PRODUCTIVITY EFFECTS OF RESEARCH ASSESSMENT EXERCISES

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Abstract

This paper provides an empirical estimation of the research productivity effects associated with periodic Research Assessment Exercises. From a sample of academic economists in the UK, data are taken directly from each individual's vita, permitting us to construct a detailed longitudinal data set with specific productivity measures at various points along each individual's experience-productivity profile. Our general approach was to measure individual productivity levels during a period immediately before each RAE event and for a period immediately after the event. Our results suggest that these periodic assessment exercises have increased the cumulative research productivity of individuals over time. These productivity enhancing effects have not been uniformly distributed across RAE ranked departments or across individuals within similar ranked programmes, however. Individuals at higher-ranked programmes tended to respond by increasing their research output in higher-quality journals, while individuals at other programmes tended to increase their publications in other outlets. Finally, the productivity response occurred primarily among individuals whose pre-RAE output was below the requisite number of publications required to be included in the RAE.

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Under financial pressure, the University Grants Committee (UGC) conducted the first Research Assessment Exercise (RAE) in 1986. The purpose of the RAE was to evaluate academic units of assessment (UOA) so that research funds could be concentrated into more research active departments in each discipline across universities (Cave, Hanney and Kogan 1991). To evaluate a department's research performance, each RAE had to explicitly (or implicitly) establish a set of performance indicators. Universities are expected to adopt strategic policies in response to the performance indicators and individuals, in turn, are expected to adjust their behaviour in response to their university policies.

This study measures the effects of the various RAEs on research productivity by examining the publications listed on the vitae of a sample of UK academic economists. Limiting the study to a single discipline makes it easier to measure research output in terms of quality and quantity. The vitae also contain information on control variables that are required to identify the true effect of the RAEs on research. By examining changes in research outputs over the four RAE cycles, we can isolate the effects of the RAEs. The system-wide average productivity of economists can only rise if the existing staff members increase their research efforts or the system attracts relatively high productivity researchers who are working elsewhere (Hare and Wyatt, 1992). Questionnaire surveys and personal interviews indicate that research performance has improved as a consequence of the RAEs, but this is not based on hard data (McNay 1997; HEFCE 1997; and Adams et al. 2000).

1. The UK Research Assessment Exercises

This study examines the effects of the 1986, 1989, 1992 and 1996 RAEs on the quantity and quality of research output among a sample of academic economists. These exercises share a number of characteristics. They all used informed peer review panels to rank each UOA within a particular discipline. While each RAE used multiple research performance indicators, they all focused on publications as a major indicator in the final ratings. However, the panels have been criticised for not explicitly indicating the weights they attach to the performance indicators and to the weights they accord

to different types of publications in making their evaluations (Johnes 1990; Cave, Hanney, and Kagan, 1991; and Adams, et al., 2000). While the Economics Assessment Panel has indicated that publication quality is more important than quantity in the evaluation process, it denies that it has attempted to rank journals in any formal sense.

The absence of an explicit weighting scheme makes it more difficult for universities to devise optimum response strategies and it increases the subjective powers of the panels. Johnes (1990) has shown that the ranking of forty UK Economics Departments is highly sensitive to the choice of weights assigned to staff and types of publications.

Based on the panel evaluations the UOA or departments are placed on a grading scale that is used to allocate available research funds in the post-RAE period. The rating scales have been expanded over time from a four point scale in 1986 to a seven point scale in 1996. Grade levels that were funded varied from exercise to exercise. In 1989 and 1992 grade 1 received no funds and in 1996, grades 1 and 2 received no funds.

It is important to note that while RAE research funds are generated by individual UOAs, such funds are provided to universities in the form of a block grant. Vice-Chancellors are free to reallocate those resources in any way they choose. Virtually all of the RAEs have been criticized for using different assessment standards in different subjects, which may have led to a misallocation of research funds (Cave, Hanney, and Kagan, 1991; and Adams, et al., 2000). Further, it is not clear that the same standards have been used within the same discipline over time (Taylor and Izadi, 1998).

Under the RAEs, departments receive credit for the publications of the staff on their payrolls at the time of the exercise. This encourages departments to recruit outstanding researchers from other institutions and has led to the development of the so-called transfer market (McNay 1997). Below we consider the research performance indicators used in each RAE.

The 1986 RAE Publication Standards. The 1986 RAE applied only to existing universities. Each UOA was specifically requested to provide details on the numbers of research staff and research

students, and titles of not more than five recent books or articles, or other comparable examples of research achievement, which the university would regard as typical of the best of its research in the subject area since 1980 (Cave, Hanney, and Kagan, 1991). The request for information on only five departmental publications was criticised for being inadequate and biased in favour of large departments. Subsequent empirical studies showed that the 1986 RAE subject ratings were positively correlated with departmental size, but less well correlated with departmental publication rates (Cave, Hanney, and Kagan 1991). We regard the 1986 RAE as somewhat of a trial run. The research performance indicators are relatively weak and directed at departments, not individuals. For these reasons, we predict that the 1986 RAE did not have a significant effect on research performance.

The 1989 RAE Publication Standards. The 1989 exercise continued to include only universities. It requested information on the total number of publications (books, chapters in books, papers in journals and other identifiable output) in relation to the number of full-time academic staff over the period 1984-1988 in each unit of assessment, bibliographic details of up to two publications for each full-time member of the academic staff, the number and value of research grants and contracts, and the number of research studentships. By focusing on the per staff number of publications and the two best publications per staff member the exercise reduced the advantage larger departments had in the previous exercise and clearly indicated that both quantity and quality of research were important considerations. While the Economics Panel like others did not indicate the relative weights it attached to different types of publications, a subsequent study by Johnes and Johnes (1993) reported that papers and letters in academic journals, authored books and contributions to the Diamond (1989) core journals had a significant influence on the 1989 RAE rankings of economics departments. These results were interpreted to mean that contributions to academic journals, especially the core journals, were the key to achieving a high rating in economics.

The 1992 RAE Publication Standards. This Exercise was the first one to cover all higher education institutions including PCFC institutions, Scottish Central Institutions, the Open University, Cranfield Institute of Technology, the Royal College of Art and higher education colleges in Wales and

Northern Ireland. For the first time UOAs did not have to include their entire academic staffs in the exercise. Their rankings were based solely on the output of those staff designated as research active. As a consequence, university decision-makers pursuing research funds faced two new strategic decisions. They had to decide which staff to include in the RAE and to which discipline panel each research group should be submitted (Talib, 1999). Deleting weak staff could improve their rating, but the number of staff submitted was a major multiple in the funding formula.

The publication standards remained unchanged in this exercise. UOAs were asked to report the total number of publications relative to the research active staff and to provide detailed information on two publications for each staff member submitted for the 1989 to 1992 period. In a subsequent study, Taylor (1995) reported that the only publication variable that had a significant effect on the 1992 RAE ratings-out of those collected was articles in refereed journals. This study confirms the importance of academic journal publications in the RAE ratings.

The 1996 RAE Publication Standards. Once again all higher education institutions were allowed to participate in the 1996 RAE and the number of submissions increased by 6 percent. The publication standards were changed significantly. The designated research active staff was invited to detail four publications for the period 1 January 1992 to 31 March 1996. The requirement to indicate the total number of publications for each UOA was dropped to emphasis that the exercise was concerned with quality not quantity.

2. Reported Effects of the RAE

The perceived effects of each RAE are based primarily on questionnaire responses and interviews conducted at different points of time when some RAEs had been completed and others were in progress. The surveys, however, did not control for other factors, so we cannot be certain whether the perceived changes are real (HEFCE, 1997). With these caveats in mind, consider the perceived effects of the RAEs.

Institutional Responses to the RAE. Survey research indicates that the RAEs have had five major impacts on UK universities relevant to this study (McNay, 1997; and HEFCE, 1997). First, universities have made a number of structural changes to improve their research performance. They have given research a higher priority, developed internal processes for evaluation, selectively allocated resources for research, placed senior managers in charge of monitoring and managing the work and planning for the next exercise. Second, universities have reallocated RAE generated research funds and other monies in such a way as to achieve the highest possible average UOA rating in the next exercise. Third, beginning with the 1992 RAE, universities have become more selective in designating their research active staff." Fourth, many universities have chosen to submit their economics staff to Business and Management Studies or other RAE panels rather than to Economic and Econometric panels.

Finally, universities adopted a number of personnel policies designed to increase the research performance of their existing faculty and to recruit outstanding researchers. These include extra pay, teaching load reductions, and early promotions for outstanding researchers. Unproductive senior faculty were encouraged to retire early and other unproductive faculty were designated as non-active research staff and given increased teaching loads. A new transfer market was created (McNay, 1997). New posts were allocated to enhance the next RAE ratings and recruitment policies became more selective in terms of research records (Harley and Lee, 1995; and McNay, 1997). Survey responses indicate that department heads believe that these institutional responses have led to improved research performance (McNay, 1997; HEFCE, 1997).

Individuals Responses to the RAE. After each RAE establishes new research performance standards, universities adopt policies and reward (and penalty) structures designed to motivate their faculty. Individuals are expected to optimise in response to the incentive system adopted by their university. Not all individual faculty members are subject to the same pressures and we therefore, expect them to respond in different ways. First, individuals in more highly rated departments are under more pressure to publish in high-quality journals, whereas individuals in lower-rated departments may feel

strong pressure to simply publish more regardless of its location. Second, individuals currently meeting or exceeding new RAE research performance standards at their grade UOA face less pressure to increase their research efforts. Those performing slightly below these standards will be under much more pressure to improve their research performance. Third, human capital theory suggests that the costs of investing in human capital increases and the returns decrease with age. Therefore, the research response to the RAE is likely to vary by age.

The survey evidence uniformly reports that academics spend more time on research and that their research output has improved, both quantitatively and qualitatively, since the introduction of the RAE (McNay, 1997; HEFCE, 1997; Adams et al. 2000). In the following analysis we test whether these perceptions can be supported by the data.

3. The Data Set and Empirical Design

The data for this study are taken from individual vitae of full-time faculty members employed at UK universities. Approximately 1000 individuals at 60 economics departments were contacted by email and asked to provide a copy of their vita. We obtained additional vitae by searching departmental web sites. This process resulted in a total of 158 individual vitae containing complete information for each individual as of 1999. The final data set is particularly appropriate for our study since it provides detailed information on individual characteristics such as academic experience, seniority and sex, as well as a variety of individual productivity measures. More importantly, it allows us to construct a detailed longitudinal data set with specific productivity measures at various phases of each individual's life cycle—exact points on the life cycle being determined by the date of each RAE event. Our sample excludes individuals who currently occupy administrative positions above the level of department chairperson.

Table 1 provides information about the sample composition and how it compares to the sample composition in other studies. Note that our sample contains a higher proportion of professors and a lower proportion of lecturers than the other surveys. We also have a higher proportion of faculty members from RAE rank 4 and a lower proportion from RAE rank 3. While we have no individuals from RAE rank 1 departments, faculty members at these institutions typically are not research scholars. Overall, however, the composition or our sample does not deviate substantially from the other samples.

Since our object is to determine whether individual research output has been responsive to Research Activity Exercises, individual productivity is measured separately for the period immediately prior to and immediately after each Exercise. Thus, for each RAE we have a before-after snapshot of an individual's research productivity. To account for the lumpiness in publications, measures of research productivity are defined over an interval. The length of each interval is determined by the number of years between RAE events. Because the number of years between RAE events is not uniform, our measure of research output is defined as the average number of publications per year during each interval.

We define the pre-RAE publication periods so that they correspond as closely as possible to the actual publication intervals requested by each RAE. The initial period for the construction of the longitudinal data set is the 1986 Research Activity Exercise. The base line publication record for each individual is measured by the average number of publications per year for a five-year period just prior to the 1986 Exercise. To the extent that there was a productivity response created by the Exercise, it should be imbedded in the individual's research output in the period immediately following the Exercise. We therefore, define post-RAE productivity as the average number of publications per year in the interval between the 1986 and the 1989 Exercises.

For the 1989 Exercise the baseline productivity record is defined for the five-year period just prior to the Exercise. Post-RAE productivity is defined as the average annual publication record between 1989 and 1992. The pre- and post-RAE productivity measures are defined similarly for the 1992 and the 1996 Exercises. As we move forward in time, we advance along each individual's experience-

productivity profile. At the same time, additional observations are added at the lower end of the experience distribution. No individuals, however, exit the sample. Thus, we are able to follow the same individuals through different phases of their life cycle and relate changes in their research output to each RAE event, holding experience constant.

4. The Empirical Results

The human capital model motivates the specification of the regressions that follow. It is assumed that productivity growth results from optimal investments in research training that diminish gradually over the life-cycle. We begin first by determining whether there were any general productivity responses to each of the Research Activity Exercises. We then make explicit life-cycle adjustments to each individual's observed productivity growth and relate deviations from the expected life-cycle productivity growth to each RAE. Further, we hypothesize that the productivity incentives are not uniform across productivity distributions.

General Productivity Response. Consider first an empirical model that captures the effects of each RAE in the following manner:

$$P_{it} = \boldsymbol{X}\beta + \delta RAE + \varepsilon \qquad t = 0,1 \qquad (1)$$

For each individual i, P_{i0} denotes the average number of publications per year during the pre-RAE period and P_{i1} denotes the average number of publications per year in the post-RAE period. The dummy variable RAE equals unity if $t = 1$ and it equals zero otherwise. The vector $\boldsymbol{X}$ contains the human capital variables experience and its squared term, as well as a control variable for the RAE rank of the department to which the individual was affiliated (proxies unmeasured quality of a heterogeneous faculty or departmental spillover effects). Holding constant the productivity effects of experience, δ will measure the independent effect of an RAE on the change in an individual's productivity between period $t = 0$ and $t = 1$. For

example, if $\delta > 0$, then the data suggest that the RAE caused individuals to increase their research output over what would have been expected from increased experience (i.e., movement along the experience-productivity profile).

Table 2 reports the general productivity effects of each Research Assessment Exercise for individuals at RAE level 4, 5 and 5^+ programmes. The sample is restricted to these programmes because the 1986 and 1989 RAEs did not cover the new universities in which most lower rated departments are found. Also, we stratify the sample by RAE rankings (*Department Quality*) in order to explore whether productivity responses differ between higher ranked and lower ranked programmes. The dependent variable for the OLS regressions in Table 2 is defined for research output published in "quality" journals.[1] Note that the estimates depict an increasing concave experience-productivity profile for academic economists in the UK.[2] This is consistent with virtually all of the previous studies that have examined life-cycle productivity profiles.[3] Also, we find that individuals at higher quality programmes (*Department Quality*) tend to produce more quality publications that individuals at lower ranked programmes.

Turning to our primary focus, in the cross-sectional regressions we can find no evidence of a significant aggregate productivity shock from any of the individual RAEs. While the coefficients on the RAE dummy variables are positive, none attain significance at conventional levels.

The last two columns of Table 2 report the pooled regressions. In both specifications, we are attempting to test whether the effects of the four Exercises have had a cumulative effect on research productivity. We structure the data in two ways. First, we estimate the model for a sample of individuals who were present during the pre-1986 exercise and follow this cohort through the four exercises (that is, we do not include any individuals who entered the profession subsequent to 1980). We refer to this as a

1. Our list of quality journals is provided in the Appendix. This list includes the top-tier general interest journals as well as second-tier general interest journals and the top field journals. For a discussion of how the list of quality journals was determined see Moore, Newman and Turnbull (1998 and 2001).
2. With the exception of the 1986 regression, all the joint F tests of the linear and quadratic experience terms are significant.
3. See for example, Oster and Hamermesh (1998).

cohort-constant model. In the last column we estimate the same model, but during each interval new entrants are permitted to enter the sample (new entrants model). The baseline productivity period is defined for the years 1980 through 1989. This is accomplished by omitting the 1986 RAE dummy variable. Each RAE dummy variable is defined for a particular segment of each individual's experience-productivity profile. Specifically, each RAE dummy is set equal to unity for the interval immediately following that exercise and ending with the year of the next exercise. The null hypothesis is that the RAE did not shift the individual's experience-productivity profile upward; that is, there was no significant increase in the individual's research output that cannot be explained by the movement along the profile.

As is true for the cross-sectional models, the pooled estimates depict an increasing concave experience-productivity profile for academic economists. In both models the results suggest that the 1992 and 1996 exercises caused a significant upward shift in the experience-productivity profiles for researchers at higher-quality programmes relative to the 1980-1989 period. Thus, while we were unable to detect these effects in the individual cross-sectional models, the pooled data suggest that there may have been a cumulative productivity shock over an individual's career; that is, cumulative research output in quality journals is higher than it would otherwise have been.[4] For example, the coefficient estimate in the cohort-constant sample implies that the effects of the 1992 RAE caused per capita publications in quality journals to increase by approximately *one* publication during the four year period following that exercise (holding constant the productivity-augmenting effects of increased experience). The cumulative effect of the 1996 exercise raised the average number of publications in the subsequent four-year period by an additional ½ publication. The corresponding publication changes in the model allowing new cohort entry are: a 0.7 increase in per capita publications following the 1992 exercise and an additional 0.8 increase in per capita publications following the 1996 exercise.

4. For the sample of economists at RAE 4, 5 and 5+ programmes, regressions were also estimated with the dependent variable (P_{it}) defined for publications in "all other outlets." The model could not "explain" the variation in the publication records outside the list of quality journals. Further, none of the coefficients on the RAE dummy variables was statistically significant. The results can be obtained from the authors upon request.

The fact that the 1992 and 1996 dummy variable coefficients are larger and more significant in the pooled, cohort-constant model than in the pooled equation with new entrants indicates that the rise in quality publications was mainly caused by existing faculty increasing their research efforts rather than by an increase from the inflow of new highly productive faculty into the profession.

Our results suggest that the 1992 RAE was the first to have a positive and significant productivity shock for individuals producing in quality journals. There are a number of possible explanations. The 1986 RAE set relatively weak publication standards at the department level. Thus, pressure on individual faculty to adjust their research behaviour may have been minimal. The 1989 RAE established a two-publication standard for individual staff, but the quality dimension was not specified and information on the total number of publications in relation to the number of full-time academic staff was requested. Subsequent analysis however, reveals that the quality of publications was a major factor in the 1989 RAE ratings.

By 1992, most economists and university administrators were cognisant of the importance of publication quality in the RAE rankings. Furthermore, the 1992 RAE was the first to allow universities to designate and submit research active staff. By this time they had developed internal monitoring systems to identify and reward active researchers and to penalize inactive researchers. It is not surprising; therefore, that individual staff members responded to the new incentives and that the 1992 RAE had a significant impact on quality research output. The relatively large and highly significant positive coefficient on the 1996 RAE dummy variable indicates the continued increase in quality publications.

In Table 3, we report pooled general productivity regressions for faculty at RAE ranked 2 and 3 programmes.5 Results are presented for both “quality publications” and publications in “all other outlets.” In this sample, the RAE dummy variables measure the productivity effects relative to the entire period prior to the 1992 exercise. The first two columns present the results for quality publications for the cohort-constant and the new entrants models. Both sets of results suggest that within the set of quality

5. Individuals in new Universities which tend to be lower ranked did not participate in the 1986 and 1989 exercises.

journals there was no cumulative productivity shock among individuals at lower-ranked programmes.[6] However, the estimates presented in the last two columns strongly suggest that the 1992 and the 1996 Exercises had a positive and significant effect on their research productivity in "other outlets." The 1992 RAE coefficient estimate in the cohort-constant sample suggests that on average, individuals increased their total number of publications in the four-year period following that exercise by about 3 (over and above what would have been expected with additional experience). While the implied productivity response may seem surprisingly high, it is important to note that the number of "other" publication outlets available to economists is also surprisingly large. In one recent world ranking of economics departments, the author used publication counts in 6*00* journal outlets.[7] Thus, the number of potential outlets, with a substantial variation in quality standards, provides ample opportunities for individuals to accumulate publication counts.

Note also, that the cohort-constant RAE coefficient is higher than the coefficient in the new entrants model, again suggesting that the productivity effects resulted from existing faculty increasing their research efforts rather that an increase from the inflow of new researchers.

Specific Productivity Responses. The general productivity response estimates contain both life-cycle effects and the potential effects of each RAE. Recall that we are advancing along the experience-productivity profile of individuals who were on the steeply sloped portion of that profile in the 1980s, but have moved (on average) to the flatter portion of their profile in the mid-1990s. Our strategy in this section is to eliminate the life-cycle productivity effects imbedded in the post-RAE productivity measures. This is accomplished by measuring an individual's relative productivity growth between the pre- and post-RAE event as a comparative change among individuals in the *same experience cohort*. Our point of reference is the productivity growth that occurred within a particular experience cohort. The objective is to distinguish between growth-induced change that occurs along an individual's life cycle

6. A publication in one of the quality journals is a relatively rare occurrence for individuals in this sample.
7. See Coupe (2000). Coupe reports that Econlit indexes about 650 journals.

productivity profile and the growth-induced change that may have resulted from the incentives created by the RAE. We start with the following measure of relative productivity change

$$P_{ij}^{1} - P_{ij}^{0} \ (P_j^{1} / P_j^{0}) \qquad (2)$$

where P_{ij}^{1} represents the average number of publications per year during a specified period post-RAE for the i^{th} individual in journal quality level j and P_{ij}^{0} denotes the same for the pre-RAE period.[8] The corresponding pre- and post-RAE publication levels for the i^{th} individual's experience cohort are P_j^{1} and P_j^{0}, respectively—both are measured by the within-sample means. We define four experience cohorts: less than 5 years of academic experience, 5 to 10 years, 11 to 15 years and greater than 15 years of experience. Thus, for an individual who started the pre-RAE productivity period with 5 years of academic experience, we compare that individual's productivity to the average productivity of all individuals in the sample with 5 to 10 years of experience. We then follow that same group of individuals into the post-RAE period, using their mean number of publications per year as our measure of P_j^{1}. This process is repeated for each subsequent Research Assessment Exercise and consequently, ensures that individuals are repeatedly compared to other individuals within the same experience cohort.

(P_j^{1} / P_j^{0}) is a hypothetical productivity growth rate, which imputes the cohort-specific growth rate to each individual. It is intended to remove that component of an individual's productivity growth that can be attributed to pure life cycle effects. A positive residual represents a relative gain in productivity; that is, a gain relative to the average for others within the same experience cohort. Converting the above differential into percentage terms yields

$$SD_i = (P_{ij}^{1} / P_{ij}^{0}) \ - \ (P_j^{1} / P_j^{0}) \qquad (3)$$

8. We use multiple years because of the lumpiness of publications and because the number of years between RAE events is not the same.

SD is intended to capture the effects of potential productivity incentives that may have been created by each RAE. To the extent that the RAE has resulted in a positive productivity response among some researchers, there will be a positive divergence between the individual's actual productivity growth and the predicted life cycle productivity growth. (P_j^1/P_j^0) represents the predicted productivity growth that an individual would have experienced had no factors peculiar to the RAE intervened to affect the individual's research output.

A positive value of *SD* means that the individual's publication record grew faster than the average among individuals within the same experience cohort. If the value of *SD* is negative, the individual's publication record grew less rapidly than the average among individuals within the same experience cohort.

We expect, however, that the effects of the RAE on individual productivity will not be uniform across individuals. To the extent that the RAE generates a productivity shock, it is not likely to affect individuals with research records that placed them at the upper portion of the productivity distribution. Individuals who are most likely to have responded to the RAEs are those who were "below the bar;" that is, those who did not produce the critical number of publications within the period prior to the RAE. Thus, we define the following variable:

$$BELOW_i = \begin{cases} 1 \text{ if } N_{ij}^0 < C_j \\ 0 \text{ Otherwise} \end{cases} \qquad (4)$$

where C_j denotes the number of publications that were required for each RAE and N_{ij} is the number of level *j* publications produced by an individual in the pre-RAE period. Level *j* takes two values: We divide publications into quality journals (see appendix) and all other outlets. Obviously, for researchers whose productivity significantly exceeds the critical value defined for the previous RAE, it is unlikely that in the post-RAE period they will deviate from their life cycle productivity profile for reasons related to the

RAE. But, for those "on the bubble" it is possible that the RAE may induce a productivity increase in the subsequent period. As an empirical proposition, we assume that individuals who had the exact number of requisite publications or slightly over are on the bubble. We therefore, define the following variable:

$$SLIGHTLY\ ABOVE_i = \begin{array}{l} 1 \text{ if } \quad N_{ij}^{0} = C_j \text{ or } \quad N_{ij}^{0} = C_j + 1 \\ 0 \text{ Otherwise} \end{array} \qquad (5)$$

In the 1989 and 1992 RAE events, $C_j = 2$, while $C_j = 4$ for the 1996 RAE. The regression model becomes:

$$SD_i = \boldsymbol{X}\beta + \gamma\,(BELOW_i) + \delta\,(SLIGHTLY\ ABOVE_i) + \varepsilon \qquad (6)$$

The vector $\boldsymbol{X}$ contains the following control variables: the individual's actual experience, the quality of the department the individual is affiliated with (*Department Quality*) and gender. *Actual Experience* is measured by the value of the individual's average experience during each productivity interval (mid-point). It merely provides an additional control for the effects of experience on productivity growth within cohorts. Gender is a control for possible productivity differentials that may exist between males and female. The gender variable (*Male*) is equal to unity if male and zero for females.

We start by estimating the productivity response across all RAE ranked programmes. This permits us to define (P_j^1/P_j^0) for four experience cohorts. Table 4 reports the first set of OLS regressions for specific productivity responses within quality journals.[9] The results strongly suggest that there was a significant productivity response for individuals whose level of research output in the pre-RAE period fell below the requisite number of publications to be included in that particular Exercise. That is, on average,

9. Individuals ain new Universities were not included in the 1989 Exercise and therefore, were deleted in the 1989 regression. They were, however, included in subsequent Exercises.

individuals whose baseline productivity was below the critical number of publications in the pre-RAE period (*BELOW*=1), responded by increasing their research output in quality journals beyond that which would have been anticipated for individuals with the same level of experience (cohort-specific productivity). The positive productivity effect appears to have resulted in the increased level of publications within quality journals.[10] Again, since the coefficient estimates appear to be fairly large, it may be useful to examine the actual change in the pre- and post-RAE output for those researchers who were below the bar. For example, the number of publications for individuals below the bar for the 1989 exercise increased from approximately 1.2 journal articles in the pre-RAE period to about 1.9 in the post-RAE period. The corresponding change for individuals above the bar was 4.65 articles in the pre-RAE period to 3.45 articles in the post-RAE period (a reduction of about 26 percent). Thus, while the percentage changes are large, the change in the number of publications is not. This distinction applies to all remaining estimates as well.

The last column of Table 5 reports the estimates from a pooled sample across the 1989, 1992 and 1996 exercises. Qualitatively, the results are the same—overall the three research assessment exercises have caused individuals below the bar to increase their research output above the level that would have been expected from the productivity-augmenting effects of accumulated experience.

There was apparently no productivity response among individuals who were "on the bubble." While the coefficient on *SLIGHTLY ABOVE* is consistently positive in all models, it never attains statistical significance. The growth in research output of individuals "on the bubble" does not deviate significantly from the expected research growth of other individuals with the same level of academic experience.

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10. In this specification C_j defined for publications in quality journals only. Regressions were also estimated for *SD* defined as publications in "all other outlets." For these regressions, C_j was defined as the number of publications in other outlets. The coefficients on *BELOW* (defined for "all other publications") never attained statistical significance for *SD* regressions.

In the general response regressions we found evidence that productivity responses varied across RAE ranked programmes. While individuals at higher-ranked programmes responded by increasing their output in quality journals, individuals at lower-ranked programmes increased their output in "other outlets."

We again divide the sample into two sub-samples: RAE rank 4, 5 and 5+ departments and RAE rank 2 and 3 departments.[11] Results for the higher-ranked programmes are reported in Table 5. With the exception of the 1996 exercise, individuals whose productivity was below the critical number of publications in the RAE responded by increasing their productivity in quality journals relative to others with the same level of experience. The pooled regression reported in the last column indicates a significant cumulative productivity response in quality journals over the three RAE events.

We also estimated a set of specific productivity regressions for individuals at RAE rank 2 and 3 departments. We could find no evidence that the *BELOW* variable had a significant effect on individual research output in quality journals in the post-RAE periods. Also, our pooled regressions for this group of economists did not reveal a cumulative effect on research output within the quality journals.[12]

In contrast, the results reported in Table 6 indicate that individuals at RAE rank 2 and 3 departments, whose publication level fell below the critical value in the pre-RAE period, responded by increasing their research output in "other outlets" (i.e., research outlets outside the 60 quality journals listed in the appendix).[13] Apparently, they have responded to the incentives the RAE created by increasing their publications in lower-quality outlets above the level anticipated for individuals in the same experience cohort. The results from the pooled regression suggest that overall there may have been

11. Stratifying the data substantially reduced the number of observations within each of the four experience cells. Thus, we had to restrict the number of experience cohorts to two categories: individuals with less than 15 years of experience and individuals with more than 14 years of experience.
12. Regression results for this sub-sample can be obtained from the authors upon request.
13. An identical set of regressions was estimated for individuals at higher-ranked programmes. The results indicate that individuals at these programmes did not increase their research output in "other outlets." These results can be obtained from the authors upon request.

positive productivity responses in other outlets to the cumulative effects of the three Exercises, even though we cannot detect these effects separately for the 1992 exercise.

Consistent with the results reported in Table 4, we find that the *SLIGHTLY ABOVE* variable never attains statistical significance in either sub-sample. Thus, overall, the specific productivity response regressions reported in this section are consistent with the aggregate productivity regressions discussed earlier. Further, they confirm our hypothesis that the productivity incentives created by the RAE are not uniform across the productivity distributions.

5. Summary and Conclusions

This study measured the effects of the various Research Activity Exercises on the research output of academic economists. Data for this study are taken directly off individual vitae, permitting us to construct a detailed longitudinal data set with specific productivity measures at various points along each individual's experience-productivity profile. Thus, we were able to determine whether changes in individual research output were systematically related to the Research Activity Exercises, holding experience constant.

Four general conclusions can be drawn from our pre/post RAE general productivity analysis. First, the 1992 RAE was the first to significantly affect the research productivity of UK economists. Economists currently residing in RAE rank 4, 5 and 5+ programmes significantly increased their publications in quality journals during the 1992 to 1996 period compared to the 1980 to 1989 period. Second, the 1992 RAE also led to a significant increase in publications in "other outlets" for economists at RAE 2 and 3 programmes, but it had no effect on their production in quality journals. Third, the 1996 RAE strongly reinforced these patterns. Fourth, the increase in research productivity following the 1992 and 1996 RAEs was due to the existing faculty increasing their research efforts rather than the result of new more productive individuals who entered the profession during our sample period. These results are

not as robust as we would like for each period. The effects reported are cumulative and cover an extended period of time, so there may be potential for omitted variable bias in our estimates.

Our next strategy involved removing life-cycle effects from each individual's productivity growth and then focusing on the subset of individuals most likely to be affected by each RAE. The results from this experiment strongly suggest that there has been a significant productivity response among individuals whose level of research output in the pre-RAE period fell below the requisite number of publications in each RAE. That is, on average, individuals whose baseline productivity was below the critical number of publications, responded by increasing their level of research output above the level that would have been expected for individuals with the same level of experience. The RAEs had no influence individually or collectively on the research productivity of economists whose pre-RAE productivity was equal to or above the publication standards of each RAE. These economists apparently felt no pressure to increase their research efforts.

Specific productivity responses varied across RAE quality departments. It appears that individuals at lower ranked programmes responded by increasing their research output in "other publication outlets," while individuals at higher ranked programmes responded by increasing their publications in "quality journals." Overall, our results suggest that individuals at the lower end of the productivity distribution have responded to the Research Assessment Exercises by increasing their observed research output. For those faculty members "on the bubble," we can find no evidence of a productivity response related to periodic research assessments. However, it is possible that these individuals may have extended their research productivity beyond what would have occurred because of life-cycle effects. That is, we cannot address the counter factual question of what would have happened to the productivity of these individuals in the absence of the RAE.

Finally, it should be noted that our results are based on a non-random sample. Individuals voluntarily contributed approximately half of our vitae and we collected the remainder from departmental web sites. It is possible, therefore, that our sample is subject to selectivity bias if successful researchers

were more likely to respond to our request. Our independent sampling from vitae on departmental web sites and our use of cohort-constant models was at least partially motivated by a desire to reduce the possible effects of this bias. Also, we cannot include in our sample individuals who may have withdrawn from the academic labor market earlier than planned because of the implementation of the RAE.

Table 1. Composition of Sample as of 1999 and Comparison with Other Studies

	Present Study	**Blackaby & Frank (2000)**	**Booth & Burton (1999)**	**Machin & Oswald (2000)**	**HEFCE (1996)**
Percent Within Rank:					
Lecturers	31.5	37.8	44.8	44.1	--
Senior Lecturers/Readers	32.7	20.1	21.4	25.2	--
Professors	34.6	25.3	18.8	20.1	--
Researchers	1.2	4.7	12.0	10.6	--
Distribution of Faculty by Department RAE Score:					
5^{+}	8.9	12.9	11.4	--	13.4
5	21.5	23.7	20.8	--	27.8
4	40.5	28.1	20.1	--	32.2
3^{a}	11.4	25.6	34.3	--	21.2
2	17.7	8.5	12.4	--	4.2
1	0	1.3	1.0	--	1.2
Percent Male:	90.6	--	--	--	--
Sample Size:	158	516	81	44	

[a] This category combines "3 upper" and "3 lower."

Table 2. General Productivity Effects of the Research Activity Exercises at RAE Level 4, 5 and 5+ Programmes: Quality Publications

Variable	1986 RAE	1989 RAE	1992 RAE	1996 RAE	Pooled Cohort Constant	Pooled With New Entrants
Experience	0.018 (0.82)	0.043[a] (1.24)	0.038[a] (1.46)	0.023[a] (0.89)	0.0132[a] (0.43)	0.043* (2.78)
Experience²	-0.001 (0.74)	-0.002[a] (1.64)	-0.001[a] (1.68)	-0.001[a] (1.43)	-0.001[a] (1.39)	-0.002* (3.25)
Department Quality	0.424* (3.91)	0.414* (5.04)	0.312* (4.63)	0.393* (5.69)	0.375* (5.73)	0.377* (8.34)
RAE86	0.063 (0.40)	--	--	--	--	
RAE89	--	0.058 (0.51)	--	--	0.068 (0.53)	-0.013 (0.13)
RAE92	--	--	0.149 (1.48)	--	0.263** (1.85)	0.179* (1.91)
RAE96	--	--	--	0.080 (0.76)	0.395* (2.37)	0.199* (2.18)
Intercept	-1.383* (2.20)	-1.573* (3.25)	-1.163* (2.99)	-1.221* (3.26)	-1.143* (2.85)	-1.473* (5.93)
d.f.	77	97	121	149	198	325
F value	4.08*	6.93*	6.31*	9.96*	6.48*	13.62*
Adjusted R^2	.13	.19	.15	.19	.14	.19

[a] Joint F-test is significant at .10 or higher
* Significant at .05
** Significant at .10
(| t | - value)

Table 3. General Productivity Effects of the Research Activity Exercises At RAE Level 2 and 3 Programmes: Pooled Regressions

Variable	Quality Publications Cohort Constant	Quality Publications With New Entrants	Other Publications Cohort Constant	Other Publications With New Entrants
Experience	0.001 (0.01)	0.003 (0.26)	0.079 (0.64)	0.091 (1.38)
Experience^2	-0.000 (0.08)	-0.001 (0.52)	0.003 (0.74)	-0.003 (1.14)
Department Quality	0.227* (5.48)	0.233* (5.82	1.490* (4.91)	1.027* (4.30)
RAE92	0.009 (0.16)	0.014 (0.28)	0.742** (1.74)	0.569** (1.92)
RAE96	-0.020 (0.25)	0.074 (1.45)	1.170* (2.02)	0.778* (2.58)
Intercept	-0.429* (2.66)	-0.469* (3.79)	-2.982* (2.52)	-2.064* (2.79)
d.f.	99	155	99	155
F value	6.15*	7.75*	6.53*	5.73*
Adjusted R^2	.20	.17	.21	.13

* Significant at .05
** Significant at .10
(| t | - value)

Table 4. Specific Productivity Response Regressions in Quality Publications for Research Activity Exercises 1989, 1992 and 1996

Variable	1989 RAE	1992 RAE	1996 RAE	Pooled 1989-1996
BELOW	1.441* (3.48)	0.775* (2.38)	0.597** (1.62)	0.851* (4.04)
SLIGHTLY ABOVE	0.500 (1.13)	0.280 (0.81)	-0.220 (0.50)	0.142 (0.61)
Actual Experience	-0.012 (0.68)	0.013 (1.21)	-0.008 (0.72)	-0.002 (0.26)
Department Quality	0.390* (2.51)	0.216* (2.82)	0.137** (1.64)	0.200* (3.76)
Male	0.668 (1.03)	0.413 (0.98)	0.174 (0.34)	0.365 (1.24)
RAE92	--	--	--	-0.120 (0.79)
RAE96	--	--	--	-0.010 (0.68)
Intercept	-2.944* (2.69)	-1.903* (2.97)	-0.827 (1.09)	-1.487* (3.20)
d.f.	55	89	109	263
F value	3.38*	2.91*	1.74	4.77*
Adjusted R^2	.17	.09	.04	.09

* Significant at .05
** Significant at .10
(| t | - value)

Table 5. Specific Productivity Response Regressions for Faculty at RAE 4, 5 and 5^{+} Departments: Quality Publications

Variable	1989 RAE	1992 RAE	1996 RAE	Pooled 1989-1996
BELOW	1.491*	0.865*	0.570	0.899*
	(3.45)	(2.05)	(1.43)	(3.80)
SLIGHTLY ABOVE	0.570	0.240	-0.250	0.133
	(1.23)	(0.55)	(0.52)	(0.51)
Actual Experience	-0.026	-0.000	-0.005	-0.008
	(1.27)	(0.02)	(0.39)	(0.90)
Department Quality	0.371**	0.123	0.115	0.165**
	(1.75)	(0.69)	(0.66)	(1.56)
Male	0.715	0.596	0.215	0.481
	(1.04)	(1.02)	(0.34)	(1.34)
RAE92	--	--	--	-0.136
				(0.73)
RAE96	--	--	--	-0.205
				(1.15)
Intercept	-2.720*	-1.499	-0.793	-1.329*
	(2.08)	(1.33)	(0.70)	(1.97)
d.f.	45	57	71	183
F value	3.37*	1.57	1.25	3.82*
Adjusted R^2	.19	.05	.02	.09

* Significant at .05
(| t | - value)

Table 6. Specific Productivity Response Regressions for Faculty at RAE Departments 2 and 3 : Other Publications

Variable	1992 RAE	1996 RAE	Pooled 1992-1996
BELOW	0.630	1.164*	.853*
	(1.17)	(2.41)	(2.50)
SLIGHTLY ABOVE	-0.437	-0.526	-0.474
	(0.75)	(1.18)	(1.47)
Actual Experience	-0.038	-0.005	-0.012
	(1.11)	(0.19)	(0.60)
Department Quality	0.015	0.074	0.027
	(0.03)	(0.16)	(0.08)
Male	0.802	0.789	0.749
	(0.56)	(0.60	(0.82)
RAE92	--	--	0.148
			(0.46)
Intercept	-0.144	-1.015	-0.600
	(0.06)	(0.55)	(0.46)
d.f.	26	32	63
F value	0.77	1.45	1.60
Adjusted R^2	-.04	.06	.05

* Significant at .05
(| t | - value)

Appendix
(Unranked)

1. *American Economic Review*
2. *Econometrica*
3. *Economic Journal*
4. *Economica*
5. *International Economic Review*
6. *Journal of Economic Theory*
Journal of Political Economy
8. *Quarterly Journal of Economics*
9. *Review of Economic Studies*
10. *Review of Economics and Statistics*
11. *American Economics Associate Papers and Proceedings*
12. *American Journal of Agricultural Economics*
13. *Brookings Papers on Economic Activity*
14. *Canadian Journal of Economics*
15. *Econometric Theory*
16. *Economic History Review*
17. *Economic Development and Cultural Change*
18. *Economic Inquiry*
19. *European Economic Review*
20. *History of Political Economy*
21. *Industrial and Labor Relations Review*
22. *Journal of Business*
23. *Journal of Business and Economic Statistics*
23. *Journal of Comparative Economics*
24. *Journal of Econometrics*
25. *Journal of Economics Dynamics and Control*
26. *Journal of Economic History*
27. *Journal of Economic Literature*
28. *Journal of Economic Behavior and Organization*
29. *Journal of Environmental Economics & Management*
30. *Journal of Finance*
31. *Journal of Financial Economics*
32. *Journal of Financial and* Quantitative *Analysis*
33. *Journal of Health Economics*
34. *Journal of Human Resources*
35. *Journal of Industrial Economics*
36. *Journal of Institutional and Theoretical Economics*
37. *Journal of International Money and Finance*
39. *Journal of International Economics*
40. *Journal of Labor Economics*
41. *Journal of Law and Economics*
42. *Journal of Legal studies*
43. *Journal of Money Credit and Banking*
44. *Journal of Macroeconomic*
45. *Journal of Mathematical Economics*
46. *Journal of Monetary Economics*
47. *Journal of Public Economics*
48. *Journal of Regional Science*
49. *Journal of the Royal Statistical Society*
50. *Journal of the American Statistical Association*
51. *Journal of Urban Economics*
52. *Kyklos*
53. *National Tax Journal*
54. *Oxford Bulletin of Economics and Statistics*
55. *Oxford Economic Papers*
56. *Public Choice*
57. *Rand Journal of Economics*
58. *Scandinavian Journal of Economics*
59. *Scottish Journal of Political Economy*
60. *Southern Economic Journal*

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