Economic Explanations of the Behaviour of Universities and Scholars

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Economics has sometimes been defined as the study of the behaviour of free markets. Sociologists Smelser and Content (1980) seem to have this definition in mind when they remark that:

> The market for academic services is something of a nightmare for economists. It is a honeycomb of ignorance, of economically "irrational" behaviour, and of obstacles to mobility of resources (p. 1).

My initial object is to survey some of what economists have had to say about the nightmare. I will first consider work that is mainly theoretical and then turn to work that is mainly empirical[1]. I use the surveyed literature as a basis to make some comments on the efficiency of the Althoff system. First, I ask what would we reasonably expect about its efficiency based on our general knowledge of institutions and human behaviour. Second, I ask how, at least in principle, we could test our expectations of its efficiency.

Adam Smith (1723-1790), the founder of economics, shared Smelser and Content's jaundiced view about the state of higher education. While he was a student, Smith rarely attended lectures at Oxford, preferring to spend his time in the library. His comments in the *Wealth of Nations* on education are among the most eloquent ever penned:

> The endowments of schools and colleges have necessarily diminished more or less the necessity of application in the teachers. Their subsistence, so far as it arises from their salaries, is evidently derived from a fund altogether independent of their success and reputation in their particular professions.
>
> The discipline of colleges and universities is in general contrived, not for the benefit of the students, but for the interest, or more properly speaking, for the ease of the masters. Its object is, in all cases, to maintain the authority of the master, and whether he neglects or performs his duty, to oblige the students in all cases to behave toward him as if he performed it with the greatest diligence and ability. It seems to presume perfect wisdom and virtue in the one order, and the greatest weakness and folly in the other. Where the masters, however, really perform their duty, there are no examples, I believe, that the greater part of the students ever neglect theirs. No discipline is ever requisite to force attendance upon lectures which are really worth the attending, as is well-known wherever any such lectures are given.
>
> Those parts of education, it is to be observed, for the teaching of which there are no public institutions, are generally the best taught. When a young man goes to a fencing or a dancing

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> school, he does not, indeed, always learn to fence or to dance very well; but he seldom fails of learning to fence or to dance (1976, pp. 760 , 764).

Smith believes that universities would be more efficient if they were run like for-profit fencing academies. In modern times something very like the Smithian vision of the college has been advocated by economist Ben Rogge and philanthropist Pierre Goodrich (Rogge and Goodrich, 1973). They advocate ending all government subsidies of university education and propose the abolition of tenure on efficiency grounds.

Like Rogge and Goodrich, Althoff also sought to increase private funding for education, but did so, not in order to decrease government funding, but as part of an effort to increase funding from all sources. Private money from industrialists Krupp and Koppel provided substantial support for one of Althoff's primary achievements: the foundation of the Kaiser Wilhelm Institutes (see vom Brocke's contribution to the Heilbronn conference).

Smith makes some assumptions that can be disputed. One is that good teaching is readily measurable and can be accurately measured and appreciated by the students. Another is that teaching, and not research, is the sole output of the university. A third is that professors do not receive direct utility from teaching, but perform it only to the extent that they are paid for it.

Max Weber's views on university education share Smith's cynicism, but not entirely for the same reasons[2]. Weber does not have Smith's confidence in the ability of students to judge good teaching:

> It is a fact that whether or not the students flock to a teacher is determined in large measure, larger than one would believe possible, by purely external things: temperament and even the inflection of his voice. After rather extensive experience and sober reflection, I have deep distrust of courses that draw crowds, however unavoidable they may be. Democracy should be used only where it is in place. Scientific training, as we are held to practice it in accordance with the tradition of German universities, is the affair of an intellectual aristocracy, and we should not hide this from ourselves (1973, pp. 133-4).

Frank Knight, one of the founding fathers of the "Chicago School" of economics expressed similar views (1932).

Recently Rosen (1987) has returned to Smith's critique of higher education to ask if we would be wise to follow Smith's advice that an academic's salary should be more directly provided from student fees. Rosen concludes that "Smith might be right if the only output of the university was teaching, but not necessarily right if research is also an important output". The problem of financing research has been compared by Johnson with the problem of rewarding those who stock a pond (1972, p. 7; see also 1973). Some fish will never be caught. Even for those that are caught, it is very difficult to determine how much of the value is contributed by the fisherman, how much by those who maintained the pond and how much by those who originally stocked it. Similarly, pure research produces ideas that may or may not produce practically useful effects. (Those interested in current contributions to the debate on the connection between pure research and technology should refer to Dosi's useful 1988 survey.)

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The problem of rewarding those who stock the pond may not be so severe if pond-stocking is its own reward. The psychic returns from advancing science have long been identified as one of the primary components in the compensation of scientists. Although, as we have seen, Adam Smith is a cynical critic of the scholar's devotion to teaching, he is an idealist when it comes to the scholar's devotion to advancing the frontiers of knowledge:

> Mathematicians, ..., who may have the most perfect assurance, both of the truth and of the importance of their discoveries, are frequently very indifferent about the reception which they may meet with from the public. ... The great work of Sir Isaac Newton, his *Mathematical Principles of Natural Philosophy*, I have been told, was for several years neglected by the public. The tranquility of that great man, it is probable, never suffered, upon that account, the interruption of a single quarter of an hour (p. 124).

Even though we now know that Smith was wrong about Newton's tranquility (see: Hall 1980, *passim;* Westfall 1980, pp. 698-780), Smith may still be correct in his more general claim that scientists receive psychic returns from the belief that their research is true and important.

Althoff also recognized the importance of psychic rewards in motivating both scientists and potential funders of science. For potential funders of science Althoff was apt to emphasize public or peer-group recognition in the form of prizes, knighthoods or other titles. For scientists themselves, one of the highest "prizes" created by Althoff was the directorship of one of the Kaiser Wilhelm Institutes (Backhaus in this volume). As Backhaus plausibly argues, such a position might have had considerably more value for a scholar who was pursuing research for the internal psychic reward rather than just for money or fame.

Theories

Human Capital Theories

Much of the modern interest in the economics of education began with G. Becker's analysis of *Human Capital* (1964). Becker argued that investment in human skills and knowledge was just as important a determinant of economic growth and prosperity as investment in physical capital. He showed how education and on-the-job training were important determinants of differences in earnings both between persons and for the same person at different points in the life-cycle. The theory and evidence was elegantly developed in Mincer's *Schooling, Experience, and Earnings* (1974). These works and a few others initiated a major change in the field of labour economics, transforming it from a field concerned mainly with institutional description into one concerned with the elaboration and testing of models of human behaviour.

A recent survey (and selection from) some of the traditional economics of education literature based on the human capital concept can be found in Psacharopoulos (1987). This literature usually did not explicitly model the behaviour of universities and scholars, but did serve to make the economics of education a legitimate topic of scholarly research.

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An exception, one of the more extended applications of human capital theory to explain the behaviour of scholars, is due to McDowell (1982). McDowell used data in professional directories, and in sources such as *Physics Abstracts,* to examine gender differences in choice of academic discipline and in research productivity. McDowell argues that "since women anticipate at least partial withdrawal from academic research for a part of their child-bearing years, they are likely to choose disciplines, such as the humanities, where their investments in human capital are less likely to depreciate rapidly". Using very rough evidence in the form of age-productivity profiles, McDowell believes that he sees convincing evidence that the research productivity of female scholars temporarily declines between the ages of 28 and 31 (pp. 763-4).

A very different application of human capital theory to the behaviour of scholars appears in "Science as a Rational Enterprise" (Diamond, 1988e, and see also Diamond, 1980; Hull, 1978; Hull *et al.*, 1978). Diamond develops a utility maximizing model of the behaviour of scientists as a response to Kuhn's claim (1970) that the acceptance or rejection of theories is an irrational process. Diamond claims that scientists maximize a function that includes as arguments the scope and elegance of scientific theories. Because of different investments in human capital (in the current theory), scientists may differ in when they accept a new theory even if the scientists are all rational in the strong sense of sharing the same values (in this case the scope and elegance of theories).

Human capital theory has also been applied to predict the scientist's optimal life-cycle investment in human capital and life-cycle productivity in terms of quantity and quality of research. These issues have been addressed both theoretically (Diamond 1984, 1987b) and empirically (Diamond, 1986a; Simonton, 1988; Stephan and Levin, 1988).

Human capital theory is not without its critics among economists. For example, not all economists agree that the main function of college is to increase the skills and knowledge (i.e. human capital) of college students. Some have suggested (Spence, 1973; see also Johnson, 1973, pp. 33-4) that the main function of college is to provide a screen that determines which students will be able to obtain high-paying, challenging jobs. Wolpin (1977) made a clever test of the screening hypothesis. He compared the level of education of those self-employed in an occupation, who presumably would have no screening motive to obtain a college education, with the level of those in the same occupation who were employed by a firm. He found that both groups obtained roughly the same level of education. From this he inferred that the main value of the education consisted in the skills obtained, in support of the standard human capital account.

Garner (1979) has applied the screening model to the case of scholars being screened for initial employment and subsequent tenure and promotion. He claims that the common practice of screening on the basis of quantity of publications "... may bias research decisions towards orthodox, low-risk projects, denying science the bold hypotheses and vigorous competition necessary for significant advance" (p. 575).

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The method of appointing and promoting scholars in the Althoff system may have avoided the drawbacks of publication counting. Althoff relied instead on a network of distinguished "trusted associates" who advised him on which scholars were able and which were not. According to most accounts, Althoff was either very skilled or very lucky in choosing trusted associates who succeeded in identifying so many Nobel Prize quality scientists.

Implicit Contract Models

Traditional economic theory of labour markets suggested that, in any period, workers would receive the value of their productive output (in technical language: their "marginal revenue product"). Actual compensation in real-world labour markets often has not seemed to correspond with what has been predicted in the traditional theory. It is often observed, for instance, that the variation in productivity of scholars far exceeds the variation in their compensation. To account for such anomalies, some economists have contributed to a growing literature sometimes loosely called "implicit contracts theory". The basic ideas in implicit contracts theory have been well summarized in Rosen's (1985) survey article. Rosen also provides references for many of the important articles that had appeared up to that time. Another useful survey article is Parsons' (1986) paper in the *Handbook of Labour Economics*.

The implicit contracts literature generally argues that, on average, over their life-cycle, workers are paid the value of their marginal product, although in any single period the worker may be paid more or less. The models differ in the explanation they offer. One common explanation is that workers are risk-averse and that the firm provides earnings insurance by paying the worker more than productivity merits during periods of low worker productivity and less than productivity merits during periods of high worker productivity. Freeman (1977) specializes this model to the case of research scientists.

Besides Freeman, a growing number of economists in recent years have modelled aspects of the labour market experience of academic scientists (W. Becker, 1975, 1979; Carmichael, 1988; Diamond, 1984, 1987, 1993c; 1993d; Frank, 1984, 1985; Ito and Kahn, 1986; Siow 1989 and Weiss and Lillard, 1982;). More general implicit labour contract models can also explain some of the features of the labour market for scientists (e.g. Harris and Holmstrom, 1982; Lazear and Rosen, 1981).

Why Is There Tenure?

In 1958 Armen Alchian (1977) was one of the first economists to try to explain academic tenure. He argued that in non-profit organizations (like many universities) the management has little incentive to reduce costs, since the money will not result in higher management salaries (at least not to the same extent as in for-profit firms). As a result Alchian expects that non-profits will invest more in aspects of the work environment that make the work

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environment more pleasant. One of these is job security, that in the academic world takes the extreme form of tenure.

Backhaus (in this volume) argues that Althoff's institutes and seminars may avoid the inefficiency that Alchian fears from non-profits. If institute directors are the residual claimants of the institute and if they are "completely consumed with their research programme and its progress" then they will have a great incentive to reduce costs by managing the institute efficiently.

As an outgrowth of the implicit contracts literature, several labour economists in the past few years have also begun to develop models of the tenure phenomenon in the academic labour market. Schwartz (1988), for instance, examines the possibility that tenure is a kind of "efficiency wage", defined as a higher-than-usual wage that is paid in order to increase the worker's incentive to be productive.

In a different implicit contracts model of tenure, Carmichael (1988) argues that faculty are much better informed than the administration about the quality of new job candidates. If the current faculty were to be judged relative to new hires, the current faculty might have an incentive to be inaccurate in their judgements about new hires. Tenure, on the Carmichael account, is awarded by the administration in order to increase the odds that the faculty will identify the best new candidates.

Siow (1989) has an intriguing model that implies that if a scientist is unlucky in the quality of his first published paper, other scientists will not read the scientist's later papers because the expected return will be higher for reading new papers by other recent PhDs.

Althoff's system of "trusted associates" may have been an effective way to circumvent the separate problems that Carmichael and Siow describe. With his group of able advisors, Althoff may not have needed to rely either on honest information from a majority of faculty members or on the quality of a scholar's first publication in order to judge whether a scholar should be appointed or promoted.

Universities as Non-profit Organizations

Adam Smith may have been the first to focus on possible inefficiencies in university education due to the reward structure set up by the university's status as a non-profit organization. Surveys of recent work on the economics of non-profit organizations can be found in Weisbrod (1989) and Holtmann (1988). The economist's definition of "non-profit organization" should be clarified, since it does not necessarily correspond to what we might, at first thought, guess. A "non-profit organization" can make a profit in the usual sense that revenues may exceed costs. What distinguishes the non-profit organization is that the managers, board of trustees or other "owners" of the organization cannot distribute the profits among themselves: they must be held in reserve or else used to increase the future expenditures of the organization. This definition is compatible with non-profits carrying out a wide variety of activities. For

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example, New York University once ran a spaghetti factory (Weisbrod, 1988, p. 163).

Although economists are not unanimous in their analysis of the profit-maximizing firm (see, e.g., Galbraith, 1967; Williamson, 1967), there tends to be a consensus on the general model that is apt to be most useful. Unfortunately, no consensus exists on the most fruitful model for non-profit organizations. This may be because work on non-profits is at the early stage preceding the development of a general model. Or it may be because non-profits differ sufficiently, so that no general account will fruitfully apply to them all.

In the past, non-profit organizations have been viewed alternatively as clubs, as worker owned co-operatives, as public utilities, and as organizations run by managers who maximize utility functions that include, as arguments, achieving the mission of the organization and improving the pleasantness of the manager's job (by having bright and attractive co-workers, by spending less time in the unpleasant task of monitoring job-performance, by having plusher offices, etc.) Some have suggested that Niskanen's (1975) model of the budget-maximizing bureaucracy may also be a fruitful model for the non-profit organization.

Most early accounts, and some recent accounts, emphasize the inefficiency of non-profit organizations. Some more recent accounts, although admitting that non-profits may have less incentive to reduce costs, argue that by responding to various sorts of "market failure" they may be the most efficient form of organization under some situations.

For example, in some activities output may be very hard to measure, at least by the consumer of the service. The instance most commonly discussed in the literature would be health care services where "tender, loving care" is an important output, although one that is hard to measure. University education has also been mentioned as an example, on the premiss (*contra* Adam Smith) that college students are not capable of judging what they should be taught or how they should be taught it. Profit-making organizations may over-provide measurable aspects of their output as opposed to those aspects that are not measurable. Of course, this problem would also apply to non-profits under models that do not have the managers caring directly about the mission of the organization. Some have argued (Ault *et al.*, 1979, p. 148; see also Becker, 1979), for instance, that universities may over-support research relative to teaching because research is easier to measure.

Another rationale for non-profits is that they function to provide public goods that have a constituency that does not have sufficient political power to have the service provided by the government. If the government provides those services demanded by the median voter (the so-called "median voter hypothesis") then the greater the heterogeneity of the population, the more we would expect to see non-profits of this type.

Manne (1973), economist and advocate of the law-and-economics movement, has distinguished three different modes of organization for universities: a for-profit firm, a non-profit organization run by a strong board of trustees, and a

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non-profit organization run by a workers' co-operative of faculty members. He views the current state of university education as increasingly dominated by the non-profit faculty-run co-operative. Garvin's views (1980) of decision making in the university, are similar to Manne's, although Garvin gives more weight to the administration's impact on decisions. Garvin's own model has the university maximizing its utility which is a function of its prestige, quality of students and number of students.

Firms are usually assumed to be profit-maximizers. But some economists, perhaps most notably John Kenneth Galbraith and Oliver E. Williamson, have argued that the diffusion of stock ownership allows some managers to pursue objectives besides profits. Following Southwick (1967), Kesselring and Strein (1986) have applied this model of the firm to the behaviour of universities (see also Rothman and Strein, 1982). In their model, university administrators maximize a function of two variables: the quality of their university and "hierarchical expense", where "hierarchical expense" means "leisure or discretionary power" (p. 104). These utility-maximizing models of the university could be interpreted as being elaborations of Culyer's claim (1970) that universities are most fruitfully viewed as clubs on the Buchanan (1965) model (see also Sandler and Tschirhart 1980).

Rent-Seeking in Academe

Rent-seeking is a socially unproductive activity that seeks a higher reward for goods and services than would be required for the producer of the goods and services to produce them. Rent-seeking has been distinguished from the socially productive activity of rent-creating in a market system. Rent-creating occurs when a firm or entrepreneur innovates and thus creates short-term rents (also known as economic profits) that will last until other firms imitate the innovation. A traditional example of a rent-seeking activity would be a firm that seeks an exclusive licence from the government in order to create a monopoly that will permit the firm to charge higher than competitive prices.

Tullock first introduced the idea of rent-seeking in a 1967 paper. Several papers have suggested that rent-seeking is an important phenomenon in academic life. Although many discussions of academic life have discussed rent-seeking activities without explicitly identifying them as such, McKenzie may have been the first in print explicitly to apply rent-seeking to the academic world (1979).

McKenzie argues that the amount of salary increases available to a department is a fixed sum that is unrelated to the department's productivity (economists will recognize this claim as analogous to the classical doctrine that there is a "wages fund"). Within a department some attempt is made to divide the fixed sum in accordance with the relative productivity of the members of the department. A faculty member thus has two methods for increasing his salary: he can increase his own productivity or he can decrease the productivity of others. According to McKenzie, decreasing the productivity of others is an

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example of rent-seeking in the academic world. Another example might be the creation of unnecessary committee work in order to waste the time of the productive.

One advantage of the institutes and seminars established by Althoff is that their structure may have reduced rent-seeking problems. We would expect such a reduction if we believe, with Backhaus, that the seminars and institutes were usually directed by able, driven, scientists who were well-informed about the productivity of the staff and scientists under their direction.

Brennan and Tollison (1980) follow McKenzie in assuming a wages fund at the departmental level (p. 348). They assume that department heads decide salary increments and that the department head is seeking to maximize the "academic worth" of the department. In the Brennan-Tollison set-up, the academic worth of a faculty member is equal to the highest salary offer that the faculty member could generate from any other university. In their model, a department head with perfect information would pay each faculty member exactly that member's reservation wage. In this way, with a fixed budget, the department head can maximize the academic worth of the department. Since the department head does not have perfect information on the faculty member's reservation wage, the rent-seeking faculty member has an incentive to make the reservation wage seem higher than it actually is. This can be done in a variety of ways: exaggerating the attractiveness of outside offers or the unpleasantness of the current location.

The authors argue that publication of salaries (as is done at many state universities in the United States) would make it more difficult for the department head to pay according to reservation salaries, hence universities with publicly reported salaries will be less efficient than those where a faculty member's salary is only known by the faculty member and the department head. Since faculty salaries were not public knowledge in the Althoff system (or in most other university systems of the time), we would expect salaries in these systems might be closer to the reservation salaries than would be found at modern state universities in the United States.

The ideas in the McKenzie and the Brennan and Tollison papers have been extended and given more formal presentation in a pair of brief papers by Stolen and Gleason (1984, 1986). A distinct rent-seeking account is provided by Grubel and Boland (1986), who have documented and criticized the long-run rise in the use of sophisticated mathematics in the economics profession. They claim that although formalization is useful in economics, the current level of formalization exceeds what can be justified based on usefulness. The authors give a rent-seeking account of why formalization has gone beyond the epistemologically optimal level. They suggest that applied economists have a higher opportunity cost of their time because applied economists are more in demand (than mathematical economists) for outside consulting. As a result, mathematical economists are more likely to serve on important committees and to participate more actively in the committees. Therefore, the mathematical economists have a greater influence on professional standards (and hence on hiring, promotion

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and salary decisions) than would be suggested by their numbers alone. As with the other forms of academic rent-seeking, the undue influence of mathematicians would likely be less of a problem under an Althoff institute system with an able, informed and internally-research oriented director at the helm.

Empirical Research

Academic Institutions

In recent years economists have increasingly attempted to measure various aspects of academic institutions. Some of this literature is usefully surveyed in Colander (1989). Although some of the papers (e.g. Diamond and Haurin, 1994a; Diamond and Levy, 1994; Feigenbaum and Levy, 1993; Levy, 1988) relate the measures to theoretical models, many other papers simply report rankings of journals, universities or individual scholars based on various measures of productivity, such as the number of publications or the number of times the published work has been cited by others. One example of this latter literature (that includes the most complete citation ranking of journals to date, along with a survey of previous journal rankings) is Diamond (1989b).

Stigler (1965) was one of the pioneers in the empirical study of academic institutions. His paper addressed several issues, including how the economics discipline changed when professional economists replaced amateur economists as the main writers in the discipline. Stigler (along with Friedland) was one of the first to use citations as a measure of quality in economics (1982a). Stigler and Friedland (1982b) also used citation analysis to learn whether schools of thought play an important role in economics.

Perhaps the first study of the geographic mobility of economists was made by Skeels and Fairbanks (1968/1969). They found that economists who publish are more likely to move than economists who do not publish. Ault *et al.* (1979, 1982) have also studied the inter-university mobility of economists as a function mainly of research productivity. They focus on research productivity because they believe that it is the most marketable aspect of academic productivity (more so than teaching and service) and that it is the most easily measurable. The authors conclude on the basis of analysis of their data on economists that:

> Upon accepting an initial academic position, publications appear to be the principal means by which an academic economist can move to a more prestigious department. While upward mobility is possible, the parameter estimates indicate that a considerable investment in research skills on the individual's part is required. Large jumps, even for those who invest successfully, are unlikely (1979, p. 152).

Evidence on the relative mobility of male and female academics can be found in Rosenfeld (1981).

Diamond (1993a; see also 1988d; 1993b) has attempted to learn whether a scientist's choice of research projects affects either the scientist's professional recognition as measured by citations or the scientist's institutional affiliation. Working with a unique data set on the polywater episode in chemistry, he finds that the effect of working on a mistaken research project (polywater) was

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relatively small in terms of citations and non-existent in terms of institutional affiliation.

Feigenbaum and Levy (1993) have replicated a substantial number of empirical articles in economics and have constructed an index of empirical accuracy. They have also collected biographical and career data on the economists who wrote the articles. Inspired by human capital and life-cycle career path considerations, they ask whether we can understand why some economists produce empirical work that is more accurate than the work produced by others.

Most scholars probably believe that the clarity of writing style is (or at least should be) an important determinant of the success of the writing. Diamond and Levy (1994) are using the Readability computer program to measure the writing quality of about 100 addresses of Presidents of the American Economic Association. They have also collected data on the career paths, number of publications and number of citations of the Presidents. In preliminary results, the authors find a long-run decline in the quality of writing in the economics profession and examine whether writing quality has any measurable effect on the reception of a work by the profession.

Diamond and Haurin, in a series of papers, have exploited the directories of the American Economic Association to answer a set of related questions about the productivity and reward structure of academic economists. In one paper (1994a) the authors document the changing popularity over the last 70 years of the various subfields of economics. In a second paper (1993a) they examine whether the changes in popularity of a subfield appear first at the elite graduate schools and then later at the rank-and-file schools. Finally, in a third paper (1994b) they examine what determines whether an economist will join and remain in the American Economic Association. The authors find, for instance, that membership is positively related to research productivity.

Recent literature on prize reward systems (e.g. Lazear and Rosen, 1981; Rosen 1986) has been examined by Diamond (1993c) to see if actual prizes in economics take the form that is suggested by theory. He finds that monetary prizes are not very important in economics and that they do not take the form that theory suggests. In future research, the earlier mentioned importance of prizes in the Althoff system would provide a promising case for contrast with the current paucity of prizes in economics.

Academic Earnings Functions

In the theory survey I mentioned that human capital theory had a major impact on the course of labour economics. One of the topics high on the new research agenda was to explain the determination of earnings in different sectors of the economy. Many empirical studies looked at earnings as a function of education, on-the-job training and other variables, often including age, race, sex and the like. Other empirical studies looked at earnings as a function of productivity. Standard economic analysis implied that workers of all types should receive earnings equal to the value of their marginal product, which is a technical way of saying that they should receive the value of their contribution to the value of

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the output. Some of these studies have looked specifically at the salaries of university professors (e.g. Bailey and Schotta, 1972; Cohn, 1973; Diamond, 1986b; Hamermesh *et al.*, 1982; Hansen *et al.*, 1978; Holtmann and Bayer, 1970; Johnson and Stafford, 1974; Katz, 1973; Koch and Chizmar, 1973; Lillard and Weiss, 1979; Siegfried and White, 1973; Tuckman, 1976; Tuckman and Hagemann, 1976; Tuckman *et al.*, 1977).

Much of the work in the estimation of salary functions implicitly assumes that we have good measures of the research productivity of scholars and that these measures consist of the quantity (number of articles) and the quality (number of citations) of a scholar's work. Within the sociology of science discipline, this assumption is controversial. It is defended by Merton (1973), who has argued that one of the primary norms of science is that it is a meritocracy: "Success depends mainly on the quality of one's work". The concrete measure of a scientist's success, in Merton's account, is the quantity of citations that the scientist receives from his peers. Some empirical studies have defended the Merton thesis (e.g. Cole and Cole, 1973; Gaston, 1978; Zuckerman and Merton, 1971), while others have (explicitly or implicitly) criticized it (e.g. Cole *et al.*, 1981; Koren, 1986, 1987; Mulkay, 1976, 1980; Peters and Ceci, 1982).

Diamond compiled a longitudinal data set on salaries, publications and citations for scientists in order to answer three questions. The first (Diamond, 1985) was how the order of authorship on an academic paper affects the compensation that a scientist receives. The second (Diamond, 1986b) was whether the academic labour market rewards the number of citations that other scientists make to a scientist's published work. The third (Diamond, 1986a) was whether a scientist's productivity declines with age. The data set is now being used (Diamond, 1993d) to examine which of two implicit contract models is most consistent with the evidence.

As exemplified by the studies just mentioned, much of my own work has made use of citations as a measure, if not of scientific "merit", at least of scientific impact. Table I presents some citation counts of Nobel Prize winners in science (Diamond, 1988c). Table II presents the marginal value of a citation in various disciplines. Tables III and IV are part of a study in progress that uses the growth in citations to measure how much scientists are hurt by pursuing a research project that later turns out to have been mistaken (Diamond, 1993a). Table V is from a study that makes use of citations to test between two alternative implicit contracts models of the scientific labour market (Diamond, 1993d).

Citations can be used not only to measure the magnitude of scientific impact but also the nature of the impact. Stigler (1982) has used citation analysis to see if his refutation of the kinked oligopoly demand curve reduced later use of the curve (he found that it did not). Diamond (1988c) has used citation analysis to see if theoretical work in the last few decades in general equilibrium analysis has had a major impact on empirical work in economics (he found that it did not). Finally, citations can be used in order to identify which topics are currently the most intense focus of research (Diamond, 1989c).

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Name	Total citations from 1966-80	Year of Nobel Prize	Year of birth	Country during research	Citations from 1966-70	Citations from 1971-75	Citations from 1976-80
1. Samuelson, Paul A.	6,654	1970	1915	US	1,334	2,412	2,908
2. Arrow, K.	6,024	1972	1921	US	1,135	2,075	2,024
3. Friedman, M.	5,929	1976	1912	US	1,058	2,274	2,597
4. Simon, Herbert	3,620	1978	1916	US	861	1,198	1,581
5. Stigler, G.J.	3,504	1982	1911	US	596	1,215	1,693
6. Myrdal, G.	3,149	1974	1898	Sweden	832	1,197	1,120
7. Buchanan, James M.	2,743	1986	1919	US	467	965	1,311
8. Hicks, Sir John R.	2,676	1972	1904	Britain	552	1,049	1,448
9. Tobin, James	2,639	1981	1918	US	498	904	1,237
10. Modigliani, Franco	2,156	1985	1918	US	407	708	1,041
11. Kuznets, S.	2,031	1971	1901	US	552	648	831
12. Schultz, Theodore W.	1,623	1979	1902	US	509	500	614
13. Leontiof, W.	1,536	1973	1906	US	414	508	616
14. Debreu, G.	1,407	1983	1921	US	228	466	693
15. Tinbergen, J.	1,400	1969	1903	Holland	471	474	455
16. Meade, James E.	1,374	1977	1907	Britain	384	398	592
17. Klein, Lawrence	1,229	1980	1920	US	142	524	563
18. Lewis, Sir William A.	1,209	1979	1915	Britain/US	392	381	436
19. Koopmans, T.	1,164	1975	1910	US	426	340	398
20. Hayek, F. von	1,159	1974	1899	Austria/ Britain/US	153	372	634
21. Stone, J.R.N.	880	1984	1913	Britain	236	300	364
22. Frisch, R.	613	1969	1895	Norway	203	236	174
23. Ohlin, Bertil	498	1977	1899	Sweden	91	91	316
24. Kantorovich, Leonid	322	1975	1912	USSR	58	85	179

Note:
Reprinted from Diamond (1988b)

Table I.
Citations Over Time to Nobel Prize Winners

Earnings and Status of Minority Academics

Some previous work has focused on the earnings or status of women scholars and black scholars, although almost no work has been published on the status of those of foreign birth or citizenship. Some examples in the economics profession include: Boddy, 1971; Ferber, 1974; Johnson and Stafford, 1974; Moore and Newman, 1977; Strober and Quester. 1977, Tuckman and Hagemann, 1976.

Using 1964 National Science Foundation data for scientists (economists were not included, but psychologists were), Holtmann and Bayer (1970) found that, *ceteris paribus*, male faculty earned $2,074 more per year than female faculty (p. 415). The Holtmann and Bayer study is noteworthy because it makes use of a data set that is especially rich in variables, such as IQ and citations, that can serve as plausible controls for ability and research productivity. When studies without such controls find that minorities are paid less, interpretation is difficult since earnings differences due to discrimination cannot be distinguished from those due to differences in productivity or to other personal characteristics such as labour force attachment.

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Main sample	Sub-sample	Number of observations in subsample[a]	Marginal value of a Citation in Dollars at Citations = 0	at Citations = 10	at Citations = 100
A	Seven pooled economics departments	148	478	426	-36
A	Economics department # 1 (includes books and articles)	25	365	344	159
A	Economics department # 5 (includes books and articles)	21	1,285	709	-4,470
B	Business employment additive form	965	51	51	51
B	Government employment additive form	1,067	54	54	54
B	Academic employment additive form	1,463	63	63	63
C	Pooled math	1,352 (110)	397	392	355
C	Pooled physics	1,616 (129)	97	94	65
C	Urban chemistry	379 (28)	54	54	52
C	Berkeley economics	300 (30)	186	170	16
D	Berkeley mathematics	506 (45)	392	387	-131

Note: [a]For longitudinal data sets C and D the number of observations exceeds the number of persons because data for a person could be observed in more than one year. The numbers in parentheses report the number of persons in data sets C and D.
(Reprinted from Diamond (1986b).

Table II.
What a Citation Is Worth

Diamond (1988a) reports evidence from the data tape for the 1985 Directory of the American Economic Association that indicates that blacks and women remain under-represented compared to their numbers in the general population. While some limited evidence of increased representation of these minorities is presented, the finding of underrepresentation is robust when other measures of career status are examined (such as rank-achieved or status of institution of employment). Although the representation of women and minorities on university faculties is greater now in the United States than in the universities in the Althoff system, if Althoff is measured against the standards of his time, he must be praised for working for the appointment and promotion of able minority scholars.

Academic Production Functions

Academics are often viewed as jointly producing two goods: research and teaching. Whether these goods are complements or substitutes is still a live

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Name	Age in 1971	Year of PhD	Citations in 1968	Citations in 1974	Citations in 1981	Location in 1969-71	Location in 1979-83
Allen, L.C.	45	1957	49	66	37	Princeton	Princeton
Bandy, A.R.	31	1968	0	5	2	Old Dominion Univrsity	Drexel
Bellamy, L.J.	–	–	809	488	469	–	1981 – University of Birmingham (England)
Bolander, R.	31	1969	0	4	2	General Motors Institute	Same
Burkhard, M.	–	–	0	1	3	–	1982 – Deutsch Bundespost F12 (Federal Republic of Germany)
Castellion, G.A.	–	1956	2	0	2	–	–
Cessac, G.L.	–	–	0	2	3	–	–
Grabaer, D.G.	–	–	1	2	0	–	–
Grant. W.M.	38	1968	3	3	12	National Bureau of Standards	Same
Hessian, J.	–	–	0	0	0	–	–
Jakobsen, R.J.	42	–	37	27	79	Battelle Cols. Labs	Same
Kassner, I.L.	40	1957	6	5	15	University of Missouri – Rolle	Same
Kollman, P.A.	27	1970	0	160	116	University of California SF	Same
Lippincott, E.R.	51	1947	120	112	74	University of Maryland	Same
Osborn, A.R.	–	–	6	4	2	–	–
Page, T.F.	–	–	14	21	45	University of Illinois – Urbana	Same
Pethica, B.A.	45	1969	44	36	32	–	1981 – Clarkson College ot Technology, New York, NY
Petsko, G.A.	23	1973	0	2	21	Wayne State University	MIT(81)
Rennie, G.K.	–	–	1	1	3	–	–
Smart, C.	–	–	17	5	17	–	1983 – under Smart, C.C. University of Edinburgh (Scotland)
Stromberg, R.R.	–	1951	24	40	18	–	–
Willis, E.	–	–	3	2	3	–	1981 – City Hospital, Compenhagen (Denmark)
Zung, J.T.	41	1960	8	2	2	University of Missouri – Rolle	Same

Table III.
Age, Citation and Location Data on Highly Visible Pro Polywater Scientists

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Name	Age in 1971	Year of PhD	Citations in 1968	Citations in 1974	Citations in 1981	Location in 1969-71	Location in 1979-83
Everett, D.M.	–	–	148	119	155	–	–
Florin, A.E.	–	–	3	1	3	–	–
Haynes, J.M.	–	–	7	3	9	–	–
McElroy, P.J.	–	–	0	0	3	–	–
Porto, S.P.S.	–	–	51	37	26	–	–
Rabfdeau, S.W.	–	–	36	18	15	–	–
Rousseau, D.L.	31	1967	5	15	0	University Southern California	Bell Labs (1981)

Table IV.
Age, Citation and Location Data on Highly Visible Con Polywater Scientists

topic of dispute. Research on the production of these goods has usually been done separately for each good. Lovell (1973), for instance, was one of the first to estimate production functions with measures of research as the output. Others have estimated production functions using some measure of teaching effectiveness as a measure of output (Heath, 1989; Walstad and Soper, 1988). Hanushek (1986) provides a useful summary of some of the research on teaching effectiveness. In a recent example, Watts and Lynch (1989) have looked at test scores in economics courses as a function of student and instructor characteristics, most notably whether the instructor was a native speaker of English. The econometric techniques in this literature are becoming quite sophisticated (see W. Becker and Walstad 1987). Alternative approaches that make use of extensions of linear programming techniques to evaluate some of these issues are also being used (Bessent *et al.*, 1982, 1983; Charnes *et al.*, 1978, 1981; Charnes *et al.*, 1985; Diamond and Medewitz, 1990).

Status of Current Literature

Economists have not achieved a unified theory of the behaviour of universities and scholars. Disagreements still occur over what is being maximized and what are the most significant constraints in the maximization. So it is not surprising that disagreements also still occur over what is the most efficient organizational form for universities to take. In education, as elsewhere, the key question remains how to allocate scarce resources. Significant progress on these issues will occur as economists, historians and other social scientists develop more accurate measures of inputs and outputs. Optimism is justified for the successful study of current scholarly institutions because the relevant data is increasingly available in readily accessible form: publication and citation data are available on-line from the Institute for Scientific Information and biographical career data are available on computer tape (every five years for members of the AEA). Computer technology now even permits the use of an

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Variable	All	Years of potential experience 0-13	14-21	22 or more
Level of potential experience[a]	0.00031	0.00279	–0.00204	0.00046
	(1.637)	(2.432)	(1.776)	(0.979)
Change in annual citations	0.00060	0.00146	0.00035	0.00018
	(8.472)	(8.764)	(3.845)	(1.627)
Constant	–0.00107	–0.02471	0.04328	–0.00780
	(0.271)	(2.291)	(2.160)	(0.563)
Number of persons	263	168	189	162
Number of observations[b]	3,347	1,115	1,080	1,167
R^2	0.022	0.072	0.016	0.003
Mean of dependent variable	0.0050	0.0014	0.0081	0.0055
Variance of dependent variable	0.0105	0.0162	0.0074	0.0080

Notes:
The absolute values of the *t*-statistics are reported in parentheses.
[a] Potential experience is equal to the year of the observation minus the year of receipt of PhD.
[b] Since the data set is longitudinal, there are multiple observations for each academic. The number of observations per academic varies, depending mainly on the availability of salary information.

Table V.
Regressions of Change in Log Salary on Observations Grouped by Experience

index of writing style as an input of the scholarly production function! (see Diamond and Levy, 1994).

Relevance of Literature to the Althoff System

The Althoff system seems to have avoided many of the sources of inefficiency that economists attribute to other institutional forms for universities. We have indicated that Althoff's "trusted associates" may have provided him with the information required to make shrewd decisions on appointments and promotion. We have also seen how the institute system, under optimistic assumptions about the director, may have avoided many of the rent-seeking problems that have been identified in many university systems.

In order to judge fairly the overall efficiency (and fairness) of the Althoff system we should pay some attention to Max Weber's argument (1973) that the Althoff system placed too much power in the hands of one person.

In all forms of institutional organization – for-profits, government, non-profits – there is competition. Generally, there is more efficiency the more alternatives there are. The model of perfect competition assumes many firms. In

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governments, services are more efficiently provided where it is easier for citizens to vote with their feet. It is easier to move between cities than between states. So unless there are significant economies of scale (as with the provision of national defence) one would expect greater efficiency in providing government services at a local level than at a national level. Backhaus (in this volume) correctly notes that "the centralization of decision rights accomplished by the institute structure is equally characteristic of the Althoff system as a whole, with Althoff himself trying to exercise co-ordinated control". While Backhaus was partly right when he said in the Heilbronn conference that the universities in the Prussian Althoff system competed with the universities in the other German states, there might have been even greater competition, and hence efficiency, if the universities in the Althoff system had also been in competition with each other.

Efficiency, of course, is not the only way of judging the Althoff system. We can also ask about the tolerance of minorities and the extent of academic freedom within the system. How the system compares to other systems on these issues depends very much on what sort of assumption we make about the sort of person who is in charge of the system. A variety of assumptions can be made. In the concrete case before us we could judge the Althoff system on the optimistic assumption that the person running the system is an intelligent, hard working, tolerant person, with good taste (as Tullock said of Althoff at the Heilbronn conference). However, Weber (and Peirce in this volume) give us good economic reasons for making more realistic assumptions. Althoff was an extraordinary man and extraordinary men are rare. Moreover, as Peirce points out, a bureaucratic system is unlikely to select the extraordinary person to be in charge. I believe that Weber was correct when he suggested that diverse autonomous universities are not only more likely to have greater overall output, but also are more likely to promote toleration of minorities and academic freedom[3].

The Althoff system contained many elements, some of which may in general advance scholarly productivity (e.g. perhaps the institute system) and some of which may in general have reduced scholarly productivity (e.g. perhaps the centralization of decision-making on appointments and promotion). Instead of judging the "Althoff system" as a whole, it may be more useful to judge the individual components separately.

So far, in this article, such judgements have been based mainly on theoretical reasoning and casual empiricism. By way of conclusion, I would like to sketch how we might go about empirically testing such judgements in a more systematic way, although I do not suggest that it would be easy to do.

In the empirical survey section, I discussed various studies that have made use of data to understand universities and scholars. This empirical literature is partly constrained by the theoretical literature and partly by the availability of data. The most common type consists of salary determination studies which treat scientists' salaries as a function of productivity measures and other control variables. Some production functions have also been

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estimated, as well as a couple of studies on subfield or problem choice and on academic mobility.

Economists sometimes estimate production functions where an output is taken to be a function of a set of inputs. Usually such production functions are estimated on the level of the individual scientist or the individual student (e.g. David Levy and I are estimating how an economist's impact (as measured by the number of citations received) is influenced by the quality of the writing style (as measured by an index generated from a computer program that analyses style).

But production functions can also be estimated for aggregates of individuals (e.g. Jeanette Medewitz and I have estimated how the average economic literacy of high school students in a school district is influenced by inputs like the level of education of parents, the percentage of students in the class who have ever taken a class in economics, the average number of hours of economics the teachers have had, the average aptitude test scores of the students and the like).

Advance of Knowledge

In the case at hand we could use proxies for the advance of knowledge as our output. Such proxies might include:

- number of Nobel Prize winners;
- number of articles published;
- number of citations;
- an expert's subjective evaluation of the number of comparable advances.

Now you would want a list of independent variables:

- number of books in library system;
- average number of research assistants per scholar;
- average course load of university researchers;
- average quality of administrators (IQ, hours worked per week);
- number of scholars in state-run universities;
- number of scholars in private universities;
- number of scholars in research institutes;
- average size of academic departments (in order to test Backhaus' team hypothesis);
- degree of concentration of control in system (the degree of Althoff-likeness).

The key independent variable for our present purposes would be the final one. Measures of academic concentration could be constructed in a manner analogous to those used to measure the concentration of industries in the industrial organization literature.

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Teaching Skills

A second important output of academic activity is teaching effectiveness. We could also use proxies for teaching effectiveness as our output. Such proxies might include:

- difference between a pre-test and a post-test;
- subjective student evaluations.

As independent variables you might want to include:

- student-teacher ratio;
- number of faculty; number of books in the library;
- average ability on IQ tests for students;
- average quality of administrators (IQ, hours worked per week, etc.);
- percentage of students in state-run versus private institutions;
- degree of concentration of control in the system.

Again, the last variable would be the key one for our present purposes.

Toleration of Minorities

A third "output" of academic activity that is mentioned elsewhere in this volume (and here) is the extent to which the academic system tolerates minorities. This output may be harder to measure than the two just discussed, but it can be measured (and has been; see, for example, Diamond, 1988a). Possible proxies for toleration of minorities might include:

- the percentage of minorities in the broader population;
- the level of economic freedom of the society;
- the degree of concentration of control in the system;
- average quality of administration (IQ, hours worked per week, etc.);
- percentage of students in state run versus private.

As independent variables, those mentioned above could be used here as well.

Academic Freedom

I do not know if academic freedom has ever been quantified – but political freedom has been, by groups like Amnesty International, so it should be possible to do the same for academic freedom (perhaps the AAUP list of censored schools would provide a start if late twentieth century United States was in the data set). In another context, Bilson (1982) has made a stimulating attempt to analyse cross-country indices of freedom. The following variables might be used as proxies for academic freedom:

- the degree of economic freedom in the society;
- the degree of political freedom in the society;

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- the degree of concentration of control in the system;
- average quality of administrators (IQ, hours worked per week, etc.);
- percentage of students in state run versus private.

In each of the projected regressions just sketched, an observation would consist of political jurisdictions over particular periods of time. For instance, four useful observations would be:

- Prussia 1882-1907;
- Prussia 1908-1918;
- Austria 1882-1907;
- Austria 1908-1918.

Accumulating sufficient data points in order to estimate the regressions suggested would be a very difficult task. Some of the necessary data may be available in secondary sources (such as the data on expenditures on education in Germany in Pfetsch, 1974). But much of the data would have to be laboriously compiled from primary sources.

As a second best approach it would be useful to do one or more additional case studies. Basically, in this volume, the contributors have examined the Althoff system under Althoff. A second case that would be very useful would be the Althoff system under someone besides Althoff. Some of the features of a second case appear in vom Brocke (1991) where he notes that the four successors to Althoff were not as tolerant of minorities as was Althoff.

Notes

1. The weight placed on various headings in the survey reflects my own interests to some extent and does not necessarily reflect the importance attached to the topic by the profession as a whole.
2. Although the sociology profession is usually more vocal in claiming Max Weber (1864-1920) as its own, the economics profession also has grounds to claim him. A superficial sign of this is Weber's inclusion in Stigler and Friedland's (1984) definitive calendar of great economists. Anderson *et al.* (1989) have used inclusion in the calendar as definitive of being a great economist.
3. Becker (1971) has emphasized how, under competition, a firm pays a price if it discriminates against minorities.

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