Scholarly Communication's Mess: Can Economic Analysis Help?

John M. Budd

School of Information Science and Learning Technologies

University of Missouri

Columbia, MO 65211

Phone: 573.882.3258

Fax: 573.884.4944

Email: buddj@missouri.edu

Abstract

This paper constitutes a trial of a game- and decision-theory based approach that is intended to examine elements of the complexities of scholarly communication as an economic endeavor. Both individual and institutional kinds of games are analyzed in order to determine what factors would affect the real economic use of game and decision theories. There are interrelationships between the two kinds that add complexity to any possible application. Further, this analysis includes ideal and practical factors that affect real economic application. As is shown here, there are serious challenges to application of the theories, but also important indicators for the furtherance of individual and institutional interests by means of negotiation.

Introduction

The ground-breaking work of Nobel Prize winner John Nash was done in the new (at the time) field of game theory. Von Neumann and Morgenstern (1944) are usually credited with “inventing” game theory some years before Nash’s prize-winning work. Nash derived a conception of equilibrium that can occur when players are presented with predicaments in which they can communicate and cooperate, and when they are rational and knowledgeable about the game’s situation. Each player can choose cooperation or noncooperation in the playing of the game. At times, the uncooperative players tend to reach a stalemate where neither benefits.

The kind of game illustrated by the Prisoner’s Dilemma assumes rationality on the parts of the players and is indicative of classic game theory. The players will make their choices based on the most likely benefits. A desired outcome in classic game theory is, as Nash (1950) posited, equilibrium. Nash’s explanation is mathematically complex; it required economists quite a bit of time to incorporate it into their theories. Herbert Gintis (2009) states the Nash equilibrium clearly: “in a two-player game [there] is a pair of strategies, each of which is a *best response* to the other; that is, each gives the player using it the highest possible payoff, given the other player’s strategy” (34). In a complex game, though, there may be many possible ways to reach equilibrium, in part because each additional player adds several possible outcomes. When economists tend to apply game theory they are looking to locate solutions to the games, and so utilities feature prominently. The players are seeking to gain optimal utility by playing the game. Utilitarianism is a problematic philosophical stance and, as Robert Sugden (2001)

suggests, the utility measure introduces a conceptual and practical difficulty into the theory because it can be evaluated in a number of ways, even within one game. Another difficulty, also identified by Sugden (2001) arises; classic game theory was designed as a conceptual, rather than an empirical, framework. A challenge presented by the theory is its fundamental applicability.

The examination presented in this paper will explore scholarly communication as a kind of game, including the features of negotiation, bargaining, and cooperation. Utility is not ignored in this analysis, but more attention is paid to justice and effectiveness than to efficiency. The examination is framed as a potential analytical tool for the examination of the complex economic and human system of scholarly communication. The related tool of decision theory (about which Binmore and other game theorists have written) will also be explored. Since the game aspect of this kind of communication involves a mix of individual and institutional players, both types of players will be included will be addressed and, in particular, the question of what characterizes relationships at this time will be studied. In particular, the real and practical elements of scholarly communication will be placed at the center of this study, so that hypothetical applications can be transcended in an effort to seek solutions to the economic dilemma of communication. Of necessity, the scholarly communication system as an economy will have to be defined so that an analysis will be able to proceed. The kinds and natures of the games that involve individuals and institutions must also be explicated here for the applications of the theories to make sense. The “mess” that is referred to in this paper centers on the complexities of weighing material and nonmaterial costs and benefits and some errors that can arise when distinctions between the two types are not made. Ultimately, this paper will attempt to ascertain the possible efficacy of game and decision theory as a research method applied to the problem of scholarly communication’s economy. Game theory certainly involves some sophisticated mathematics, but there is an aspect of the theory that is even more important for application in certain settings—justice (or fairness). In other words, game theory today can constitute more than a narrow economic tool that is only applicable to purely rational and utilitarian situations (and here is where some of the utilitarian challenges enter). In particular, the following question can be asked: What is the means by which cooperation can be most effectively secured so as to avoid conflict and result in just results for all players? One way to achieve the desired outcome (in cooperative games) is to devise a way to allow all players to “win.” It has to be emphasized here that “winning” does not mean defeating an opponent, but working with others so that optimal mutual benefit can be realized. In short, a “dilemma” may be avoided if the game is characterized by cooperation. There is not sufficient space here to delve deeply into all of the moral groundings of game theory application, but Ken Binmore’s (1998) work, while problematic in some ways (discussed below), will be a basis for the examination that follows. For Binmore, David Hume is the hero of game theory inasmuch as Hume articulated a necessary reciprocity that had to be at the heart of any society in equilibrium. Hume may attract Binmore’s attention because Hume’s moral philosophy is an attempt to recognize the balance in human nature between benevolence and selfish acquisitiveness. Binmore (2008) advocates for a rational examination of the possibilities that arise in situations where players interact (whether the players have

complete or incomplete information), but he dismisses the metaphysical rationality of Kant in favor of Hume. Binmore's position should be examined carefully, and will be later in this paper. There are few applications of game theory in library and information science and only a few of decision theory. Those that do exist tend to deal primarily with systems design (see, for example, Pirimuthu and Shaw, 2009 and Ye and Forgionne, 2008) or knowledge management (see Jolly and Wakeland, 2009). There are likewise few applications in the literature of higher education, and those that do exist tend to reside in the realm of economics education (see Dickinson, 2002).

An Economy of Publication

Perhaps the first thing to note about scholarly communication as an economic mechanism is its "peculiarity" (see Bergstrom, 2010). The librarians tend to be the selectors of informational items in the traditional sense of print subscriptions and licensed resources, the community comprises faculty and other scholars as producers and consumers, and the institution foots the bills. Add to this complexity the secondary producers of the information items, the publishers and disseminators (particularly insofar as the disseminators add value through indexing and the like). At the present time, and almost all of the history of scholarly communication, secondary producers have established the prices for the information items. It has been presumed that those producers have added value to the materials in the forms of readable communication, indexing and abstracting information, and other actions. The presumption is now being called into question, perhaps most particularly by creators of Open Access resources and digital institutional repositories. The acceptance of the secondary producers' role has been accompanied by instances of the inelasticity of prices. The lack of elasticity is a consequence of a particular monopolistic character of information items. There may be more than one journal on the subject of, say plasma physics, but each article in the literature is, to a considerable extent, unique. If a university, its faculty and students, and its library want to have access to the major work done in the field of plasma physics, then they will have to pay for a large number of information items. They do this by subscribing to numerous journals and/or licensing access to one or more databases that will provide the full text of articles.

If any game is to be governed by decisions that are in players' best interests, then the decisions should be rational. There is a substantial literature that addresses such concerns; many points, though, are reiterated throughout that literature. For example, in complex games, as Hart and Mansour (2010) observe, "each player is assumed to know initially *only his own payoff function*, and not those of the other players" [emphasis in original] (108). No player is omniscient, so overall rationality (in the sense of *a priori* knowledge of possible benefit that is satisfactory to all players) is elusive. The objectives of the players in the scholarly communication system are diverse, so diverse that measures of utility and benefit are difficult to ascertain. In particular, it is difficult to state utility in terms of preferences for all players. The challenge is exacerbated because the underlying nature of decision making is plagued by uncertainty. For example, from the standpoint of consumption, because the contents of Journal A were useful to Researcher X in 2010 does not mean that the contents of Journal A will be useful to Researcher X in

2011. The state of affairs can be described as follows: “The veil of uncertainty represents a real lack of knowledge about events which are yet to occur” (Allingham 2002, 84). Another way to comprehend the differences in assessment depends on understanding that Researcher X may evaluated utility in context, and the contexts of 2010 and 2011 can be quite different (such as concentration on different research projects).

There are numerous conditions inherent in the scholarly communication system that renders rational decisions extremely difficult. While there are numerous complaints leveled at secondary producers because of the prices they charge, the secondary producers are working within the inelastic economic structure and in their own interests. Those secondary producers have a history of creating information items in ways that have included efficiencies aimed at meeting market demands (including incorporating a peer review process and the packaging of informational items into issues). Journals have editors and editorial boards, and use expert referees to review each manuscript in order to fulfill a gatekeeper function. That function is aimed at ensuring a level of quality meant to offer assurances regarding appropriateness of methodologies, importance of research questions and problems, and the reasonableness of findings. There are expenses attached to the gatekeeper activities. A prestigious scientific journal can receive hundreds, perhaps even thousands, of submissions each year. If the operation of a journal requires the services of a full-time editor, and perhaps even an editorial staff, the expenses can be considerable. Even if editors are not compensated directly for their labor they may receive indirect compensation from their institutions (in the forms of graduate assistants, release from some teaching responsibilities, or other things that do have costs). If there is still a print version of the journal (and there is for many titles at this time), there are production and distribution expenses. If the journal is available in an electronic format there are the costs associated with the technology. It becomes clear that a scientific journal of moderate size could have annual costs of \$500,000 or more.

Individuals’ Games

The costs of producing a journal, as is indicated above, are contingent upon the number of informational items published in the journal, among other factors. Another set of players enters the game at this point. The faculty at universities and colleges seek to communicate with others in a discipline or sub-discipline. In part they publish to fulfill requirements of funding agencies (and to demonstrate that the funding has had some tangible output). In part they publish for their own motivations, which can include contributions to a public good of increasing knowledge. Since a component of the authors’ motivation is evaluation by third parties (such as tenure and promotion committees) there will be some metric used for measurement of the relative (or absolute) contributions by the authors. Whether relative or absolute, the worth of publications, while not entirely determinate, could be estimated. A certain number of publications in an ideal set of journals might contribute to a favorable tenure and promotion decision, which has cumulative material advantage to a faculty member. More publications in the smallest set of top-tier journals can lead to both material and non-material (reputational) benefit to a faculty member. The worth of publications, however, is not constant across disciplines, so campus-level decision making is not easy. Another challenge to the game- and

decision- theoretic examination of the scholarly communication system is identification of both the variables related to authorship and the utility function that authors may lean towards. If more is better (and that itself is a debatable premise), can there be a measure that can be used in a game or decision matrix? A more complicated question, but one that may be more indicative of the predicament faced by the players of the game is whether something like a decision tree might be descriptive of the choices faced. A decision tree may be employed by any player to examine the relative benefits of various options.

Figure 1
Decision Tree

A decision can actually introduce uncertainty of a certain kind. For example, the decision to license a database could be inserted in “A” in the model; this could represent the uncertainty regarding future use of the resource, as outcomes, by faculty and students. “C” could be the uncertainty relating to future price increases. The subsequent outcome could be retention or cancellation of the license. Some resolution of uncertainty (say, in the case of “B”) could lead to a subsequent decision, “2.” The model, if employed as a means to anticipate possible variables, especially variables for which there is uncertainty, could aid decision making in libraries.

One of the difficulties with faculty’s behavior is that is not naturally or necessarily cooperative, either with editors or with administrators on their campuses or with one

another. The last of the competitive factors becomes evident as one acknowledges that a prestigious journal can only publish X articles per year. If one faculty member on a campus publishes in that journal, another faculty member in the field has an $X - 1$ chance of publishing in it. So, as long as a greater number of publications enhances an individual's stature and is in the individual's interests, an individual may seek to publish more. It is an open question whether the practice of maximizing the number of publications is rational (in the more sweeping philosophical sense of inherent logical action based on collective utility or good). Hypothetically, there is no upper limit to an individual's publications, although practically there is only so much time that anyone can devote to inquiry and writing. Many individuals seek to increase the number of items published (if that is someone's primary motivation) through co-authorship, which is certainly a kind of cooperation, but one that may be based in maximizing all faculty members' publications rather than optimizing possibilities for knowledge growth among readers of the literature. With co-authorship work can be distributed and greater output can be realized if more hands are put to work. Co-authorship can also be a tactic used to maximize limited (if not scarce) resources, including money, lab space, graduate assistants, and time. There are undeniable benefits to the enhancement of the knowledge bases of disciplines, and the complex economic imperative exists of governments giving funding preference to collaborative work. Co-authorship, however, is certainly problematic for many reasons, not least of which is the vested interest on the part of authors to continue the practice of incorporating many people into the list of authors, including awarding some people "honorary" authorship. Separate from the concerns of the present investigation (though without doubt important) is the matter of accountability. If a number of names are listed as authors of an item, who is really responsible for the content (see Cho and McKee, 2002, http://sciencecareers.sciencemag.org/career_magazine/previous_issues/articles/2002_03_01/noDOI.1847997411683997393)? More pertinent to the concerns of examining game- and decision-theoretic matters, there is apparent authorship inflation that can create a perturbation in analysis.

If a hypothetical scenario were to be created, we could look at evidence available from the practices of individuals today. An assistant professor in astronomy at a major research university has 63 publications at the time of the commencement of a tenure and promotion review. Such a high number of publications may well be an outlier for an assistant professor. Another assistant professor (this one in sociology) has nineteen publications, which is probably representative of a productive assistant professor in that discipline. According to the Scopus[®] database, the faculty at Stanford University (without doubt a major research university) produced 37,200 publications during the period 2005 through 2009. Stanford's rate of publication production is typical for research universities. This university (according to its Web site) has 1,903 faculty, which means that the average individual published 19.5 items during the time period (if one reduces the calculation to simplistic elements). These numbers provide some indication (albeit incomplete and biased to larger amounts of publications) of the activities of faculty at research universities. The combined activities of scholars over time leads to a resource like ScienceDirect[®] having about nine million articles in its database.

The data indicate further some of the complexities of the scholarly communication system, examined as a game. Each faculty member, with each submission of a paper, engages a journal in elements of a game in which the faculty member “wins” if the paper is accepted for publication. The journal is less invested in the decision regarding the typical paper submitted (at least as far as an individual author and his/her paper is concerned), and is making selections based on some future considerations. The journal editor—and to a considerable extent the author, but for potentially different motivations—wants the journal’s contents to be read. Evidence of an article having been read is its citation in future literature, so measures like impact factor are closely watched by editors. Complexity becomes evident with these measures; people are not citing the contents of a journal as such, but cite the articles that happen to be published in the journal. Editors, then, want to make decisions that result in accepting papers for publication that will have an impact on readers. It becomes clear that the game, expressed in this way (with potential wins by both the editor and the journal) is not in keeping with customary two-player game theory (see Rapoport 1966).

For example, *Science Watch* has tracked the most cited papers from twenty countries for the period 1998-August 31, 2008 (see, <http://sciencewatch.com/dr/cou/2009/09janALLPAPRS/>). For the United States the most cited paper was R. Ross’s “Mechanisms of Disease,” published in the *New England Journal of Medicine* in 1999. Ross gains by having been recognized as the author of the most cited paper for nearly ten-year period (and also for having the magnitude of citations—more than 7,000). The journal also benefits greatly by having published the most cited paper. Even though there is not necessarily any *a priori* cooperation—Ross and the *New England Journal of Medicine* had no game-theoretic relationship regarding the paper in question before he submitted it—and even though there could be potential antagonism as part of the review process, both players ultimately benefited. The situation that has to be analyzed if one is to gain a purchase on scholarly communication’s complications, though, includes the reviewers of the paper, reviewers whom the editor selected. In the case of Ross, one can assume that a positive review of the submitted paper was received by the editor. Suppose one or more of the reviewers had been able to identify Ross as the author, even with a double-blind process. Suppose further that one or more of the reviewers were competitors of Ross, and sent negative reviews of the paper to the editor. The *New England Journal of Medicine* might not have published the paper, because of the influence of third parties, and might not have received the benefits attendant to the paper’s publication. Can the complexity of this version of a game be represented symbolically?

There is no easy answer to the foregoing question, but some conditions for possible representation can be identified. For one thing, the game just described (regardless of author or journal) can be described as a transferable-utility (TU) game. That is, one can argue that there is a coalition between the author and the editor, at least at a point in time. The coalition is apparent when a paper has been accepted for publication and the editor is working with the author on revisions intended to strengthen the paper. Kalai (2010)

suggests that this TU game has a real-valued function (something tangible from which the players can gain, and can gain maximally by working in coalition). The function, particularly the value of the interaction (v), can be expressed as:

$$v = (v(S))_{S \in j} \quad (\text{Kalai 2010, 128})$$

The expression assumes a coalition of players (S) with the set of players explicitly defined ($S \in j$). A difficulty with this representation is that it does not include the pre-publication actions, including peer review. It is very likely that a journal intends that pre-publication stage to be a coalitional action as well. The editor may strive to select unbiased reviews designed to offer the most informative decision support for the editor. If those conditions hold, then the foregoing symbolic representation can be used for the editor-reviewer relationship. If one or more of the reviewers does not work within the structure of coalition, though, a Nash equilibrium cannot be achieved. Since the key element of cooperation is absent, the game effectively falls apart. Stated in another way, the journal and the author suffer losses, although they have played the game in good faith. The economics of the example of unfaithful reviewers makes the use game theory difficult in this situation. It is not simply that there is incomplete information available to the players, there can be competing interests that preclude cooperation. Authors, as players, may be oblivious to knowledge that reviewers hide. The customary probabilities of acceptance of a paper for publication do not obtain.

Only a portion of the game that a faculty member plays has been dealt with so far. Almost all faculty members are also engaged in some relationship with their institutions. Institutions such as universities are similar to journals in that they too have some level of indifference when it comes to specific individuals. The administrators of universities are concerned, first, with their organizations; they want prestige, recognition, and honor for the institutions. Those individuals who care about those positive factors are likely to be supported by means of tenure, promotion, and pay raises. As is the case with faculty members trying to publish papers in journals, the tenure, promotion, and pay decisions include third parties. There are committees, department chairs, and deans that review faculty members' dossiers and make recommendations about the decisions. Non-cooperative environments can exist in this game as well. As David Hume, in his *Treatise of Human Nature*, discovered, the existence of descriptive statements may have no relation to prescriptive or normative statements. The existence of committees charged with the impartial and objective review of the accomplishments does not mean that impartial and objective reviews will be forthcoming. In other words, there is no guarantee of egalitarian treatment of all faculty members in the review processes (either of papers submitted to journals or of dossiers submitted to committees). As will be shown in the Conclusion, the failure of this metaethical imperative carries along with it a failure of utilitarianism as applied to game theory.

Institutions' Games

The overall economy of universities and the resources that faculty and students rely on is even more complicated, and is certainly more expensive than is illustrated by individual instances. For example, according to the 2007-2008 data reported by the Association of Research Libraries (ARL), 111 university libraries spent a total of

\$627,707,869 on serials. ARL also reports that the institutions employed 186,759 faculty; the cost of serials per faculty is \$3,361.06. These universities report spending a total of \$554,637,844 on ongoing electronic resources (Kyrillidou and Bland 2009). Adjusting for the three universities that do not report expenditures, the cost for the electronic resources per faculty member is \$2,969.81. Approximating the expenditures per faculty member for the 2007-2008 year, the figure for library resources is \$6,405.14. Of course faculty are not the only users (beneficiaries) of the resources, students are also likely to make heavy use of electronic resources. The calculation does not necessarily equal a dollar value of resources that each faculty member uses, but is a very rough indicator of the magnitude of financial resources that have to be used to provide the university community something approaching full access to scholarly information. The “peculiarity” of this economy is hinted at when these data are looked at as part of the game.

If this particular state of affairs constitutes a game, then who are the players? As has been shown in the individuals’ games, two players are faculty members—with their own conceptions of utility and good—and individual universities—which have only somewhat related, but substantially different conceptions of utility and good. For the faculty (and for the present consideration we must add all faculty, not just those aiming for tenure and promotion) the utility concerns tend to be personal (or more personal than institutional). Numbers of publications can result in further promotion in rank and higher merit pay raises. If purely personal utility is the aim, a greater number of publications may give a faculty member leverage in negotiating a position at a different university at a higher salary. Hausman and McPherson (1996) write, “Not only does most game theory specify the values and choices of agents in terms of preference satisfaction, but game-theoretic analyses of social interactions implicitly assume that the only (and hence the proper) perspectives for individuals to adopt in their social interactions is individual maximization” (189). The concern for the good can come from a desire to contribute to a body of knowledge, thus advancing inquiry and learning in the faculty member’s discipline, but game theory tends “to rule out a collective perspective—a perspective that considers what *we* should do and what the consequences will be for *us*” [emphasis in original] (Hausman and McPherson 1996, 196). The position of the university will be discussed below.

There are other players in this version of the game. While faculty, students, and others create the scholarship and research that is published, producers make that scholarship and research available. These players are familiar to librarians and, in general, to faculty. They set prices and determine how many items will be published in a given year. If all of these players are taken as participants in the game, it quickly becomes apparent that the game is comprised of non-cooperative players, each aiming at individual utility maximization. The faculty have their own desires and conceptions of utility that sometimes do not take the other players into account. Co-authorship can be based on genuine collaboration, so the shared motivations should be taken into account where such activity exists. The producers seek to maximize prices by setting prices at rates that the markets (libraries) will bear. These are not necessarily new insights, but when viewed in the context of game theory, the sources of conflict are clarified. The

absence of cooperation is evident in the operating margins of some of the leading producers. For example, Elsevier journals reported an operating margin for 2010 of 25.7% (see http://reports.reedelsevier.com/ar10/financial_review/chief_financial_officers_report.htm). Springer reported an operating margin for 2010 of 33.9%, before accounting for “amortization and impairment of intangible assets” (see <http://www.springer.com/about+springer/company+information/annual+report?SGWID=0-175705-0-0-0>). In 2008 Wiley reported a direct contribution to profit for their Scientific, Technical, Medical and Scholarly division of 39.4% (see http://www.wiley.com/legacy/annual_reports/ar_2009//10kWiley2009.pdf). If this game were to be cooperative, more affordable resources would be available to the research libraries and, ultimately, to the students and scholars who use them. As it stands, for libraries to play this game they must lose something.

The costs of some kinds of resources are high and the prices rise annually. The ARL data illustrate that the expenditures on serials have risen at an annual rate of 7.3% from 1986 to 2008. Expenditures on monographs rose only 2.9% annually during that period. Also, the number of items borrowed through interlibrary loan rose 6.0% on average from 1986 to 2008 (Kyrillidou and Bland 2009) (indicating yet another kind of game being played, a cooperative one among librarians aimed at sharing the informational items owned by each institution). Serials producers are benefiting from a set of decisions that librarians are making (whether librarians would prefer to make these decisions or not). A question that can and should be asked about the cancellations is whether the action is rational. If paying for the diminishing information resources affects some faculty members but not others, then there could be a selectivity that is not guided completely by reason. In other words, reaction to what one set of players chooses to do is not cooperative; the benefit is localized with one player or set of players, while both the utility and the benefit of others suffers.

A complete application of game theory should also include other players external to colleges and universities—state legislatures. While these bodies may have somewhat limited impact on private institutions, legislatures periodically raise the possibility of increasing teaching loads at state schools. If such a move were to be successful in any state the dynamics of rewards and effort would be upset. Legislature’s appropriations decisions also have a strong effect on funding for libraries, which naturally results in access to resources and services for academic communities. Reductions to appropriations have a negative impact on all aspects of the lives of colleges and universities. The complexity of the data that are available illustrates the empirical limitations of game theory in real economic situations. Just as the individuals publishing in journals and being evaluated by committees do not necessarily share the goals of publishers, neither do libraries. The librarians on college and university campuses want to provide access to the optimum number and the most beneficial content of informational items to the campus community. Secondary producers want to optimize profit. The latter group seeks to accomplish their goal by convincing as many libraries as possible to subscribe to, or license, their products, and to convince the libraries to pay the price charged. To date,

secondary producers have been the winners of this game. The trend need not necessarily be continued into the future, and decision theory can indicate ways that the trend can be interrupted. Game and decision theory suggest that processes of bargaining and negotiation can result in a “minimax” result for all players. According to Winkler (2003), the minimax criterion holds that “for each action, find the possible loss, and then choose the action for which this largest loss is smallest” (210). This seems convoluted, but it essentially reduces the possible loss to the minimum. Even minimax computation is inefficient and incomplete at the present time, because of the uncertain overall economic climate. Bayesian probability would hold that the probability of event *A*, given event *B*, is based on the prior probability of *A*. So we should be able to calculate $P(A|B)$, but we cannot because the prior probability of *A* does not inform future probabilities.

Again there are similarities between the institutional game and the more individual one. There are other parties that affect outcomes. College and university administrators make decisions about budgets and dictate whether libraries have more or less to spend year to year. To complicate matters, the individual game affects the institutional one. In particular, inasmuch as greater numbers are valued in the evaluation of individual faculty members, secondary producers benefit both by having more and more papers submitted to their journals and by the pressure on libraries to provide access to the journals in which faculty publish. A question arises: Can the institutional game be resolved without resolution of the individual game? That is an elusive question, but one might argue that negotiation by librarians to reduce costs of informational items could influence the stances of individual faculty members and journal editors. Reduction in the number of papers submitted to journals and in the number of journals and/or issues published could result in an overall reduction in costs. Negotiation of this type is based on a specific assumption that would guide librarians’ decision making. The assumption is that the current communication system produces more informational items than are required to build the overall knowledge base. If, for example, a scientist (or team of scientists) engages in creating Least Publishable Units (LPUs) in order to inflate publication records, the additional informational items may even obscure access to the totality of the research results. [LPUs refer to the slicing of products resulting from research into the smallest items that can be published.] This behavior may be admitted to reluctantly by some: “One thing I have learned as an administrator is that, while I may make the effort to discern quality in a faculty member’s record, the further up the line the tenure and profession package passes, the harder it is for administrators, or members of a faculty committee, to do that” (Owen 2004, C3). Those same people who admit the difficulty for evaluation can state some advantage, though: “the LPU will keep Professor Up-and-Coming writing. When we accumulate data for [the] big paper, there is a tendency to let it pile up until the inertia of unanalyzed, unphotographed, undigested data makes the prospect of sitting down to write it almost overwhelming” (Owen 2010, C4). Both of the factors may enter the game, but they may also cloud genuinely rational decision making with *rationalizations*. Elimination of the redundant or superfluous publications can lead to a system that is more economical, including with regard to tenure and promotion decisions.

Another question arises at this point: Can a commercial production system contribute to needed reforms to the scholarly communication system? While the answer to this question could be yes, commercial secondary producers have to be concerned about revenues and profits. Those producers will play the game according to a set of interests and preferences that reflect their commercial nature. While cooperation is not impossible, those interests and preferences are very different from those of librarians and faculty. The librarians might be expecting the secondary producers to negotiate, but the players are approaching the game from two separate viewpoints. In game-theory parlance, a dominant strategy equilibrium of a strategic game can exist. If it could be said that libraries/scholars constitute one player and traditional producers/secondary producers constitute a second player, the latter player is in a dictatorial position. There is a possibility that open and common negotiation could be blocked by differing interests, so the employment of Bayesian probability in a game-theoretic situation is not likely to occur, much less be successful.

The institutional game could be altered in the near future, even if the individual game is not drastically reformed. Open Access production of informational items is a model that is quite different from the conventional commercial one. There are still substantial costs associated with Open Access production, but those costs are lower than they are for most journals, especially if profit is not a variable in calculating costs. Intricacies of Open Access will not be addressed here; only a few points will be raised. If there can be some application of game theory to the analysis of libraries' relation to Open Access producers, then there must be a possibility for examination of common interests and preferences. The ideal of Open Access includes a closer cooperative relationship with authors/scholars. That ideal transforms the game—insofar as it is actually achieved—by altering choice relations, reducing cooptation by a dominant player, and It has been stated here that there are likely to be tensions, if not conflicts, between individual researchers and the secondary producers of journals. Reduction, if not elimination, of the tension could lead to cooperative games wherein some resulting equilibrium is possible. There will also have to be the possibility for examination of actual negotiation and bargaining, which cooperation could facilitate. These factors indicate that the shift that Open Access may (and the emphasis has to be on *may*) help bring about will be a fundamental economic one. For more on Open Access and costs, see Beaudoin-Lafon (2010).

Conclusion and Further Study

Does the dynamic scholarly communication system result in the most ethical and moral economy for higher education? In actuality, it does not address any ethical concerns at all. The probability expression inherent in game theory does nothing more than indicate which set of data is more likely to point to something like a favorable tenure decision and which does not. For simple pragmatics this probability expression may be useful; faculty members have indications of what actions they should engage in if they want to earn tenure. Moreover, the expression indicates these data to faculty when the individuals are at the beginning of their careers. Binmore (1998) would place this expression within the realm of the utilitarian; it is a good outcome of the data collection

and probability calculation that faculty are informed about the ways tenure decisions are likely to be made in universities. Binmore (2009) represents the preference relationship by the symbol “ $\prec$,” in terms of a real-valued utility function:

$$u(a) \leq u(b) \text{ if and only if } a \prec b \text{ (14)}$$

In other words, the utility of a is less than or equal to the utility of b if and only if a is less preferable than b to those making choices. The representation is a commonplace of game theory and is so foundational as to be a matter for introductory textbooks. For librarianship, however, the foundation has to be made explicit. If one followed Binmore closely when it comes to tenure and promotion decisions, some assumptions would have to be made, and some of the assumptions will be problematic. One that is not problematic is that individuals who choose to seek tenure and promotion at a university, and who are aware of the probability, are likely to decide to publish strategically in ways that will operate in their best interests (such as publishing many peer-reviewed journal articles as they can during the six-year period or publishing the highest portion of their work in the acknowledged top-tier journals). Those individuals are likely, then, to be on the faculties of universities at the end of the six-year period.

Here is a potential difficulty with Binmore’s (1998) commitment to nonteleological utilitarianism (utility not guided by *a priori* purpose). The nonteleological position implies that utilitarianism, as he is advocating for it, is a product of reason. He draws support for his position from Hume. Hume (2000), though (as is noted above), said that “reason is, and ought to be, the slave of the passions” (Section 2.3.3.4). Hume means that the will does not enter into rationality; reason relates only to the external world (hence the absence of a purpose that could only be willed). The university has a teleological preference; it bases decisions primarily on numbers of publications; prestige through publication is a purposeful decision by university administrators. The preference has a set of possible origins: more publications results in greater visibility for the institution (by virtue of the faculty members’ affiliations being known); the publications add to prestige (greater numbers lead to higher rankings in polls and surveys); the publications exhibit cardinal and ordinal rankings among peers (if one counts total publications or publications per capita); or the publications provide an indirect indicator of scholarly depth and/or value of the university. Many of the faculty also have teleological preferences. Some want to earn tenure and be promoted at the universities, possibly to ensure security. The interests of some faculty may be directed towards adding to the overall knowledge bases of their fields. Those faculty who leave the university prior to the tenure and promotion decision may be exhibiting a teleological preference in favor of teaching and/or service. Given the preferences just described, at best a teleological utilitarianism could be argued for. Librarians also have teleological preferences that are less self-centered than are those of administrators or faculty and, hence, there is a possibility for tension.

The foregoing has been an exploration of the potential applicability of game theory to the economies of academic libraries, higher education, and information production. The economies are undeniably complex, but there are some challenges associated with employing classic game theory. Some of the difficulties are rather

ancillary to game theory proper. For example, there is only a relatively small number of “top tier” or high prestige journals in any given field. Faculty—those seeking tenure or senior faculty—face a considerable amount of competition when it comes to publishing in those journals. A challenge that junior faculty face is what Robert Merton (1968) termed “the Matthew Effect” once someone has established a record in publication, that person is more likely than others to have success publishing in the future. Also, for almost all journals, especially in social science and humanities disciplines, there is a delay between acceptance of a paper and its actual publication. That delay can work against the faculty members seeking tenure and promotion. Another difficulty is that some journal editors are reporting that it is getting more difficult to recruit manuscript reviewers and to obtain timely and useful reviews of submitted manuscripts. Conversely, those faculty who do produce timely and useful reviews of manuscripts find themselves burdened by the demand to review more and more papers (see Myers 2009). All of these, plus other, factors affect the economies of which higher education and its components are part.

The assumptions of rationality and common knowledge (among others) can be problematic; in part, not all players are aware that they are participating in a form of a game when it comes to, for example, tenure and promotion decisions. The information production pricing and payment economy has even more difficult challenges associated with it. There may be alternatives to classic game theory; some theoretical work has been done recently with an evolutionary alternative (see, for example, Sandholm, 2010 for a recent work). Classic game theory tends to be based on the tenets of physics, but some economists are suggesting that biology may be a more apt source for underlying principles (see Hammerstein and Selten 1994 for an earlier conception of the connection). If game theory is intended to have a moral aspect, the difficulties with the applications attempted here include two implications: (1) game theory, as it has been developed to date, is limited in its ability to capture that moral aspects, and/or (2) higher education, libraries, and information production are not incorporating moral behavior into their operations (at least in the senses that game theorists articulate the ideals of the moral aspect of the theory). A further examination of game theory’s application to the kinds of problems addressed here should include the emerging evolutionary turn. It must be noted that economists themselves are working through the implications of the biological model, so a stable theoretical framework has not been developed at this time. Gul (2010) notes that “there is empirical evidence that economic agents care not only about their own physical outcomes but also about the outcomes of their opponents and how the two compare” (22). This kind of thinking carries import for the entirety of the actions surrounding cancellations and can be grounding for further research in the relations between libraries and information producers. Perhaps most particularly, examination of the predominance of databases and other resources that aggregate access to journal literature should include an evolutionary approach to information provision. If, say, Open Access connotes a greater degree of cooperation among multiple players (editors, authors, and librarians), the possible benefits, including in a transferrable-utility framework, can be explored. Even with that kind of analytical approach some complex value-laden variables remain, such as page charges, and authors’ ability to pay them,

would have to be components. Sugden (2001), who does see considerable potential for the evolutionary alternative, emphasizes that this alternative must be sensitive to historical contingencies. The study of evolution is historical; it investigates the changes that occur over time. The study of the economies dealt with here should, in future, be likewise historical.

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