Perceived Income, Promotion and Incentive Effects

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February 2002

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ABSTRACT

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This paper examines the disincentive effects of perceived underpayment on individuals' exerted effort and promotion. To this end we develop a theoretical framework and obtain empirical evidence by analysing British academia data. We find that, *tenured* academics will tend to invest less effort in publishing as the difference between their perceived deserved income and actual income increases. On the other hand, for non-tenured academics this relationship is ambiguous. Our model predicts that if, however, tenured staff also derive utility directly from publication, over and above that associated with income and promotion, the difference between perceived and actual income has a smaller negative effect on the actual effort invested in research.

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1. **Introduction**

This paper investigates the disincentive effects of underpayment on individual productivity. We are interested in the relationship between the effort invested by a worker at the work place and the difference between perceived deserved income and actual income received. Many firms have difficulty in assessing their employees' contribution to total output and profits (Radner 1993), as a consequence, workers may earn less or more than they think they deserve. Does the payment of workers above or below their perceived marginal revenue product have defined effects on their effort on the job?

The economics literature to date includes a discussion on workers' attempts to influence their employers' promotion review decisions - Milgrom and Robert (1992) define such activities as "influence costs", where through rent-seeking activity individuals earn rents in the form of promotion. Epstein and Spiegel (2001) take an alternative approach. They consider the effect of the difference between perceived income and actual income on influence costs and thus explain why the effect of income inequality on productivity and growth is ambiguous. In this paper we investigate the effect the difference between perceived income and actual income has on the level of effort invested by the worker in productive activities.

We first develop a theoretical framework to analyse this relationship. We consider a two period model. In the first period a worker determines how much effort to invest at the workplace. In the second period the worker is either promoted (with an associated salary rise) or not. The probability of promotion is a direct function of the effort invested in the first period. The worker, while making his/her decisions regarding the level of effort to invest in the first period takes into account the difference between his/her actual income earned and that which he/she thinks is deserved. As we show, as the difference between the two incomes (the perceived/deserved and the actual) increases, the level of effort invested by the worker may either increase or decrease. *In general* if the worker believes he/she should be earning more, then the worker is either discouraged and invests less effort *or* contrarily, is encouraged to increase effort to "prove" to superiors that he/she is worthy of the promotion. We develop conditions under which the workers will increase or decreases their level of effort as a result of an increase in the difference between perceived and actual income.

In order to examine this relationship empirically we use individual data from a sample of British academics from 5 old established universities. The British academic profession provides an interesting application for our analysis. The Hay report, published in 1997, suggested that over the ten-year period 1987-1996 university pay in Britain dropped a staggering 20% in real terms, falling behind the remuneration levels of comparable professions in the public sector. Dearing (1997)

confirmed this trend, warning that although academic remuneration should be sufficient to recruit, retain and motivate staff of the required quality, the majority of staff in British higher education were in fact paid substantially below comparable private and public sector rates. Concern was that the long-term underpayment of academics might decrease productivity, and/or may spark the drain of high quality individuals from academia into more lucrative positions in the private sector, or to academic positions abroad.

An advantage of the study of this particular labour market is that productivity is relatively easy to observe and quantify. The emergence of the research assessment exercise[3] in Britain has emphasised the importance of publication to an academic career. Our dataset includes detailed information on individual research productivity, measured through the number of publications held by an individual. Our data also contains information on annual salary and on a measure of an academic's perceived or deserved salary. It has been suggested that academics as an occupational group may be less concerned about salary than the average worker, with non-pecuniary aspects of the job such as rewarding work taking precedence over salary. We consider the case that individuals derive utility from their job, over and above that derived from salary, during the course of our analysis. One might however wish to see the estimates derived from our empirical analysis as a lower bound estimate of the relationship between effort and reward.

The remainder of the paper is organised as follows. Section 2 introduces a theoretical model that investigates the relationship between the level of effort and the difference between the perceived and actual income of the worker. Section 3 introduces our dataset, summary statistics derived from our sample and discusses the empirical results. Section 4 concludes.

2. The Model

Our analysis focuses on the relationship between the effort invested by a worker at the work place and the difference between that worker's deserved income (that is the income that he or she thinks he/she deserves) and the actual income he/she receives. Since our empirical analysis is based on academic data, so we introduce our model in terms of publications and time invested in research activities and annual salary. Our theoretical and empirical results have however a more general application.

Each academic determines optimally how much time to spend in research activities, which may in turn yield publications in refereed journals. In order to simplify our story we assume that each academic has one unit of time, which he/she divides optimally between two alternatives:

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leisure and effort spent in research. Denote L the level of leisure and e the amount of effort invested in research activities, thus

$$L + e = 1 \qquad\qquad (1)$$

Academics differ in their research abilities. In order to simplify our analysis we focus on a "representative" academic, who can be thought of as an "average" academic. We consider the number of publications the representative academic generates which is assumed to be a positive function of his/her time expenditure in research activities. Denote *Pub(e)* as the number of publications a representative academic produces, given e units of effort.

We consider a two period model. In the first period the academic earns an income of I_1 and must determine how much effort to invest in research activities. This effort will generate publications and as a result, with probability P the academic will be promoted and receive a higher income of I_2 in the second period ($I_2 > I_1$). With probability *1-P* the academic is not promoted and will earn the same income he received in the first period. The probability of promotion is a direct function of the number of average publications, thus the probability of promotion is also a positive function of the effort invested in research activities: *P(e)* such that $\dfrac{\partial P}{\partial e} \geq 0$. It may be the case that an academic cannot be promoted in the future, since he/she may already hold a professorial position. Moreover, we could also think about promotion as the tenure hurdle – the probability of those that have tenure of receiving tenure is zero.

We simplify our analysis by assuming that the level of income is independent of the effort level. For the particular profession that we consider in our empirical section – that is British academia - this is a realistic assumption, since salaries **within** grades are based on a fixed salary structure and rise automatically in annual increments, irrespective of an individual's effort on the job. Allowing for the income, I, to be a function of the number of publications and thus also a function of the level of effort would however not change our main results[4].

Let us now consider the utility of the representative academic, *u*. An individual's utility is a function of a number of parameters: first, it is positively related to an academic's leisure time, *L*; second, it is positively related to an academic's actual income, I_1; it is positively related to the number of publications published (this assumes that an academic derives utility from his/her job

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[3] The research assessment exercise grades departments within UK universities on the basis of individual members' research output. Assessment in undertaken every 5 years.
[4] Proofs of propositions under the case that income is a function of effort in research activities is available on request.

over and above that associated with income[5]); and, finally, it is negatively related to the difference between the income a worker thinks he/she should earn, I^e, that is deserved income, and the actual income he/she receives, I. The difference between the income that he or she thinks he/she deserves, and the actual income that he/she actually receives is denoted by $A = I^e - I$. [6]

The representative academic's utility in the first period can therefore be written as follows:

$$u_1 = u_1(L_1, I_1, Pub_1, A_1) \tag{2}$$

The academic's expected utility in the second period is given by:

$$E[U_2] = P(e)u_2(L_2, I_2, Pub_2, A_2) + (1 - P(e))u_3(L_2, I_1, Pub_2, A_3) \tag{3}$$

such that $\dfrac{\partial u_i(.)}{\partial L_i} > 0, \dfrac{\partial u_i(.)}{\partial I_i} > 0, \dfrac{\partial u_i(.)}{\partial Pub_i} > 0$ and $\dfrac{\partial u_i(L_i, I_i, Pub_i,)}{\partial A_i} < 0$.

We assume that the level of effort invested in the first period determines the number of publications published in the second. In the first period an academic therefore takes as given his income level, I_1, the publications he/she held on entry to his/her current position (if any), Pub_1, and the difference between his perceived income and his actual income, A_1. An academic then decides on his investment in research which may yield a promotion at the end of period 1, resulting in a higher income in the second period and a new difference between actual and deserved income, A_2. If the academic is not promoted, however, he will continue to earn I_1 while his deserved income will have risen, thus $A_3 > A_1$. It is clear therefore that A_2 and A_3 are a function of the effort invested in the first period.

The expected utility of the representative academic over both periods is given by

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[5] This might be seen, for example, as the satisfaction derived from successful publication, international recognition, internal departmental politics, enjoying research itself, the opportunity to attend conferences, etc.
[6] Epstein and Spiegel (2001) look at the difference between what the worker contributes to the firm and what he/she earns.

$$E[U] =$$

$$= u_1(L_1, I_1, Pub_1, A_1) + P(e)u_2(L_2, I_2, Pub_2(e), A_2(e)) +$$

$$+ (1 - P(e))u_3(L_2, I_1, Pub_2(e), A_3(e)) \tag{4}$$

s.t.

$$L + e = 1$$

The academic's objective is therefore to determine the optimal amount of effort to invest in the first period. The first order conditions are given by[7]

$$\frac{\partial E[U]}{\partial e} =$$

$$= -\frac{\partial u_1}{\partial L_1} + \frac{\partial P(e)}{\partial e}(u_2(.) - u_3(.)) + \tag{5}$$

$$+ P(e)\left(\left(\frac{\partial u_2}{\partial Pub_2} - \frac{\partial u_3}{\partial Pub_2}\right)\frac{\partial Pub_2}{\partial e} + \frac{\partial u_2}{\partial A_2}\frac{\partial A_2}{\partial e} - \frac{\partial u_3}{\partial A_3}\frac{\partial A_3}{\partial e}\right)$$

$$+ \frac{\partial u_3}{\partial Pub_2}\frac{\partial Pub_2}{\partial e} + \frac{\partial u_3}{\partial A_3}\frac{\partial A_3}{\partial e} = 0$$

Thus,

$$\frac{\partial u_1}{\partial L_1} = \frac{\partial P(e)}{\partial e}(u_2(.) - u_3(.)) +$$

$$+ P(e)\left(\left(\frac{\partial u_2}{\partial Pub_2} - \frac{\partial u_3}{\partial Pub_2}\right)\frac{\partial Pub_2}{\partial e} + \frac{\partial u_2}{\partial A_2}\frac{\partial A_2}{\partial e} - \frac{\partial u_3}{\partial A_3}\frac{\partial A_3}{\partial e}\right) \tag{6}$$

$$+ \frac{\partial u_3}{\partial Pub_2}\frac{\partial Pub_2}{\partial e} + \frac{\partial u_3}{\partial A_3}\frac{\partial A_3}{\partial e}$$

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[7] Assuming that second order condition holds.

The LHS represents the marginal cost of the investment - the decrease in leisure resulting from an increase in effort invested in research. On the RHS we see the marginal benefit of investing effort in research, $\frac{\partial P(e)}{\partial e}(u_2(.) - u_3(.))$ represents the marginal probability times the increase in utility as a result of winning the promotion. $P(e)\left(\left(\frac{\partial u_2}{\partial Pub_2} - \frac{\partial u_3}{\partial Pub_2}\right)\frac{\partial Pub_2}{\partial e} + \frac{\partial u_2}{\partial A_2}\frac{\partial A_2}{\partial e} - \frac{\partial u_3}{\partial A_3}\frac{\partial A_3}{\partial e}\right)$ represents the marginal increase in utility multiplied by the probability of winning the promotion. $\left(\frac{\partial u_2}{\partial Pub_2} - \frac{\partial u_3}{\partial Pub_2}\right)\frac{\partial Pub_2}{\partial e}$ represents the marginal effect of an increase in effort on utility through additional publication. Notice that assuming a decreasing marginal utility of the number of publications we obtain that $\frac{\partial u_2}{\partial Pub_2} - \frac{\partial u_3}{\partial Pub_2} < 0$. $\frac{\partial u_2}{\partial A_2}\frac{\partial A_2}{\partial e} - \frac{\partial u_3}{\partial A_3}\frac{\partial A_3}{\partial e}$ represents the marginal effect of an increase in the level of effort on utility via the difference between deserved income and actual income. It is natural to assume that $\frac{\partial A_2}{\partial e} < 0 \; and \; \frac{\partial A_3}{\partial e} > 0$ namely, increasing effort will decrease A if an academic wins a promotion, while it will increase A if an academic looses the promotion[8], therefore $\frac{\partial u_2}{\partial A_2}\frac{\partial A_2}{\partial e} - \frac{\partial u_3}{\partial A_3}\frac{\partial A_3}{\partial e} > 0$. The last term $\frac{\partial u_3}{\partial Pub_2}\frac{\partial Pub_2}{\partial e} + \frac{\partial u_3}{\partial A_3}\frac{\partial A_3}{\partial e}$ represents the marginal effect of increasing effort on utility when not receiving promotion. The first term is the positive effect of an increase in publications while the second effect represents the negative effect of increasing effort and increasing the difference between deserved and actual income. The sum may be either negative or positive.

We denote the level of effort that satisfies (6) by e^*. We are now interested in investigating what effect a change in A_1 has on individual productivity, measured by the effort/number of publications invested/produced by the representative academic. Thus we calculate: $\frac{\partial e^*}{\partial A_1}$. It can be verified that $\frac{\partial e^*}{\partial A_1} = -\frac{\frac{\partial^2 E[U]}{\partial e \partial A_1}}{\frac{\partial^2 E[U]}{\partial e^2}}$, thus the sign of $\frac{\partial e^*}{\partial A_1}$ is the same as that of $\frac{\partial^2 E[U]}{\partial e \partial A_1}$. Thus we calculate $\frac{\partial^2 E[U]}{\partial e \partial A_1}$:

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[8] One could argue that A_2 may increase even if the academic wins the promotion as both the perceived income and the actual income will increase. We simplify our calculations by assuming that this doesn't happen. In general our results

$$\frac{\partial^2 E[U]}{\partial e\, \partial A_1} = -\frac{\partial^2 u_1}{\partial L_1 \partial A_1} + \frac{\partial P(e)}{\partial e}\frac{\partial\left(u_2(.) - u_3(.)\right)}{\partial A_1} +$$

$$+ P(e)\left(\left(\frac{\partial^2 u_2}{\partial Pub_2 \partial A_1} - \frac{\partial^2 u_3}{\partial Pub_2 \partial A_1}\right)\frac{\partial Pub_2}{\partial e} + \frac{\partial^2 u_2}{\partial A_2 \partial A_1}\frac{\partial A_2}{\partial e} - \frac{\partial^2 u_3}{\partial A_3 \partial A_1}\frac{\partial A_3}{\partial e}\right)$$

$$+ \frac{\partial^2 u_3}{\partial Pub_2 \partial A_1}\frac{\partial Pub_2}{\partial e} + \frac{\partial^2 u_3}{\partial A_3 \partial A_1}\frac{\partial A_3}{\partial e}$$

(7)

It is assumed that u_i exhibits decreasing returns to our various variables thus, $\frac{\partial^2 u_1}{\partial L_1^2} < 0$, $\frac{\partial^2 u_i(.)}{\partial A_1^2} < 0$, $\frac{\partial^2 u_i}{\partial Pub_2^2} < 0$ and $\frac{\partial^2 u_i}{\partial A_i^2} < 0$. Together with the natural assumptions regarding our first order derivatives we obtain:

$$\frac{\partial^2 u_1}{\partial L_1 \partial A_1} > 0, \frac{\partial^2 u_2}{\partial Pub_2 \partial A_1} > 0, \frac{\partial^2 u_3}{\partial Pub_2 \partial A_1} > 0, \frac{\partial^2 u_2}{\partial A_2 \partial A_1} < 0 \text{ and } \frac{\partial^2 u_3}{\partial A_3 \partial A_1} < 0.$$

Let us first consider the *extreme case* where the probability of promotion is very small or doesn't exist at all. This case will hold for all those academics that have tenure or do not believe that they will be promoted. Under this case $P(e) = \frac{\partial P(e)}{\partial e} = 0$ therefore,

$$\left.\frac{\partial^2 E[U]}{\partial e\, \partial A_1}\right|_{\frac{\partial P(e)}{\partial e} = P(e) = 0} = -\frac{\partial^2 u_1}{\partial L_1 \partial A_1} + \frac{\partial^2 u_3}{\partial Pub_2 \partial A_1}\frac{\partial Pub_2}{\partial e} + \frac{\partial^2 u_3}{\partial A_3 \partial A_1}\frac{\partial A_3}{\partial e}$$

(8)

The effect on leisure is negative while the effect on publication is positive and the effect of the difference between deserved and actual income is also negative. We therefore obtain,

Result 1: *If the academic has a low or no probability of being promoted then:*

If the academic is only (or mostly) concerned with publications (a "true" academic) he will increase his effort (if possible) in research activities.

If the academic is also concerned about his leisure and his/her deserved verses actual income, then the effect of an increase in A on the level of effort is ambiguous.

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will still hold if we relax this assumption.

This result states that if an academic cannot be promoted, but is only concerned about publication then he will invest all his time in publication. If, however, he is also concerned about the difference between his deserved and actual income and about his leisure time, then he may increase or decrease the time invested in research activities.

Now let us turn to the case where an academic may be promoted. Notice that in comparison to the case where an academic will not be promoted (8) we now have to take into consideration one more element (7): the effect on the future utility if promoted:

$$\frac{\partial P(e)}{\partial e}\frac{\partial\left(u_2(.)-u_3(.)\right)}{\partial A_1}+$$

$$P(e)\left(\left(\frac{\partial^2 u_2}{\partial Pub_2\partial A_1}-\frac{\partial^2 u_3}{\partial Pub_2\partial A_1}\right)\frac{\partial Pub_2}{\partial e}+\frac{\partial^2 u_2}{\partial A_2\partial A_1}\frac{\partial A_2}{\partial e}-\frac{\partial^2 u_3}{\partial A_3\partial A_1}\frac{\partial A_3}{\partial e}\right)$$

(9)

Note that $\dfrac{\partial P(e)}{\partial e}>0$, $\dfrac{\partial Pub_2}{\partial e}>0$ and given what we have described above, it is clear that

$\dfrac{\partial^2 u_2}{\partial Pub_2\partial A_1}-\dfrac{\partial^2 u_3}{\partial Pub_2\partial A_1}>0$ and $\dfrac{\partial^2 u_2}{\partial A_2\partial A_1}\dfrac{\partial A_2}{\partial e}-\dfrac{\partial^2 u_3}{\partial A_3\partial A_1}\dfrac{\partial A_3}{\partial e}>0$. The sign of the term

$\dfrac{\partial\left(u_2(.)-u_3(.)\right)}{\partial A_1}$ is positive, since the effect of A when one has been promoted should be smaller

than that when the person hasn't been promoted (remember that $u_2(.)-u_3(.)>0$ and that the utility has a decreasing margin with regard to A). We have therefore added three new components to (8) which all are positive. We may conclude therefore that

Result 2: *If the academic believes he/she may be promoted as a result of increasing his/her effort he/she will invest more time and effort in research activities than the academic, with the same attributes, that doesn't believe he/she will be promoted.*

To conclude, from results 1 and 2 and the above analysis we hypothesise that an academic believing that he/she earns less than he/she deserves, may in turn (1) increase effort on the job in order to prove their worth for a promotion or, (2) decrease research activities in the face of insufficient pecuniary reward. An academics response may hinge critically on the probability of promotion. In other words, tenured academics will tend to publish less as the difference between the income they

think they deserved and actual income increases. On the other hand, non-tenured academics may increase or decrease the effort invested in research activities as the difference between deserved and actual income increases.

In section 4 we turn to look at the empirical evidence on incentives effects on productivity in British academia. Section 3 first introduces the data source and it's main characteristics.

3. Data

The data used in this paper come from a cross section study undertaken in 1995/1996 of the academic staff of five old established British universities: Aberdeen, Dundee, Glasgow, Heriot-Watt and St. Andrews. The data was collected by means of a postal questionnaire, sent to the entire academic population, across all disciplines, of each university. 'Academic staff' included professors, readers, senior lecturers and lecturers, research assistants and fellows. The personnel department of each university compiled a current list of staff, and questionnaires, including instructions for completion, were distributed through the internal mail service of each university, anonymously completed by respondents and returned. The questionnaire collected information on personal background, education, working history and current job. The average response rate achieved was 30%, resulting in detailed information on 878 academics[9]. The data is weighted by gender, rank and subject area, and in these aspects is representative.

An advantage of this dataset for our analysis is it's detail. It provides detailed information on individual productivity, measured by the number of publications held by an individual, actual annual salary and an indication of whether actual salary reflects that which individuals consider they deserve. Ideally one might also wish to have information on research quantity, but unfortunately the quality of research is very hard to measure across all disciplines. Unless one wanted to concentrate on a narrowly defined subject field, where quality is clearly defined, quantity should represent a reasonable measure of research output. Annual salary is reported gross, before deductions for tax, national insurance, etc. A measure of the difference between the income that an academic feels he/she deserves, and the actual income that he/she receives is provided by individual response to the question: 'All things considered, which of the following statements do you feel best describes your present salary?: (i) Much less than I deserve, (ii) Somewhat less than I deserve, (iii) About what I deserve, (iv) Somewhat more than I deserve and (v) Much more than I deserve'.

The comparative disadvantage of the dataset is its' cross sectional nature. We are only able to analyse a snap-shot of the academic profession at one point in time without the ability to correct

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[9] The limited availability of statistics for the UK academic population makes it difficult to comment to what extent our data is representative. Comparison with summary information on the parent population of academics in Scotland made available by the university personnel departments reveals that females are marginally over-represented in our dataset. Across rank and subject area, at least, the data are representative of the academic population.

for selection in and out of the profession, nor are we able to observe the dynamic effects of underpayment on individual effort. 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.

[TABLES 1 AND 2 ABOUT HERE **]**

Table 1 presents the definitions of the explanatory variables used in our empirical analysis. Of the 878 academics from whom information was collected, we select fulltime academics, those paid on the non-clinical scale and those academics that are under the age of 64. Dropping those cases with missing information, we are left with 689 observations. Table 2 reports summary statistics for our variables of interest. From the first column we see that in our sample of academics 70% are male, and 89% are UK citizens. Our academics hold on average around 17 years of experience, nearly 10 years of which have been spent with their current university. Forty percent of academics are employed on a contract with less than a 3 year's duration (or in other words, 60% are tenured). Academics work over 50 hours per week on average, taking 24 days holiday per year. The table shows that the number of published papers is considerably higher on average in Science. The clear differences in research output by subject field highlights the necessity to control for subject field in our analysis. One way to do this would be to estimate the research ouput by scientific field, but our relatively small number of observations does not favour such an approach. Instead we normalize the number of papers by subtracting means and dividing by standard errors by subject field. This also allows us to consider what it takes to publish more than the average in an academic's field. The last panel of table 2 presents statistics on academics' actual and perceived salaries. We see that the majority of academics report that they receive a lower salary than they feel they deserve (79%), a large proportion report that they receive much less than they deserve (18%). Colomns 2 to 6 break all statistics down by contract type (short term or tenured) and grade.

[TABLES 3 and 4 ABOUT HERE **]**

Table 3 presents simple OLS regression on the determinants of individual productivity of the form:

$$P_i = \alpha_i + \beta_{1i} PC_i + \beta_{2i} JC_i + \beta_{3i} U_i + \varepsilon_i \tag{10}$$

Where P_i is the number of refereed publications normalised by subject field, PC_i is a vector of personal characteristics of the individual, JC_i is a vector of job characteristics and U_i represents the gap between actual and deserved salary of an individual. The first column in table 3 presents the results of this regression, excluding underpayment variables, for the whole of our sample. Interesting results to mention are that (1) we reveal a significant male advantage in publication output, (2) experience, tenure and holding a PhD are important predictors of publication success, and (3) hours of work are not significant in the determination of academic productivity.

The career path of the average academic entails two important hurdles - achieving tenure - that is acquiring a permanent position at an institution, and getting promoted from grade to grade. The first interpretation of the extreme case of our model - that is that the probability of promotion is very small or doesn't exist at all - is the case when an individual is already tenured. Columns 2 and 3 of table 3 therefore split our sample into those academics with a tenured position and those on short-term contracts. From column 2 we now see that hours of work are a significant predictor of the productivity of tenured staff. In using the specification in equation (10) with cross sectional data one might be concerned about the direction of causality - underpayment may not be causing decrease in productivity, but rather low productivity may impact negatively on wage and hence on the difference between deserved and actual income. Without longitudinal data, we are unable to isolate the two effects. This split however allows us to consider a mixed bag of academics – the untenured, which will contain both talented academics and 'rejects', against a bag of talented tenured academics, hence, analysis of the latter group already conditions on a certain level productivity standard.

We are centrally concerned however with the possible disincentive effects of underpayment on individual productivity, more specifically the correlation between the productivity and the difference between the perceived and actual income. Columns 4 and 5 therefore include a dummy variable indicating those individuals that consider they deserve a higher salary than the currently receive (more), and those individuals that consider they deserve less (less). The base category here is those individuals that respond that they are paid about what they deserve. We see that the coefficient on perceived underpayment is significantly negative, for both tenured and short-term contract staff, this effect is only significant for tenured staff however[10]. Columns 6 and 7 now replace our more and less variables with more detailed information on the extent of any under or over payment that respondents perceive. We see that for tenured staff, the negative relationship between perceived underpayment and productivity *increases in magnitude* with the gap between

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[10] Note that with cross sectional data we cannot say anything concrete about the direction of causality of this relationship.

deserved and actual pay. Once again, this effect is only significant for tenured staff. Interestingly, when we run separate regressions for men and women (not reported here) this underpayment effect is found to only be significant for men.

Alternatively, a second interpretation of the extreme case of our model - that is that the probability of promotion is very small or doesn't exist at all - is the case when an individual already holds the position of professor. Combing grade information with information on tenure, we divide our sample into three groups, or grades, of academic. Grade 1 consists of researchers or lecturer A staff, who can be promoted to higher grades and are unlikely to hold tenured positions. Grade 2 consists of lecturer B staff, senior lecturers and readers, who are likely to hold tenured positions but can still be promoted, since they hold positions lower than the title of professor. Finally, Grade 3 consists of tenured professors[11] - those individuals who cannot be promoted along either of our two definitions.

[TABLES 5 ABOUT HERE]

Table 4 presents our analysis of the determinates of productivity for these three grades of staff. The first three columns of table 4 exclude variables relating to deserved salary. Interesting results include (1) the persistence of a significant gender effect in productivity for grade 1 and 2, but not grade 3 staff and (2) the significant effect of a PhD from Oxford or Cambridge for grade 3 staff. Introduction of our more and less variables in columns 4 to 6 indicate the significantly positive relationship between being paid more than deserved for grade 1 staff and the significantly negative effect of underpayment for professors. Inclusion of our more detailed information on the extent of under and overpayment in columns 7 to 9 indicates that the magnitude of the negative relationship for professors increases with increasing distance between perceived and actual pay levels.

4. Conclusion

This paper investigates the disincentive effects of underpayment on individual productivity. We are interested in the relationship between the effort invested by a worker at the work place and the difference between the income that he or she thinks he/she deserves, and the income that he/she actually receives. In the first half of the paper we develop a theoretical model which suggests that an academic believing that he earns less than he deserves, may in turn (1) increase effort on the job in order to prove their worth for a promotion or, (2) decrease research activities in the face of insufficient pecuniary reward. We outline that an academics' response may hinge critically on the

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[11] In fact this is equal to the number of professors, since all are tenured).

probability of promotion and /or increase in income. In other words, holding human capital characteristics constant, tenured academics will tend to publish less as the difference between the income they think they deserved and actual income increases. On the other hand, non-tenured academics may increase or decrease the effort invested in research activities as the difference between deserved and actual income increases. Our model predicts that if, however, tenured staff also derive utility directly from publication other than that associated with income and promotion, the difference between perceived and actual income will have a smaller effect on the actual effort invested in research.

In the second half of the paper we look at empirical evidence to support our theoretical analysis and find that taking promotion as a tenure hurdle, we reveal no evidence of any significant relationship of pay on performance for contract staff, where performance is measured in relation to the average in one's field. For tenured staff however, our analysis reveals a significantly negative relationship between underpayment and productivity. This effect increases with the magnitude of the distance between perceived and actual salary. The direction of the relationship between underpayment and productivity is confirmed when taking promotion as a combination of tenure and promotion hurdle. We find that professors are likely to be increasingly less productive, as they consider themselves progressively underpaid. We also find evidence that junior staff, however, experience accelerated productivity as they regard themselves generously rewarded.

Hence it appears that underpayment has limited effects on productivity for those individuals who still have promotion or tenure opportunities. Underpayment may be particularly damaging to individuals who hold tenure/the title of professor are unsuccessful in salary negotiation and are limited in their outside options. One might question therefore why such individuals remain in academia at all. The answer may lie in the fact that academics do what they are good at – publishing and gaining international recognition, rather than earning money!

5. Bibliography

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Table 1: List of Variables

Name	Definition
Individual characteristics	
Male	= 1 if male, = 0 if female
UK Citizen	= 1 if UK citizen, = 0 otherwise
No of Kids	Number of children
Married	=1 if married, = 0 otherwise
Job characteristics	
Experience	Length of total labour market experience, measured in years
Experience Sq	Experience Squared
Tenure	Length of time with current employer, measured in years
Tenure Sq	Tenure Squared
Small Department	=1 if the respondent works in a department of 10 or less academic staff, =0 otherwise.
Medium-sized department	=1 if the respondent works in a department of more than 10 but less than 40 academic staff, =0 otherwise.
Large Department	=1 if the respondent works in a department of 40 or more academic staff, =0 otherwise.
Oxbridge PhD	= 1 if holds a PhD from Oxford or Cambridge, = 0 otherwise
Having PhD	= 1 if holds a PhD, = 0 otherwise
Hours	Usual hours worked per week
Holiday	Number of days holiday taken per year on average
Time-out	Length of time out of labour force, measured in years
Job position	
Short-term contract	= 1 if contract for 3 or less years, = 0 otherwise
Grade 1	= 1 if untenured staff member in grades of researcher, lecturer, senior lecturer or reader
Grade 2	= 1 if tenured staff member in grades of researcher, lecturer, senior lecturer or reader
Grade 3	= 1 if professor, = 0 otherwise
Faculty	Dummies for the five faculties in which respondents work: Arts, Science, Engineering, Social Sciences, Medicine
Publications	
No of Publications	Total number of refereed publications published
(No of Publications-mean in field) / (Standard deviation in field)	z-score of the total number of refereed publications published by subject field
Salary	
Much less than I deserve	= 1 if in reply to the question 'All things considered, which of the following statements do you feel best describes your present salary?' respondent replied: 'Much less than I deserve', = 0 otherwise.
Less than I deserve	= 1 if respondent replied 'Somewhat less than I deserve', = 0 otherwise.
About what I deserve	= 1 if respondent replied 'About what I deserve', = 0 otherwise.
Somewhat more than I deserve	= 1 if respondent replied 'Somewhat more than I deserve, = 0 otherwise.
Much more than I deserve'	= 1 if respondent replied 'Much more than I deserve', = 0 otherwise.
Less	= 1 if respondent replied 'Much less than I deserve' or 'somewhat less than I deserve'
More	= 1 if respondent replied 'Much more than I deserve' or 'somewhat more than I deserve'
Annual Salary	Gross annual salary of respondent

Table 2: Summary Statistics

Name	All	Short term staff	Tenured staff	Grade 1	Grade 2	Grade 3
Individual characteristics						
Male	.70	.54	.81	.54	.77	.96
UK Citizen	.89	.85	.91	.83	.91	.96
No of Kids	1.15 (1.26)	.54 (.98)	1.55 (1.26)	.51 (.927)	1.50 (1.24)	2.03 (1.23)
Married	.37	.54	.26	.55	.26	.17
Job characteristics						
Experience	16.95 (10.83)	9.73 (8.50)	21.63 (9.53)	9.21 (7.53)	21.25 (9.09)	27.28 (7.56)
Tenure	9.90 (11.03)	4.43 (8.35)	13.52 (11.10)	4.54 (9.029)	13.20 (10.19)	16.43 (11.53)
Small Department	.47	.41	.52	.41	.55	.47
Medium-sized department	.22	.24	.20	.23	.19	.22
Large Department	.31	.35	.28	.36	.26	.31
Oxbridge PhD	.09	.04	.14	.04	.12	.2
Having PhD	.70	.61	.77	.64	.73	.81
Hours	50.86 (11.36)	46.89 (11.46)	53.49 (10.52)	47.40 (11.47)	52.24 (9.80)	57.21 (11.62)
Holiday	24.10 (9.18)	25.52 (9.23)	23.16 (9.05)	25.18 (9.31)	23.91 (9.06)	21.47 (8.69)
Time-out	.54 (1.90)	.83 (2.31)	.34 (1.55)	.85 (2.54)	.38 (1.30)	.06 (.33)
Job position						
Short-term contract	.40	-	-	-	-	-
Grade 1	.44	-	-	-	-	-
Grade 2	.41	-	-	-	-	-
Grade 3	.15	-	-	-	-	-
Publications						
No of Publications	21.66 (33.23)	8.67 (23.80)	30.26 (35.72)	6.23 (10.70)	24.32 (26.49)	59.44 (54.76)
No of Publications (science)	29.55 (42.67)	10.62 (30.84)	45.95 (44.77)	8.22 (12.55)	37.46 (33.59)	91.33 (67.60)
No of Publications (medicine)	22.81 (31.55)	8.51 (12.17)	38.89 (38.32)	5.38 (6.98)	27.64 (25.90)	64.11 (48.84)
No of Publications (social science)	14.62 (21.30)	2.87 (6.90)	18.14 (22.83)	2.09 (3.07)	12.22 (12.93)	39.09 (30.19)
No of Publications (engineering)	16.59 (26.09)	8.13 (26.58)	22.55 (24.26)	4.48 (5.17)	20.19 (22.26)	43.71 (45.24)
No of Publications (arts)	12.63 (15.90)	4.35 (8.21)	14.59 (16.67)	5.29 (8.05)	12.49 (11.03)	27.31 (28.48)
Salary						
Annual Salary	25,226.99 (9782.14)	18,498.12 (6986.87)	29,681.08 (8773.78)	17,923.34 (4910.26)	27,925.66 (7013.97)	39,102.27 (8097.553)
Much less than I deserve	.18 (.39)	.14 (.35)	.27 (.41)	.18 (.38)	.18 (.39)	.19 (.40)
Less than I deserve	.52 (.50)	.49 (.50)	.54 (.50)	.48 (.50)	.58 (.50)	.49 (.50)
About what I deserve	.27 (.44)	.33 (.47)	.23 (.42)	.32 (.47)	.22 (.41)	.29 (.45)
Somewhat more than I deserve	.02 (.15)	.03 (.17)	.08 (.13)	.02 (.15)	.02 (.14)	.02 (.14)
Much more than I deserve	.04 (.07)	.01 (.08)	.002 (.05)	.003 (.06)	.003 (.06)	.009 (.10)
Less	.70 (.46)	.63 (.48)	.75 (.43)	.66 (.48)	.76 (.43)	.68 (.47)
More	.03 (.16)	.06 (.18)	.02 (.14)	.03 (.16)	.02 (.15)	.03 (.17)
No of observations	689	271	418	299	286	104

Standard deviations in parentheses.

Table 3: OLS
The determinants of individual productivity by contract type, dependent variable = z-score of number of refereed publications by subject field

No. of published papers	All	Tenured Staff	Short-term contract holders	Tenured Staff	Short-term contract holders	Tenured Staff	Short-term contract holders
Salary							
A lot less than I deserve						-.280* (.148)	-.062 (.088)
Less than I deserve						-.178 (.120)	-.062 (.059)
More than I deserve						-.109 (.362)	.155 (.173)
A lot more than I deserve						-.122 (1.221)	.261 (.990)
Less				-.205* (.115)	-.062 (.057)		
More				-.111 (.349)	.158 (.170)		
Individual Characteristics							
Male	.300*** (.082)	.457*** (.145)	.097* (.059)	.463*** (.145)	.087 (.060)	.467*** (.145)	.087 (.060)
UK Citizen	0.107 (.110)	.259 (.169)	-.183** (.091)	.230 (.170)	-.165* (.091)	.244 (.171)	-.165* (.092)
No. of Kids	.081*** (.035)	.028 (.049)	.218*** (.041)	.029 (.049)	.223*** (.042)	.028 (.049)	.223*** (.042)
Married	.071 (.077)	.012 (.127)	.167*** (.058)	.022 (.127)	.166*** (.058)	.022 (.127)	.166*** (.058)
Job Characteristics							
Experience	.029*** (.012)	.036 (.023)	-.013 (.010)	.034 (.023)	-.011 (.010)	.034 (.023)	-.011 (.010)
Experience Sq	-.000 (.000)	-.001 (.000)	.001*** (.000)	-.000 (.000)	.001*** (.000)	-.000 (.000)	.001*** (.000)
Tenure	.020*** (.008)	.015 (.011)	.021*** (.009)	.016 (.011)	.021*** (.009)	.016 (.011)	.021*** (.009)
Tenure Sq	-.000 (.000)	-.000 (.000)	-.000* (.000)	-.000 (.000)	-.000** (.000)	-.000 (.000)	-.000** (.000)
Small department	- .130 (.082)	-.186 (.129)	-.136** (.069)	-.190 (.129)	-.133* (.071)	-.190 (.130)	-.133* (.072)
Large department	-.020 (.0920)	-.058 (.143)	.025 (.076)	-.053 (143)	.027 (.076)	-.052 (.144)	.027 (.077)
Oxbridge PhD	.123 (.107)	.125 (.142)	.338*** (.147)	.136 (.142)	.355*** (.147)	.133 (.144)	.355*** (.148)
PhD	.359*** (.074)	.407*** (.123)	.184*** (.057)	.420*** (.123)	.169*** (.057)	.425*** (.124)	.169*** (.059)
Hours	.006* (.003)	.010** (.005)	.001 (.003)	.011** (.005)	.001 (.003)	.011** (.005)	.001 (.003)
Holiday	-.004 (.003)	-.005 (.005)	-.001 (.003)	-.005 (.005)	-.002 (.003)	-.005 (.005)	-.002 (.003)
Time out	-.015 (.019)	-.011 (.031)	-.035*** (.015)	-.012 (.031)	-.037*** (.015)	-.013 (.031)	-.038*** (.015)
Faculty							
Science	-.062 (.104)	-.125 (.153)	-.051 (.096)	-.100 (.153)	-.031 (.099)	-.093 (.154)	-.031 (.099)
Medicine	.293*** (.096)	.428 *** (.153)	.160* (.082)	.457*** (.153)	.150* (.083)	.449*** (.154)	.149* (.084)
Social Science	.151 (.109)	.187 (155)	-.073 (.110)	.215 (.155)	-.056 (.111)	.226 (.156)	-.056 (.112)
Engineering	-.066 (.125)	-0.137 (.183)	-.009 (.114)	-.107 (.184)	.034 (.117)	-.106 (.184)	.034 (.117)
Constant	-1.424*** (.242)	-1.772*** (.417)	-.722 (.204)	-1.683*** (.420)	-.719*** (.203)	-1.695*** (.421)	-.719*** (.206)
No of observations	689	418	271	418	271	418	271
Adj. R squared	.326	.198	.534	.201	.535	.180	.531

Table 4: OLS
The determinants of individual productivity by contract type and promotion opportunity, dependent variable = z-score of number of refereed publications by subject field

No. of published papers	Grade 1	Grade 2	Grade 3	Grade	Grade 2	Grade 3	Grade 1	Grade 2	Grade 3
Salary									
A lot less than I deserve							.106**	.104	-1.300***
							(.049)	(.136)	(.468)
Less than I deserve							-.007	.084	-.620*
							(.037)	(.101)	(.367)
More than I deserve							.207*	.377	-1.100
							(.115)	(.282)	(1.103)
A lot more than I deserve							.071	1.161	-.019
							(.868)	(2.391)	(1.930)
Less				.020	.087	-.794**			
				(.035)	(.098)	(.353)			
More				.195*	.387	-.763			
				(.115)	(.279)	(.977)			
Individual Characteristics									
Male	.099***	.279***	-0.430	.090***	.270***	-0.861	.086***	.268***	-.463
	(.036)	(.111)	(1.421)	(.036)	(.111)	(1.415)	(.036)	(.112)	(1.430)
UK Citizen	.001	.126	-1.069	.004	.161	-1-127	-.003	.161	-.921
	(.049)	(.142)	(.849)	(.049)	(.144)	(.835)	(.049)	(.145)	(.843)
No. of Kids	.040	.053	.114	.043*	.052	.070	.050*	.052*	.094
	(.026)	(.041)	(.147)	(.026)	(.041)	(146)	(.026)	(.041)	(.146)
Married	-.052	.069	.070	.041	.063	-.050	.049	.061	-.046
	(.034)	(.104)	(.446)	(.035)	(.105)	(.442)	(.035)	(.105)	(.440)
Job Characteristics									
Experience	.026***	.038*	.105	.027***	.033	.075	.025***	.033	.083
	(.006)	(.022)	(.113)	(.006)	(.022)	(.112)	(.006)	(.022)	(.111)
Experience Sq	-.001***	-.001*	-.001	-.001***	-0.000	-.001	-.001***	-.001	-.001
	(.000)	(.001)	(.002)	(.000)	(000)	(.002)	(000)	(001)	(.002)
Tenure	.022***	.031**	-.003	.021***	.033**	.012	.020***	.033**	.012
	(.006)	(.016)	(.043)	(.006)	(.016)	(.043)	(.006)	(.016)	(.043)
Tenure Sq	-.000***	-.000	.001	-.000***	-.001	.001	-.000***	-.001	.000
	(.000)	(.001)	(.001)	(.000)	(.001)	(.001)	(.000)	(.001)	(.001)
Small department	-.091**	.000	-.561	-.101***	-.017	-.779*	-.119***	-.016	-.770*
	(.040)	(.110)	(.423)	(.042)	(.110)	(.427)	(.042)	(.444)	(.435)
Large department	-.008	.010	-.485	-.012	.005	-.546	-.018	.004	-.589
	(.047)	(.123)	(.425)	(.047)	(123)	(.418)	(.047)	(.124)	(.431)
Oxbridge PhD	.081	.186	-.971***	.080	.191	-.908***	.062	.190	-.994***
	(.086)	(.131)	(.379)	(.087)	(.132)	(.378)	(.086)	(.132)	(.382)
PhD	.158***	.397***	.680*	.154***	.379***	.855**	.141***	.379***	.885**
	(.036)	(.096)	(.410	(.036)	(.097)	(.410)	(.036)	(.099)	(.408)
Hours	.003**	.007	-.020	.003**	.006	-.014	.003**	.006	-.013
	(.002)	(.004)	(.015)	(.002)	(.004)	(.015)	(.002)	(.004)	(.016)
Holiday	-.010	.007	-.040**	-.002	.006	-.039**	-.002	.006	-.045***
	(.002)	(.004)	(.020)	(.002)	(.004)	(.019)	(.002)	(.004)	(.020)
Time out	.006	-.047	-.870	.004	-.047	-.957	.004	-.048	-.629
	(.008)	(.033)	(.894)	(.008)	(.033)	(.882)	(.008)	(.033)	(.901)
Faculty									
Science	-.075	-.083	.510	-.079	-.100	.468	-.085	-.097	.441
	(.055)	(.131)	(.507)	(.056)	(.132)	(.500)	(.056)	(.133)	(505)
Medicine	.028	.333***	1.060**	.018	.313***	1.130**	.019	.314***	1.104**
	(.048)	(.128)	(.495)	(.049)	(.129)	(.494)	(.048)	(.129)	(.492)
Social Science	-.115*	.069	.433	-.119**	.050	.596	-.122**	.046	.651
	(.059)	(.138)	(.500)	(.060)	(.139)	(.499)	(.060)	(.141)	(.502)
Engineering	-.091	.029	-.164	-.097	.001	.014	-.097	.003	.146
	(.068)	(.152)	(.585)	(.069)	(.153)	(.580)	(.069)	(.154)	(.582)
Constant	-.926***	-1.870***	1,962	-.915***	-1.860***	2.966	-.871***	-1.853***	2.223
	(.119)	(.374)	(2.830)	(.119)	(.375)	(12.91)	(.119)	(.379)	(2.872)
No of observations	299	286	104	299	286	104	299	286	104
Adj. R squared	.359	.224	.130	.361	.225	.161	.371	.219	.170

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