i with wage $w_i$ is:

$$P(s_i=28, w_i \mid s_i=m, w_i=w_i^m) = P(s_i=28, w_i)/P(s_i=m, w_i=w_i^m)$$

Again the nominator is the same as for the model without restrictions. For 3 professors with a reported salary below the professional minimum, we set the salary equal to this professional minimum. Note that for this model the correlation between the non-professional and the professional wage is identified. Still the maximum likelihood procedure (of GAUSS) has problems to optimise the likelihood with respect to this parameter. As this parameter is only identified on the basis of the data on the professors, and the minimum scale restriction is of little importance for the professors, this is not a surprise. We set this correlation equal to zero.

Appendix B: Simulation results

This appendix discusses the simulations of our salary scale model. For the salary scale model we present the results for the model with restrictions. Results should therefore be interpreted as an upper bound, since the model is based on a sample excluding certain academics (see discussion following equation 1c, section 4). As reference academics we choose two academics in social sciences; one academic with characteristics close to the average lecturer, and one academic with characteristics close to the average senior lecturer/reader. Tables B.1 and B.2 present the characteristics of these reference academics. In our simulation we do not restrict outcomes to particular spinal points, but allow them instead to vary. Besides calculating the probabilities according to differing spinal points and the resulting expected wage for the reference academics,

we also calculate the impact on salary of an additional book, chapter, paper, grant, teaching skills, 1 year out-of-labour-force, gender, and gender plus 1 year out-of-labour-force.

We first discuss the simulation of the reference academics in tables B.1 and B.2. Table B1 shows a lot of probability mass at spinal points 11 and 18, which most likely represents clustering at the top of the lecturer A and lecturer B scales as individuals wait for promotion to the next salary scale. We also find a high mass in points 12, 13 and 20. In table B.2 the relevant high mass points are 18, 20, 24 and being a professor. The predicted salaries seem in line with what might be expected on the basis of the actual salaries in the data.

Although the variables on research productivity were highly significant in our model, the size of their impact is modest in our simulations. An additional published book increases the expected wage by 0.7 to 0.8 percent, while an additional published paper increases the expected wage by 0.3 to 0.4 percent. Astonishing in this respect is the impact of teaching skills, a change to having good teaching skills increases the expected salary by 4.1 to 6.2 percent. For our second reference academic this change increases the probability of being professor from 15.1 to 23.8 percent. An explanation for this large effect is that the teaching skill variable also picks up other skills, like presentation skills. Also large is the impact of an out-of-the-labour-force spell, a one-year spell decreases the expected salary by 1.3 to 1.8 percent. Although gender itself was not significant in our model, the simulations shows that the impact of gender-related issues might be considerabele. Changing our male reference academics without an out-of-labour-force spell into woman with a one year out-of-labour-force spell decreases, ceteris paribus, the expected salary by 2.8 to 3.8 percent.

Table B.1: simulations on individual and productivity characteristics (1)

| reference | Male citizen, 36 years, 12 years experience, 4 years tenure, no time-out-of-labour-force |
|---|---|
| academic 1 = | 1 book, 2 chapters, 6 papers, 2 grants, PhD, no teaching skills |

| Scale | ref. | +1 book | +1 chapt. | +1 paper | +1 grant | +tch sk. | +1 out-of | woman | +1 out-of |
|---|---|---|---|---|---|---|---|---|---|
| 4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 7 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 8 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 9 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10 | 4.26 | 3.99 | 4.29 | 4.14 | 4.07 | 2.85 | 4.87 | 4.95 | 5.61 |
| 11 | 13.89 | 13.17 | 13.95 | 13.56 | 13.38 | 10.03 | 15.44 | 15.65 | 17.24 |
| 12 | 10.38 | 10.00 | 10.41 | 10.21 | 10.11 | 8.18 | 11.16 | 11.27 | 12.01 |
| 13 | 15.85 | 15.51 | 15.88 | 15.70 | 15.61 | 13.63 | 16.50 | 16.58 | 17.12 |
| 14 | 2.06 | 2.03 | 2.06 | 2.05 | 2.04 | 1.88 | 2.10 | 2.10 | 2.12 |
| 15 | 7.44 | 7.39 | 7.44 | 7.42 | 7.41 | 7.00 | 7.49 | 7.49 | 7.48 |
| 16 | 3.28 | 3.28 | 3.27 | 3.28 | 3.28 | 3.19 | 3.25 | 3.25 | 3.20 |
| 17 | 7.62 | 7.67 | 7.61 | 7.64 | 7.66 | 7.72 | 7.45 | 7.43 | 7.21 |
| 18 | 14.34 | 14.67 | 14.31 | 14.50 | 14.58 | 15.89 | 13.59 | 13.48 | 12.66 |
| 20 | 10.10 | 10.56 | 10.06 | 10.31 | 10.43 | 12.67 | 9.13 | 9.00 | 8.07 |
| 21 | 4.03 | 4.29 | 4.01 | 4.15 | 4.22 | 5.62 | 3.50 | 3.44 | 2.96 |
| 22 | 1.45 | 1.56 | 1.44 | 1.50 | 1.53 | 2.15 | 1.23 | 1.21 | 1.02 |
| 23 | 0.61 | 0.66 | 0.61 | 0.63 | 0.65 | 0.93 | 0.51 | 0.50 | 0.42 |
| 24 | 3.21 | 3.52 | 3.18 | 3.35 | 3.43 | 5.26 | 2.63 | 2.55 | 2.07 |
| 25 | 0.73 | 0.81 | 0.72 | 0.77 | 0.79 | 1.35 | 0.57 | 0.55 | 0.42 |
| 26 | 0.20 | 0.22 | 0.19 | 0.21 | 0.21 | 0.39 | 0.15 | 0.14 | 0.11 |
| 27 | 0.10 | 0.11 | 0.10 | 0.11 | 0.11 | 0.20 | 0.08 | 0.07 | 0.05 |
| Prof. | 0.47 | 0.54 | 0.46 | 0.50 | 0.52 | 1.06 | 0.34 | 0.33 | 0.23 |
| Salary | | | | | | | | | |
| in £1,000 | 23.26 | 23.42 | 23.25 | 23.33 | 23.37 | 24.21 | 22.95 | 22.91 | 22.62 |
| Deviation | | | | | | | | | |
| Percent | 0.00 | 0.65 | -0.06 | 0.30 | 0.47 | 4.05 | -1.34 | -1.51 | -2.76 |

Table B 2: simulations on individual and productivity characteristics (2)

| | |
|---|---|
| Reference | male citizen, 48 years, 24 years experience, 16 years tenure, no time-out-of-labour-force |
| academic 2 = | 2 books, 4 chapters, 16 papers, 6 grants, PhD, no teaching skills |

| scale | ref. | +1 book | +1 chapt. | +1 paper | +1 grant | + tch.sk | +1 out-of | woman | +1 out-of |
|---|---|---|---|---|---|---|---|---|---|
| 4 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 5 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 7 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 8 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 9 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 11 | 1.17 | 1.03 | 1.19 | 1.11 | 1.07 | 0.55 | 1.52 | 1.57 | 2.01 |
| 12 | 1.36 | 1.22 | 1.38 | 1.29 | 1.26 | 0.69 | 1.71 | 1.76 | 2.18 |
| 13 | 3.25 | 2.96 | 3.28 | 3.12 | 3.04 | 1.81 | 3.95 | 4.05 | 4.85 |
| 14 | 0.56 | 0.52 | 0.57 | 0.54 | 0.53 | 0.33 | 0.67 | 0.69 | 0.80 |
| 15 | 2.39 | 2.21 | 2.41 | 2.31 | 2.26 | 1.45 | 2.82 | 2.88 | 3.33 |
| 16 | 1.27 | 1.18 | 1.27 | 1.22 | 1.20 | 0.80 | 1.47 | 1.50 | 1.71 |
| 17 | 3.60 | 3.36 | 3.62 | 3.49 | 3.43 | 2.35 | 4.11 | 4.18 | 4.71 |
| 18 | 10.73 | 10.20 | 10.78 | 10.49 | 10.35 | 7.70 | 11.85 | 12.00 | 13.05 |
| 20 | 14.28 | 13.87 | 14.32 | 14.09 | 13.99 | 11.62 | 15.05 | 15.14 | 15.72 |
| 21 | 9.65 | 9.54 | 9.66 | 9.60 | 9.58 | 8.69 | 9.79 | 9.80 | 9.80 |
| 22 | 4.68 | 4.68 | 4.68 | 4.68 | 4.68 | 4.46 | 4.65 | 4.64 | 4.54 |
| 23 | 2.27 | 2.28 | 2.27 | 2.27 | 2.28 | 2.22 | 2.23 | 2.22 | 2.15 |
| 24 | 17.85 | 18.18 | 17.82 | 18.01 | 18.09 | 19.04 | 17.00 | 16.88 | 15.84 |
| 25 | 7.50 | 7.80 | 7.47 | 7.64 | 7.71 | 8.99 | 6.83 | 6.74 | 6.05 |
| 26 | 2.72 | 2.85 | 2.70 | 2.78 | 2.82 | 3.45 | 2.42 | 2.38 | 2.10 |
| 27 | 1.59 | 1.68 | 1.58 | 1.63 | 1.65 | 2.07 | 1.40 | 1.38 | 1.20 |
| Prof. | 15.12 | 16.46 | 14.99 | 15.71 | 16.06 | 23.77 | 12.51 | 12.18 | 9.96 |
| Salary | | | | | | | | | |
| in £1,000 | 29.34 | 29.57 | 29.31 | 29.45 | 29.53 | 31.14 | 28.81 | 28.74 | 28.22 |
| Deviation | | | | | | | | | |
| Percent | 0.00 | 0.81 | -0.10 | 0.39 | 0.64 | 6.16 | -1.81 | -2.05 | -3.82 |

Appendix C: Comparable wage regressions

In this appendix we calculate straightforward wage regression to compare them to the results of our spinal point and salary scale model. Define $w_i$ as the natural logarithm of the salary of individual i, $x_i$ as a vector of explanatory variables, $\beta$ as a parameter vector, and $\varepsilon_i^w$ as an individual disturbance term.

(B.1) $$w_i = x_i'\beta + \varepsilon_i^w$$

The OLS results are given in table C.1. We consider salary determination of our full sample of academics, of academics excluding professors and of professors only. Note that the results of the last two regressions should be interpreted with care, as selection effects play a role.

For the full sample we reveal an insignificant reward to male academics above female. As for the salary scale model, excluding the productivity variables from the analysis reveals a significant gender-wage gap at a one percent significance level. Experience is positively rewarded and spells outside the labour market have a significantly negative effect on academic salaries. Academics in Heriot-Watt experience a significant salary advantage relative to the excluded university Glasgow. Results reveal significantly positive rewards to productivity variables such as the number of books and papers published, grants awarded and high teaching ability. Overall the conclusions are in line with the results from the salary scale model.

Comparison of these results with those of academics excluding professors reveals similar patterns, although the reward to tenure is now significant. As stated in the beginning of this paragraph, the results should be taken with care as selection effects might play a major role here. For academics with much experience, tenure, and publications, becoming professor is a likely event. As the professors are excluded, the impact of these variables might be biased considerably. The same holds for the regression on the wages of the professors. Notice the negative impact of the number of books written, and also the n-shaped effect of tenure is negative after 8 years. Although this result is in line with Ransom (1993), it does not seem very reasonable to draw strong conclusions on the basis of these results.

Table C.1: Estimation results of wage regressions

| | Full sample (635 obs.) | | Exclud. Professors (544 obs.) | | Professors only (91 obs.) | |
|---|---|---|---|---|---|---|
| | par. | s.e | par. | s.e. | par. | s.e. |
| Individual char. | | | | | | |
| Intercept | 9.5323 | ***(0.0270) | 9.5565 | ***(0.0236) | 10.4829 | ***(0.1708) |
| Gender | 0.0243 | (0.0149) | 0.0010 | (0.0127) | -0.0637 | (0.0827) |
| Citizen | 0.0263 | (0.0190) | 0.0094 | (0.0161) | -0.0229 | (0.0643) |
| Job char. | | | | | | |
| Experience | 0.0329 | ***(0.0025) | 0.0267 | ***(0.0023) | 0.0057 | (0.0093) |
| Experience²/10 | -0.0045 | ***(0.0006) | -0.0039 | ***(0.0006) | 0.0001 | (0.0016) |
| Tenure | 0.0029 | (0.0027) | 0.0122 | ***(0.0026) | 0.0043 | (0.0042) |
| Tenure²/10 | -0.0011 | (0.0009) | -0.0028 | ***(0.0008) | -0.0027 | **(0.0013) |
| Time-out | -0.0171 | ***(0.0037) | -0.0116 | ***(0.0031) | -0.0642 | (0.0425) |
| University | | | | | | |
| Aberdeen | 0.0254 | (0.0185) | 0.0219 | (0.0172) | 0.0338 | (0.0335) |
| Dundee | -0.0050 | (0.0162) | 0.0110 | (0.0142) | -0.0047 | (0.0422) |
| Heriot-Watts | 0.0599 | **(0.0262) | 0.0685 | ***(0.0250) | -0.0054 | (0.0408) |
| St Andrews | -0.0008 | (0.0180) | -0.0041 | (0.0162) | 0.0716 | **(0.0334) |
| Faculty | | | | | | |
| Arts | 0.0089 | (0.0184) | 0.0111 | (0.0166) | -0.0287 | (0.0355) |
| Engineer | -0.0302 | (0.0199) | -0.0379 | **(0.0178) | 0.0328 | (0.0422) |
| Medicine | 0.0090 | (0.0199) | 0.0020 | (0.0177) | 0.0759 | *(0.0447) |
| Soc.Science | 0.0500 | ***(0.0191) | 0.0428 | **(0.0176) | -0.0122 | (0.0348) |
| Publications | | | | | | |
| Books /average by fac. | 0.0096 | ***(0.0032) | 0.0060 | (0.0040) | -0.0061 | *(0.0034) |
| Chapt. /average by fac. | -0.0013 | (0.0025) | 0.0005 | (0.0025) | -0.0036 | (0.0040) |
| Papers /average by fac. | 0.0443 | ***(0.0058) | 0.0325 | ***(0.0074) | 0.0025 | (0.0064) |
| Other | | | | | | |
| Grants /average by fac. | 0.0231 | ***(0.0045) | 0.0165 | ***(0.0045) | 0.0103 | (0.0068) |
| Having PhD | 0.0246 | *(0.0146) | 0.0449 | ***(0.0132) | -0.0494 | (0.0311) |
| Teach.skill | 0.0566 | ***(0.0157) | 0.0507 | ***(0.0147) | 0.0480 | *(0.0268) |