A Tool to Assess Journal Price Discrimination[1]

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This econometric study tests pricing practices of publishers and their monopoly power. It suggests that traditional publishers will retain their market clout as they shift to offering electronic publications. Librarians' common experience with price discrimination was corroborated by a powerful model comparing prices charged to institutions while holding constant for production costs, source of publication, discipline areas, and the availability of titles in electronic format. The model also provides a robust selection tool to compare actual prices to model-predicted prices among the subscriptions within any given collection and to predict those that, statistically, are significantly overpriced. The study results reveal that commercial publishers are not the only ones that appear to overprice titles by a statistically significant amount. Campuses face continued increases in prices for traditional and electronic resources, but statistical modeling offers an opportunity for controlling costs.

Librarians decide whether to acquire or retain a subscription to any given serial based on three variables: relevance, quality, and price. Comparing its general theme to the academic program determines the relevance of a journal. A strong correlation between the subject of the journal and the disciplines covered by the relevant program tends to support a favorable decision. The quality of a title likely will be determined subjectively or be dependent on survey information and reputation in the field. A determination of high quality also will tend to support acquisition. These two variables are not readily amenable to quantitative analysis, but price is. In fact, as this article shows, an econometric analysis of the prices of selected titles can be a powerful way to overcome the negative impact of publisher monopoly power on the expenditure pattern of libraries.

Economic theory predicts that when barriers to entry diminish, monopoly power is eroded by the entry of new competitive products. This means that as monopoly power diminishes, prices tend to be established at rates closer to the value placed on them by libraries. By comparison, the open systems architecture approach taken by IBM in the early days of the development of the personal computer (PC) market provided opportunities to many upstart firms that successfully emerged with competitively priced computers. In contrast, the closed archi-

tectural approach applied by Apple Computer imposed a barrier to entry that, over time, dampened the growth of the market and kept prices high for their alternative technology.

Extending this theory to the journal literature suggests that perhaps the opportunity provided by electronic technology will lower the barriers to entry of new journals. In effect, because it might be easier for new scholarly journals to get started by using desktop publishing technology, the lowered barriers offered by this technology would erode the monopoly power held by the major print publishers. Indeed, desktop publication technology, along with major improvements in digital storage capacity, has proved effective as a means of introducing new periodicals. However, new tech-

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Because most publishers offer some products in print only and others within the described electronic set, the prices of the electronic version might be expected to reflect an erosion of monopoly power.

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nology also has been more effective in allowing existing print journals to offer electronic counterparts. In less than a decade, more than a thousand peer-reviewed electronic journals have been introduced to the scholarly environment. ARL's *Directory of Electronic Journals, Newsletters, and Academic Discussion Lists* listed 417 peer-reviewed titles in 1996.[2] That figure grew to 1,049 in 1997, with hundreds of existing print titles expanding their outreach in electronic versions.

This rapid expansion of the e-journal market suggests that, indeed, there may be cost advantages in the electronic environment that offer substance to the hope that periodical price inflation might come under control. Alternatively, expanded profit opportunity also might motivate a move to offer electronic periodicals among traditional publishers. With that in mind, the author designed an experiment to determine whether price inflation

might be dampened by electronic scholarship. The rest of this article describes the results of an econometric analysis of prices for 859 periodical titles for three consecutive years. The article concludes with a description of an analytical tool that may be used to assess journal prices.

Economic Theory and Model

To analyze the effects of electronic availability on journal price, a straightforward model was established that applied ordinary least squares (OLS) regression on cross-sectional data similar to analyses reported by others.[3] Earlier models typically regressed price on a number of variables to distinguish the statistical relevance of publisher type in determining price.[4] Not only do these studies confirm librarians' belief that certain publishers practice price discrimination, but they also show that periodical prices are driven by other factors, as well. The costs of production based on frequency of issue, number of pages, and presence of illustrations impact price. The availability of alternative revenue from advertising and the exchange rate risk for foreign publishers also affect price. Quality measures on the content, such as number of times a periodical is cited, affect demand, which then impacts price. Production economies of scale available to some journals with large circulation also have been shown to affect price.[5]

Additional work using an alternative model examined the possibility that publishers exercise monopoly power in setting prices. By substituting a measure of monopoly power in place of price, it has been shown that publishers have some ability to influence price.[6] Theory predicts that in a competitive market, even when it is characterized as monopolistic competition, the price offered to individuals will be elastic.[7] Faced with a change in price of the subscriptions purchased from her or his own pocket, a scholar will act discriminably. Raise the price to individuals, and some will cancel their subscriptions in favor of access to a library. Thus, the price of periodicals to individuals is a

determinant of demand for library access.[8] In contrast, the price to libraries, which is often much higher than the price to individuals, is set at a level intended to extract consumer surplus. The difference in these prices should offer a reasonable measure of the extent of monopoly power, assuming that the individual subscription price is an acceptable proxy for the marginal cost of production.[9] Even if not completely true, some measure of monopoly power is represented by the difference in the prices. If a dummy variable is then included in the data set for whether each journal is available electronically, this measure should vary statistically on that dummy.

By modifying the earlier models, the analysis here seeks to determine whether monopoly power may be eroded in the electronic market. The methodology applied uses two specifications for an OLS regression model. The first regresses institutional price on the characteristics of a set of journal titles held by Trinity University's library. The data set developed is considerably larger than those used in previous studies. Therefore, this study attempts to confirm the earlier works that concentrated on economics or chemistry journals across a larger set of disciplines. The specification includes the variables established earlier: frequency of publication, circulation, pages per year, and several dummy variables to control for whether the journals contain advertising and for country of publication. Dummy variables are included for type of publisher, with the residual being commercial. A second specification regresses the difference in price for libraries compared to individuals on the same set of variables. Both specifications also include an additional dummy for electronic availability, which is intended to show whether price or monopoly power of given journals is driven in part by that publishing opportunity.[10]

It is anticipated that at the margin, the impact on publishers of Trinity canceling some of its print subscriptions would be trivial. However, national availability of the electronic versions could precipitate cancellations among many institutions in favor of electronic access. Prices then would be adjusted accordingly. Because most publishers offer some products in print only and others within the described electronic set, the prices of the electronic version might be expected to reflect an erosion of monopoly power. Thus, the cross-sectional data would capture the effect of electronic availability on monopoly power.

The larger data set used here, composed of 859 periodical titles representing nearly all the academic disciplines, mitigates several concerns experienced by other investigators. The only study found in the literature thus far that looks at publishers from the standpoint of the exercise of monopoly power focused on price discrimination.[11] This project extends that analysis in two ways. First, a much broader database is used. Most of the previous work focused on limited data sets of fewer than a hundred titles in a single academic discipline. Second, the analysis is extended by assuming the existence of price discrimination given the difference in price to individuals versus libraries for most scholarly journals. With controls in the model for previous discoveries regarding price discrimination, this project attempted to test the null hypothesis that monopoly power will not increase in the electronic domain.

It is impossible to distinguish the specific price of each journal from the electronic titles licensed from vendors such as Ebsco, UMI, and other aggregators because each is priced at a flat fee for the entire set of the aggregator. This pricing scheme may reflect an attempt by publishers to capture revenue lost to interlibrary lending. However, it also may reflect publisher expectations that article demand will increase when user nondollar costs decrease. Therefore, monopoly power will be reflected back on the subscription price of print versions. As a result, the price of print copies is assumed *as a proxy for* the specific electronic price of each title if the copies could be made available on a title-by-title basis.

However, an alternative result could emerge. In monopolistic competition, anything that differentiates a product may increase its monopoly power. Firms that sell laundry detergent spend tremendous amounts of money on advertising. They do so to create the impression that their product is qualitatively distinguishable from others. Similarly, it may be that electronic availability of specific titles will create an impression of superior quality.

The general model of the first specification is written: $y_j = a + b_1 LOWPRICE_j + b_2 EUROPE_j + b_3 GRTBRIT_j + b_4 OTHER_j + b_5 RISK_j + b_6 ASSOC_j + b_7 FOUND_j + b_8 GOVERN_j + b_9 UNIV_j + b_{10} FREQ_j + b_{11} ARTPGS_j + b_{12} PEER_j + b_{13} CCC_j + b_{14} ARTILLUS_j + b_{15} ADVERT_j + b_{16} SUBFEE_j + b_{17} AGE_j + b_{18} BOOK_j + b_{19} TOTCITES_j + b_{20} IMPACT_j + b_{21} SCIENCE_j + b_{22} SOCSCI_j + b_{23} ELECTRNIC_j + b_{24} CIRC_j + e_j$, where, y equals the library price (INSTIT) for journal $j = 1, 2, 3, \ldots n$. The general model of the second specification is written the same way except that y equals an index of monopoly power (LERNER). The definitions of independent variables are given in table 1, along with the expected signs on and calculations of the parameters b_1 through b_{24} to be estimated by traditional single-regression techniques.

It should be understood that most of the variables listed in table 1 were suggested based on previous studies that have demonstrated their appropriateness. Testing with the regression model was required to determine the variables ultimately useful to this study. Additional variables were introduced as the experiments suggested them. A very brief rationale for the expected sign and the importance of the variables is in order.

If the difference in price between what publishers charge libraries versus individuals represents price discrimination, a variable for the individual price (LOWPRICE) will be a significant predictor of price to institutions (INSTIT). As the individual experiences an increase in price, substitution of access to the library will take place. That is, higher individual prices will shift users toward use of the library, thus raising demand for library subscriptions, which will pull institutional prices higher. The sign on this variable is expected to be positive.

One group of variables deals with the issue of price discrimination based on the monopoly power that can be exercised by foreign publishers. Publishers in Great Britain (GRTBRIT), Western Europe (EUROPE), and other countries outside the United States (OTHER) may have enough market power to influence price. Therefore, these variables will carry a positive sign if a sizeable market influence is exerted. Some of these publishers also will be concerned with currency exchange risks (RISK), which they will adjust for in prices. However, because they offer discounts through vendors to libraries that prepay subscriptions, this variable will carry a negative sign if the price to individuals captures most of the financial burden of risk adjustment.

On the basis of observations over time, it is expected that commercial publishers price discriminate more than their nonprofit counterparts do. Therefore, in comparison to the commercial residual, associations and societies (ASSOC), government agencies (GOVERN), university presses (UNIV), and foundations (FOUND) will capture the generally lower prices of the nonprofits. The signs on all these are expected to be negative.

All the publishers will experience production costs, processing and communication expenses, that can be exposed through variables that control for frequency (FREQ), total pages of articles printed per year (ARTPGS), peer review (PEER), copyright clearance registration expenses (CCC), and the presence of graphics, maps, and illustrations (ARTILLUS). All of these costs will affect price positively to the extent that they are passed on to buyers. On the other hand, the inclusion of advertising (ADVERT) will provide additional revenue to that of sales, so this variable is expected to be negative because journals that include ads will have less incentive to extract revenue

TABLE 1
Regression Variables with Expected Signs

Dependent Variables:

INSTIT = The price for library subscriptions

LERNER = Monopoly power as represented by INSTIT minus LOWPRICE

Independent Variables:	Dummies	Expected Sign
LOWPRICE = Price for individuals		+
EUROPE = 1 if the journal published in Europe, 0 otherwise	√	+
GRTBRIT = 1 if the journal published in Great Britain, 0 otherwise	√	+
OTHER = 1 if the journal published outside U.S., Europe, and Great Britain, 0 otherwise	√	+
RISK = Standard deviation of the monthly free-market exchange rate between the currency of the home country of a foreign publisher to the U.S. dollar		+
ASSOC = 1 if the ournal published by an association, 0 otherwise	√	–
FOUND = 1 if the journal published by a foundation, 0 otherwise	√	–
GOVERN = 1 if the journal published by a govt agency, 0 otherwise	√	–
UNIV = 1 if the journal published by a university press, 0 otherwise	√	–
FREQ = Number of issues per year		+
ARTPGS = Number of pages printed per year		+
PEER = 1 if article submissions are peer reviewed, 0 otherwise	√	+
CCC = 1 if ournal is registered with the CCC, 0 otherwise	√	+
ARTILLUS = 1 if the journal contains graphics or illustrations, 0 otherwise	√	+
ADVERT = Number of pages of advertising in journal for the year		–
SUBFEE = 1 if journal requires authors to submit page charges, 0 otherwise	√	–
AGE = Current year minus the date the journal first published		–
BOOK = 1 if the journal publishes book reviews, 0 otherwise	√	+
TOTCITES = Sum of the ISI citation measures		+
IMPACT = Index of impact from the ISI citation studies		+
SCIENCE = 1 if the ournal is in the humanities, 0 otherwise	√	+
SOCSCI = 1 if the ournal is in the social sciences, 0 otherwise	√	+
ELECTRNIC = 1 if available in electronic form, 0 otherwise	√	–
CIRC = Reported number of subscriptions to the journal		+

through sales. Similarly, control for journals receiving revenue from page charges or submission fees is captured by another dummy variable (SUBFEE), which should be significant and negative. New entries into the publishing arena are expected to experience advertising costs in order to increase awareness of their products, which will be partially passed on to consumers. Therefore, age (AGE), which is the difference between the current date and the date the journal started, will be a negative predictor of price and monopoly power. A dummy variable for journals that publish book reviews (BOOK) is included to control for publishing cost differences in this type of material for those journals emphasizing reviews.

Moreover, a pattern was noted of establishing individual prices that are almost exactly half the prices required of institutional purchasers.

Previous studies have developed measures of quality based on rankings of publications compared to each other within a given discipline. Most of these comparisons work from information available from the Institute for Scientific Information (ISI). Data acquired from this source showing the impact factor (IMPACT), immediacy index, half-life, total cites (TOTCITES), and cites per year will be tested by using two of these variables to capture quality of journals. These variables are expected to be positive with regard to both price and monopoly power.

The prices of journals across disciplines may be driven by different factors. In general, prices are higher in the sciences and technical areas and lower in the humanities. This is understandable when one considers that essentially no market exists for scholarly publications in the humanities outside academe. In contrast, scientific publications are used heavily in corporate research by pharmaceutical firms and other industries highly dependent on research. As a result, two additional dummies are included in the model to segment the specification along discipline lines. Two dummy variables (SCIENCE, SOCSCI) will control for differences in price among the science and social sciences as compared to the residual category of humanities. These variables are expected to be positive and strong predictors of price.

Finally, a dummy variable is included to determine whether the availability of each journal electronically (ELCTRNIC) has a positive impact on ability to price discriminate. Because it has been hypothesized that monopoly power will erode in the electronic arena, this variable should be a statistically significant and negative predictor of monopoly power. However, to the extent that a journal's availability in an electronic format distinguishes it from print counterparts, there is some expectation that this variable could be positive. This would capture additional price discrimination by publishers that are able to capture lost revenue in the electronic environment.

As indicated in earlier studies, it could be expected that circulation (CIRC) would capture the effects of economies of scale, which those publications distributed in larger quantities will experience. Thus, this variable is expected to be negative. However, it introduces an econometric problem because it is likely to be endogenous to the determination of price (INSTIT) in the first specification and to the measure of monopoly power (LERNER) in the second. In effect, circulation, which is a measure of demand, drives price and, in turn, changes in price drive circulation. Therefore, the specification here is complicated by the likelihood that a variable's inclusion for circulation implies simultaneous equations. This project attempted to overcome this limitation by considering another version of the specification with a multistage OLS regression. All the variables in the model were approximated with data collected from original sources.

Database Development

At the outset, it was the intention of this investigation to build the database for the

regression by enhancing the data on subscriptions available from Trinity's integrated library system. To augment these statistics, the number of article pages, the number of advertisement pages, and pricing information had to be obtained from the journals themselves. Additional information such as impact measures, total citations, and related factors were acquired from ISI. Some data were obtained from a serials bibliography.[12]

Table 2 lists the nondummy variables with statistical averages, which are appropriate to the model specification as determined by theory and previous efforts by others. The data associated with those variables were obtained most readily by examining the journals and compiling the statistics from the actual items. Because literally millions of journal pages had to be examined, the investigation focused on the subset of the scholarly literature represented by the Trinity collection. Trinity gathers the current issues of every periodical subscription in one location, organized according to classification number. Data were gathered by pulling every other current periodical from the display shelves. All titles that were obtained free of charge, were news oriented, or were dependent on advertising revenue were dropped from the data collection in favor of scholarly, academic titles.

As might be expected with such a massive data-gathering project, several problems developed during the process. Accurate, reliable circulation data proved to be difficult to acquire. Although Ulrich's directory tries to provide these figures, they sometimes are misleading, missing, and/or not updated every year. Alternatively, the circulation figures posted by the journals themselves in compliance with postal regulations are unavailable for foreign-based periodicals. Furthermore, an attempt to retrieve these data from the U.S. Post Office revealed that that agency does nothing to compile the information. Therefore, the figures were gathered from the journals themselves

TABLE 2
Non-dummy Regression Variables
with Minimum, Maximum, and Mean Values for 1997

Dependent Variables:	Minimum	Maximum	Mean
INSTIT = The price for library subscriptions	8.00	2,896.00	241.00
LERNER = Monopoly power as represented by INSTIT minus LOWPRICE	0.00	1,856.00	108.43

Independent Variables:	Minimum	Maximum	Mean
LOWPRICE = Price for individuals	5.00	1,968.00	96.93
RISK = Standard deviation of the monthly free-market exchange rate between the currency of the home country of a foreign publisher to the U.S. dollar	0.00	184.70	0.40
FREQ = The number of issues per year	1.00	52.00	5.90
ARTPGS = Number of pages printed per year	14.00	3,209.00	956.38
ADVERT = Number of pages of advertising in journal for the year	0.00	5,104.00	28.08
AGE = Current year minus the date the journal first published	0.00	182.00	42.95
TOTCITES = Sum of the ISI citation measures	10.00	296,759.00	4,330.54
IMPACT = Index of impact from the ISI citation studies	0.00	37.29	1.30
CIRC = Reported number of subscriptions to the journal	249.00	252,573.00	6,033.23

and compared to the Ulrich's information. When no figure was supplied in the journal, the Ulrich's estimate was used. When both were available, the investigation relied on the postal reporting of the journals. No efforts to acquire circulation counts from the foreign-based journals were made during this phase of research.

Obtaining price information also proved challenging. Prices to libraries are usually indicated within each publication. Therefore, that source was relied on for institutional prices, which were then checked against actual Trinity invoices to verify accuracy. In many cases, the price to individuals was not indicated in the journal itself. In fact, this proved to be the general case for many large foreign-based publishers. The common supposition among librarians that individual subscriptions to these titles have declined to zero seems to be borne out by answers to queries to the publishers requesting the price for individuals.[13] Answers were inconsistent and sometimes wildly different from year to year. In other cases, the publisher responded as if it did not know the answer. Moreover, a pattern was noted of establishing individual prices that are almost exactly half the prices required of institutional purchasers.

In some cases, individual prices were bound up in membership charges. For the purposes of this analysis, the information available was interpreted to parse out the lowest price that an individual would normally pay. Letters to a few societal publishers resolved some difficult questions. The issue of shadow prices associated with whether some subset of individual subscribers would pay association dues for services not wanted in order to obtain a given periodical was ignored on the assumption that the effect on the model using aggregated statistics would be trivial. Likewise, the opportunity costs associated with substituting access in the library (transportation to the library, searching, photocopying, and so forth) for personal subscriptions also were ignored on the assumption that these would typically be borne by subordinates to the researcher and, in the aggregate, would not substantially affect the outcome.[14]

Data gathering also sometimes ran into problems determining whether a publisher was commercial. In a number of cases, periodicals contained indications of both a commercial and a societal (or university press) involvement. After carefully looking at pricing patterns, it became apparent that the price tended to be driven by commercial issues. In fact, discussion at a recent conference of university presses substantiated that they are being pressed by parent institutions to stand on their own and produce a profit.[15] Similarly, many societies indicate that their publications produce a return to equity that offsets dues payments by members.[16] Therefore, each periodical where a combination of commercial and societal or university press was involved was coded as if it were commercial.

Unfortunately, also, ISI does not index all the titles included in the sample gathered at Trinity. Therefore, quality variables based on ISI statistics, such as impact factor or total citations to each title, could not be included in the analysis for many of the observations. This information was available for approximately 60 percent of the database.

Also early on, it was difficult to determine reliably when a journal was actually available electronically. The journal itself was relied on to indicate whether it had an electronic counterpart. In most cases, this information was available and could be verified by other sources. However, in 1995, fewer than fifty titles that were part of the database had electronic counterparts. By 1997, this information could be corroborated and 294 titles for which the publishers were offering electronic versions were in the database.

Model Results

Generally, the results of the OLS regression tests of institutional price conformed to both theory and earlier studies. In fact, the sign on every variable that held up in the regressions conformed to expectations, with the exception of the variable

TABLE 3
OLS and Three-stage Analysis
of Institutional Price for 1997 (97INSTIT)

Dependent variable: 97INSTIT
Independent Variables:

Term	OLS Model			Three-stage Model		
	Estimate	t Ratio	Prob>|t|	Estimate	t Ratio	Prob>|t|
Intercept	-7.7295	-0.30	0.7679	-53.8460	-1.78	0.0750***
97LOWPRICE	0.7345	17.69	<0.0001*	2.9445	14.56	<0.0001*
EUROPE	96.5960	3.63	0.0003*	96.2500	2.95	0.0030*
GRTBRIT	81.2282	5.45	<0.0001*	84.7660	4.53	<0.0001*
OTHER	23.1433	0.87	0.3837	26.8190	0.82	0.4100
ASSOC	-80.7462	-5.39	<0.0001*	-91.0110	-4.80	<0.0000*
FOUND	-62.5348	-2.22	0.0266**	-69.7290	-1.98	0.0490**
GOVERN	-54.7575	-0.67	0.5022	-56.1010	-0.56	0.5750
UNIV	-63.9232	-4.59	<0.0001*	-74.9410	-3.96	<0.0000*
FREQ	21.9225	14.62	<0.0001*			
97ARTPGS	0.0556	11.59	<0.0001*			
PEER	53.2032	4.81	<0.0001*			
CCC	3.7960	0.32	0.7463			
ARTILLUST	17.7048	1.05	0.2937			
97ADVERT	-0.4852	-7.94	<0.0001*			
97SUBFEE	-55.2221	-2.99	0.0029*			
97AGE	-0.8906	-4.65	<0.0001*			
BOOK	-23.2038	-1.93	0.0546***			
SCIENCE	37.0897	1.95	0.0511***	50.3920	1.78	0.0750***
SOCSCI	-17.1302	-1.13	0.2573	-20.3560	-1.11	0.2680
97ELCTRNIC	61.0898	5.51	<0.0001*	57.3430	4.23	<0.0000*

* Significant at the 0.01 level
** Significant at the 0.05 level
*** Significant at the 0.10 level

Summary of Fit

RSquare	0.8105	RSquare	.05249
RSquare Adj	0.8053	Durbin-Watson	1.8982
Root Mean Square Error	138.4037	Von Neumann ratio	1.9007
Mean of Response	202.0081		
Observations (or Sum Wgts)	744		

Analysis of Variance

Source	DF	Sum of Squares	Mean Square
Model	20	59241126	2962056
Error	723	13849486	19156
C total	743	73090612	
FRatio	154.63	Prob>F	<.0001

TABLE 4
OLS Analysis of Publisher Monopoly Power
for 1997 (97LERNER)

Dependent variable: 97LERNER
Independent Variables:

Term	Estimate	t Ratio	Prob>|t|
Intercept	-27.2726	-1.02	0.3075
EUROPE	95.2394	3.48	0.0005*
GRTBRIT	75.2878	4.93	<0.0001*
OTHER	20.4782	0.75	0.4529
ASSOC	-72.6558	-4.73	<0.0001*
FOUND	-52.6606	-1.82	0.0685***
GOVERN	-47.7689	-0.57	0.5687
UNIV	-53.0263	-3.73	0.0002*
FREQ	20.3354	13.39	<0.0001*
97ARTPGS	0.0502	10.34	<0.0001*
PEER	55.6431	4.90	<0.0001*
CCC	-0.8208	-0.07	0.9456
ARTILLUST	16.3332	0.94	0.3456
97ADVERT	-0.4405	-7.06	<0.0001*
97SUBFEE	-56.2801	-2.96	0.0031*
97AGE	-0.8804	-4.47	<0.0001*
BOOK	-12.8829	-1.05	0.2940
SCIENCE	20.1348	1.04	0.2973
SOCSCI	-16.2970	-1.05	0.2941
97ELCTRNIC	64.7188	5.69	<0.0001*

* Significant at the 0.01 level
** Significant at the 0.05 level
*** Significant at the 0.10 level

Summary of Fit

RSquare	0.6455
RSquare Adj	0.6362
Root Mean Square Error	142.1684
Mean of Response	110.5228
Observations (or Sum Wgts)	744

Analysis of Variance

Source	DF	Sum of Squares	Mean Square
Model	19	26647512	1402501
Error	724	14633380	20212
C total	743	41280892	
FRatio	69.39	Prob>F	<.0001

for electronic availability (ELCTRNIC). For a few variables determined to be important by earlier studies, the tests were statistically insignificant. When their removal would have diminished the power of the model to predict by not holding constant for an important factor, the variables were left in the reported results.

The basic models were run on data for 1995, 1996, and 1997. The results were nearly the same for all three years, with the exception of the variable for electronic availability (ELCTRNIC). In both the model to predict institutional price and the model to predict monopoly power, the analyses converged consistently with about a hundred observations lost because of null values. The results of the analyses are summarized in tables 3 and 4. Table 3 reports two versions of the results to accommodate a statistical complication introduced by potential endogenity of the price charged individuals (LOWPRICE).

To explain these results, some caveats apply. First, asserting that these statistical models prove certain points can be misleading. By analogy, a Missouri road map is a model. It would be unreasonable to try to use such a map to *prove* that St. Louis is located at the conjunction of two major rivers on the eastern boundary of the state. However, used properly, the map makes highly reliable predictions for any traveler. Provided a traveler in Missouri knows where he is to begin with, the map provides, with

a high degree of certainty, the direction to go in and the roads to take to get to St. Louis. Once in St. Louis, the traveler could corroborate the evidence provided by the map that, indeed, the city is located where the Missouri and Mississippi rivers join at the midpoint of the state's eastern border.

Similarly, it is better to understand that statistical models such as OLS regressions provide reliable support to make predictions. In fact, these models can predict with a degree of confidence in excess of 90 percent, which is all that any statistical model can do. Therefore, although the results from the tests do not prove per se that certain publishers overprice their products or hold monopoly power, they do provide reliable predictors. In the case of the tests described here, the models predict that if given periodicals produced by certain publishers are examined, their price is likely to be too high compared to all the other periodicals examined in the tests. Furthermore, it can be confidently predicted that the outcome is accurate nine or more times out of ten.

Second, the results here apply to a data set of periodicals subscribed to by Trinity University. The predictions they make would apply reasonably well to any school with nearly the same subscription list and perhaps as well to others with similar subscription lists. Although predicted prices for specific titles would vary considerably, the general outcomes of these tests could be expected to describe conditions for similar kinds of institutions with similar core collections. The reliability of the predictions would decline if an attempt were made to apply them to substantially smaller or larger collections or to collections skewed heavily toward fewer disciplines.

In terms of Trinity's collection of periodicals, the model predicts the price of academic periodicals with an R-squared statistic in excess of 0.81, indicating that over 80 percent in the variation of the dependent variable library price (INSTIT) is explained by the model. Similarly, the R-squared statistic on the alternative model examining monopoly power (LERNER) exceeds 0.64 and thus explains over 64 percent of the variation in the variable for monopoly power. Both models have very large F-statistics; thus, both are statistically significant at better than the 0.01 level. That is, they predict correctly in excess of 99 percent of the time.

The outcomes of the models in terms of specific independent variables also are very reliable. Nearly every independent variable conformed to theory, corroborated previously reported analyses, showed the expected sign, and was statistically significant. A few variables in the original function specified failed to be statistically significant. The variable separating the broad discipline of social science (SOCSCI) and those separating certain other factors (OTHER, FOUND, and CCC) were left in the model to control for important concerns that could contribute to price or monopoly power and to complete the relevant dummy sets. The subset of social science periodicals represented by a dummy variable (SOCSCI) was retained to distinguish those titles from science and the residual titles, which were all humanities. The variable for countries outside the United States, Great Britain, and Europe (OTHER) was left in to distinguish publications published outside this country from those published within. The costs associated with registering with the Copyright Clearance Center (CCC) that could affect prices was left in to provide assurance that the study was controlling for this cost of production. The extra production costs associated with illustrations (ARTILLUS) were left in to control for this issue.

A few variables that were shown to be statistically significant in other studies were specified in the original function here but were dropped from the results when they proved to be very insignificant and when they were not associated with other dummy variables. Following the work of others studying revenue lost to photocopying, this study incorporated data from ISI on total citations (TOTCITES) and impact factor (IMPACT) as proxies for quality variations

among titles.[17] Neither of these variables held up in the final results, in part because their values could not be obtained for much more than about half the collection. Citation-based variables may never produce significant results because of the cross-disciplinary nature of this database. Citation rates, in general, vary considerably from the arts compared to the sciences.

In an earlier study on economics titles, the exchange rate risk faced by foreign publishers with the decline of the dollar in world markets proved reliable as a predictor of price. In this study, this variable (RISK), as proxied by the standard deviation of the annual exchange rate for the currency of each country with the dollar, was insignificant. It is likely that this variable did not hold up in the model because the exchange rate of dollars for the foreign countries represented was reasonably steady within the 1995 to 1997 time frame of the analysis. Therefore, exchange rate risk may have played a minor role in setting prices for those years.

Finally, the variable used to control for the circulation rates (subscriptions sold by the publishers) was not usable in the model. There is a statistical complication associated with this variable (CIRC) related to endogenity and with the variable for the price charged to individuals (LOWPRICE), which is closely related to circulation rates. Also, reliable circulation figures were available for too few observations to produce meaningful results using that variable. On the other hand, the price charged to individuals turned out to be statistically significant and positive. As this variable (LOWPRICE) is increased, the model predicts and experience confirms a positive increase in the price charged to libraries (INSTIT). This is as expected because the loss of revenue caused by individual subscription cancellations will be reflected in library prices as publishers attempt to make it up. However, this variable (LOWPRICE) may introduce the same statistical problem that the statistic for circulation does. (The problem introduced by both variables is discussed in the next section.)

All the other variables expected to contribute to predictions of price and monopoly power held according to expected sign and statistical significance except for the dummy variable for electronic availability. Some variables included in the study that did not explicitly contribute to costs of production nevertheless contributed to variations in the dependent variable. Science periodicals (SCIENCE) in the collection are more expensive compared to periodicals in social science and the humanities. Publications originating in Western Europe (EUROPE) and Great Britain (GRTBRIT) are priced higher, on average, than U.S. periodicals. Publications of associations and societies (ASSOC), university presses (UNIV), government publications (GOVERN), and foundations (FOUND) are all priced lower than commercial publications.

Other variables that control for factors that could contribute to production costs were retained in the models because of their statistical significance. The costs of peer review (PEER), higher frequency of publication (FREQ), and higher number of pages of article content published (ARTPAGES) contribute positively to higher prices charged to libraries. Those higher prices are thus partially explained by higher production costs. Alternative sources of revenue from page charges or submission fees (SUBFEE) and advertising (ADVERT) help hold prices down, as expected. The models show that what librarians believe to be predictable are indeed predictable with a high degree of certainty within the data set examined.

One variable was used to extend this study beyond those reported earlier to determine the potential impact of electronic availability (ELECTRNIC). If barriers to entry would be lowered by the opportunity to publish offered by electronic technology, this variable would be negative. Alternatively, if the electronic domain offered an opportunity for publishers to retain better control of their publications and possibly extend their pricing power, it would be positive. In the regression run on 1997 data where there

was a large subset of electronically available periodicals, the results on this variable were statistically significant and positive.

As the primary outcome of the analysis, it is possible to reject the null hypothesis that monopoly power will not increase in the electronic domain. Actually, the analysis indicates that the opportunity to publish electronically neither lowers barriers to entry nor erodes the monopoly power of publishers. The dummy variable reflecting the availability of electronic versions of titles (ELECTRNIC) was statistically significant and positive in both specifications. Therefore, librarians can likely expect to see prices continue to increase and monopoly power extended as publishers introduce electronic versions of their products.

Many variations of the model were submitted to OLS regression analysis to provide some assurance that as few contributing factors as possible would be overlooked. In fact, nearly every issue that could be assessed quantitatively and included was. There are two related factors for which a proxy could not be developed: economies of scope and economies of scale. Presumably, those publishers publishing greater numbers of journal titles could take advantage of sharing editorial and other production activities across journals by assigning employee slack time from one title to another. Economies of scope associated with this sharing should reduce production costs and, thus, price. In fact, some of those publishers, particularly Western European commercial houses with large numbers of publications, actually appear to price higher.[18] Related to this, there should be economies of scale associated with titles produced in large quantities for each issue.

When the number of copies printed for a given issue is large, the fixed costs of production represented by factors such as editorial labor or building facilities are spread across more sales. Therefore, economies of scale come into play and prices might realistically be expected to be lower. Unfortunately, circulation figures (CIRC) capture the number of copies printed but also are linked closely to the price of and demand for given publications. Dealing with this issue in the regression introduced complications.

Similarly, there is a linkage between the price charged to individuals (LOWPRICE) and the price charged to libraries (INSTI). It expresses itself through demand reactions. As the price to individuals increases, subscribers respond by canceling subscriptions, producing a consequent loss of revenue to publishers and an increase in demand for access to library subscriptions. Publishers' attempts to recover lost revenue show up in higher prices charged to libraries, which also is a reaction to higher demand for library access by those individuals who still need the content but have cancelled personal subscriptions. As a further consequence, total circulation decreases. The mathematical complications introduced into the study model by these interactions are discussed further below.

The Circulation Issue

Attempts to include a variable for circulation figures, or in other terms the number of subscriptions sold, introduce problems in the regression analysis. Circulation figures reported to the U.S. Post Office, by law, are recorded within each publication at least once a year. Those reports indicate the total print run along with the number of copies sold, retained in inventory, and given away of the average issue for the given year. Circulation figures also are reported by *Ulrich's Periodicals Directory*. A comparison of these sources indicated that Ulrich's numbers usually were close to the reported counts of subscriptions sold. Therefore, a circulation estimate was compiled using the reported numbers, when available, and Ulrich's numbers when the journal did not report. The estimated circulation was included as a variable in several runs of the model. In most cases, the function converged with one-half of the observations lost due to null values. The variable for circulation (CIRC) carried a negative sign but did not hold up as statistically significant.

The negative sign on the circulation variable corroborates the argument that there is an inverse relationship between circulation and price. That is, price increases produce a response from subscribers, which results in cancellations. However, this relationship may not be modeled meaningfully for several reasons. Previous work has shown that examinations of this relationship across a broad range of titles produce scatter plots rather than systematic functions.[19] In part, this is likely due to the aggregated nature of the circulation figures reported. For any given journal, neither the internal reports nor those given by Ulrich's distinguish quantities sold to individuals from those sold to libraries. Because the prices offered to these two groups of subscribers differ considerably, the resulting price-versus-demand relationship is unclear.

It can be argued that the prices to individuals (LOWPRICE) and to libraries (INSTIT) are determined simultaneously and thus there is a danger of biased regression coefficients. To address this concern, the model displayed in the first column of table 3 was reestimated as a two-equation model. LOWPRICE was modeled as a function of FREQ, ARTPGS, PEER, CCC, ARTILLUS, ADVERT, SUBFEE, AGE, and BOOK. Each of these variables is hypothesized to affect the net cost of producing a journal. The institutional price (INSTIT) is then modeled as a function of the predicted values of LOWPRICE as well as EUROPE, GRTBRT, OTHER, ASSOC, FOUND, GOVERN, UNIV, SCIENCE, SOCSCI, and ELCTRNIC. A three-stage OLS procedure generated the results shown in the second column of table 3.

All of the coefficients retain their signs and are within a standard error of their OLS counterparts. The p-values also are roughly equivalent. The first-stage results are not presented here but continue to confirm the hypotheses concerning costs presented above. LOWPRICE is positively related to FREQ, ARTPGS, PEER, and CCC. ADVERT, SUBFEE, AGE, and BOOK all tend to reduce LOWPRICE. As

was the case in the OLS results, ARTILLUS was positive, but statistically insignificant.

Demand for individual and library subscriptions is more likely determined by the overall size of the market for research in each given discipline. With some obvious exceptions, most journals serve a restricted audience. It is unlikely that any given journal in the humanities would be widely read by scholars working in the sciences. Each journal contains unique information not found in any other journal. Therefore, titles tend not to be in direct competition with each other. Also, when a scholarly discipline is studied by a relatively small contingent of scholars, the number of subscriptions is likely to be smaller in total. Overall, these factors suggest that the demand-versus-price relationship has to be examined on a title-by-title basis or through an alternative model of some kind.

The alternative model also must overcome an endogenous relationship of circulation in the model specified for this study. Placing a variable for circulation in the model introduces a classic demand and supply in the same equation problem.[20] In effect, when an estimate for circulation is included, the simpler model attempts to solve simultaneous equations. This is further complicated by the difference in demand by individuals and institutions. Therefore, there really are four simultaneous equations: demand and supply for individual subscriptions, and demand and supply for institutional subscriptions. Solving four simultaneous equations implies a need for data on both subscription prices and both estimates of circulation. Because estimates of individual-versus-institutional subscriptions could not be obtained, it was impossible to specify a reliable function to explain the relationship statistically.

The complications introduced by the variables requiring a specification to solve four simultaneous equations take this analysis beyond the scope of this project. However, this complication leaves the proposed hypothesis test largely unaf-

fected. The specified model accommodates every variable previously established as exogenous and relevant except for a proxy of economies of scope and a metric of quality. In the first case, economies of scope should yield lower prices from those publishers producing a very large number of titles. Yet, the model demonstrates a correlation between high prices and publishers of numerous titles. In the second case, a metric of quality cannot be established for a cross-discipline data set. For example, it is meaningless to compare the academic quality of a music journal to one in physics or in business.

Furthermore, certain patterns showed up in the data. These may lead to additional fruitful analysis, which could extend the analysis reported here. Some titles in the data set are so high priced that they effectively have no market except to institutions. Where it was impossible to obtain the price charged to individuals, it was speculated that this was because the publisher was not selling to individuals. As this was examined, a pattern suggested itself. These titles appeared to be very high priced, had low circulation, and often were described by users as second tier in quality.

Other Statistical Considerations
The analyses reported here are based on statistical procedures applied using the SAS Institute's JMP™ software, which was developed to run on a PC. This particular version was chosen because, among other advantages, it automatically applies several standard statistical tests to confront the possibility of misleading results produced by problems typical of OLS regression analyses, such as hetereoskedasticy and collinearity. Moreover, the software plots the effects of each variable in a way that makes spotting statistical problems easy. As the various attempts were run, which ultimately produced the results reported, a few variables introduced problems. Only one collinearity issue emerged, as explained above, and the few variables that introduced ex-

ceptional leverage were excluded from the analysis. Fortunately, the only potentially useful added variable, which was based on ISI quality measures, where the problems could not be corrected was eliminated for other reasons noted above.

However, the specified model does not explain why prices change from year to year, especially at an inflation rate exceeding the CPI. This project attempted to deal with this question by creating another specification to explain the price change from 1995 to 1997 based on the change in the variables over that same time frame. Delta values were calculated by subtracting the 1995 values from the 1997 values for all of the variables listed in table 1 where they were meaningfully possible. Most of the dummy variables did not change because they were based on location or other essentially unchangeable issues. The dummy for electronic availability was subject to change, so it was retained along with the delta values.

Table 5 displays the results of an OLS analysis of the change in institution price (Δ INSTIT) on the independent delta values. When this model was run using only the delta values, it converged with a statistically significant lack of fit. Because the lack of fit indicates that statistically significant variables were missing from that model, the regression was run on the same function as described in table 3 but substituted delta values for those variables that changed over time. Two reports on this effort are included in table 5.

As might be expected, the variables that predict the price to institutions in the basic model also tend to predict changes in price over time. In fact, the signs on the variables are the same and the statistical significance of all but the one dummy variable for foundation publications (FOUND) remains. However, this regression continues to lack some variables that could affect price. As noted before, there is no reliable metric of quality across the data set and trying to provide one is encumbered by inconsistent definitions of quality among a broad set of disciplines. In addition, it is impossible to control for

TABLE 5
OLS Analysis of the Change in
Institutional Price from 1995 to 1997 (ΔINSTIT)

Dependent variable: ΔINSTIT
Independent Variables:

Term	Estimate	t Ratio	Prob>|t|	Estimate	t Ratio	Prob>|t|
Intercept	-3.5292	-0.34	0.7310	-2.198156	-0.22	0.8246
ΔLOWPRICE	0.0761	3.33	0.0009*	-	-	-
EUROPE	44.5040	3.87	0.0001*	54.7353	4.99	<0.0001*
GRTBRIT	28.7676	4.84	<0.0001*	32.7037	5.10	<0.0001*
OTHER	13.4242	1.25	0.2131	14.4774	1.17	0.2423
ASSOC	-28.4983	-4.82	<0.0001*	-35.0194	-5.36	<0.0001*
FOUND	-18.4451	-1.63	0.1030	-23.5840	-1.82	0.0694
GOVERN	-15.9448	-0.50	0.6157	-22.4261	-0.60	0.5462
UNIV	-17.7830	-3.24	0.0013*	-22.4015	-3.60	0.0003*
FREQ	6.9292	15.38	<0.0001*	7.8379	16.76	<0.0001*
97ARTPGS	0.0361	4.66	<0.0001*	0.0245	2.94	0.0033*
PEER	16.0182	3.65	0.0003*	19.7601	4.06	<0.0001*
CCC	2.2858	0.49	0.6234	-	-	-
ARTILLUST	4.2592	0.64	0.5212	-	-	-
ΔADVERT	-0.4191	-3.75	0.0002*	-0.3635	-2.80	0.0053*
ΔSUBFEE	-11.2972	-0.74	0.4616	-31.6983	-1.96	0.0498**
97AGE	-0.2830	-3.75	0.0002*	-0.3050	-3.57	0.0004*
BOOK	-11.6550	-2.47	0.0139**	-13.6738	-2.59	0.0097*
SCIENCE	21.0204	2.79	0.0054*	33.6816	4.17	<0.0001*
SOCSCI	-0.1130	-0.02	0.9849	0.2735	0.04	0.9672
ΔELCTRNIC	18.04703	3.9	0.0001*	27.5325	5.33	<0.0001*

* Significant at the 0.01 level
** Significant at the 0.05 level
*** Significant at the 0.10 level

Summary of Fit

RSquare	0.4851		0.5027
RSquare Adj	0.4701		0.4914
Root Mean Square Error	53.8845		63.2643
Mean of Response	33.8169		41.0601
Observations (or Sum Wgts)	710		765

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	DF	Sum of Squares	Mean Square
Model	20	1884567	94228.4	17	3021962	177762
Error	689	2000535	2903.5	747	2989770	4002
C total	709	3885102		764	6011731	

FRatio 32.453		Prob>F	<.0001	44.4143	Prob>F	<0.0001

economies of scale in this model, but if a variable were available, it would likely carry a negative sign. Therefore, in addition to these and the variables included in the model, it could be assumed that at least one other significant variable is missing. At this point, because quality and scale would not change dramatically in three years, it was further assumed that the missing variable would control for vagaries in publisher pricing.

Isolating Specific Publisher Pricing

The model specified and described above provided results that are not surprising to librarians. While holding constant for as many factors as possible that have been claimed to drive price increases by publishers, the model indicates that some publishers overprice their journals compared to other titles. In fact, the statistical tool used in the analysis contains the means to look at every individual title compared to the whole data set to see which titles the model predicts will be the most overpriced. Table 6 isolates those titles priced at amounts statistically significantly higher than the model predicts for them. This table holds the key to a very powerful tool that librarians can use in selecting journals to add to or deselect from their collections.

Table 6 isolated the twenty titles for which the prices charged by the publishers are statistically significantly higher than the model predicts for them within the data set. The software used for the analysis provides the means to save residuals on every observation. Some of those residuals are statistically significant. Based on the model reported in tables 3 and 4, the investigation isolated the most overpriced journals using the residuals and sorted for those that were statistically significant. Therefore, this isolated subset of the data set exposes the titles that are the best candidates for cancellation based on predicted subscription price for the most recent complete year.

To use the model as a selection tool, Trinity would have to expand the data set to cover all subscriptions and enter the relevant data for every title. Although this undertaking may sound somewhat daunting, it does not add substantially to the record keeping already routine for most libraries. With the caveat that the information has to be entered into an automated record-keeping system, the standard bibliographic and check-in records already retained include nearly all the quantitative variables important to the specified model. Most of the dummy variables can be recorded once and then used indefinitely. The most difficult variable to obtain, and one that must wait for the completion of the subscription year to obtain accurately, is number of article pages.

Although determining the number of pages committed to advertising and articles was essential to the experiment conducted here, it is not necessary for a slightly different model with equal predictive power. During the analyses, a dummy variable was submitted for whether each journal takes paid advertisements and a quantitative variable for total pages to be used in lieu of number of article pages. Without changing anything else, the regressions using these alternatives yielded results closely approximating those reported in tables 3 and 4, based on the original specification.

In fact, saving residuals on results isolated all twenty of the titles listed in table 6. Two additional titles identified by the simpler model emerged as a result of slightly different residuals. For a library to use this tool, some simple additions need to be made to augment standard library record keeping for subscriptions. Those records need only be submitted to the model specified to isolate candidates for cancellation based on the extent of the difference between the price charged and the price predicted by the model.

Table 6 makes it clear that aggressive price escalation may not be limited to commercial publishers. Emerging in this table are five societal publishers that priced specific journals significantly in excess of the model predictions. Indeed, pressure from membership likely encourages societal

TABLE 6
Comparison of Actual Institutional Price to Model-predicted Price, Ranked by Percent Difference

Title	Publisher	Institutional Price in 1997	Model-Predicted Price for 1997	Excess of Actual Price over Predicted Price	Actual Price As a Percent of Predicted Price
Journal of Econometrics	Elsevier Science	$1,798	$609	$1,189	295%
Review of Scientific Instruments	American Institute of Physics	$1,030	$429	$601	240%
Journal of Cell Science	Company of Biologists, Ltd	$1,195	$537	$658	223%
Geomorphology	Elsevier Science	$1,185	$562	$623	211%
Veterinary Immunology and Immunopathology	Elsevier Science	$1,463	$713	$750	205%
Developmental and Comparative Immunology	Elsevier Science	$876	$444	$432	198%
Organometallics	American Chemical Society	$1,340	$694	$646	193%
Personality and Individual Differences	Elsevier Science	$1,029	$576	$453	179%
Vision Research	Elsevier Science	$1,895	$1,066	$829	178%
Computers and Chemical Engineering	Elsevier Science	$1,403	$809	$594	173%
Earth Science reviews	Elsevier Science	$648	$379	$269	171%
Communications in Algebra	Marcel Dekker Journals	$1,975	$1,253	$722	158%
Geophysical Journal International	Blackwell	$1,043	$677	$366	154%
Cognition	Elsevier Science	$983	$654	$329	150%
Journal of Molecular Spectroscopy	Academic Press	$1,603	$1,124	$479	143%
Inorganic Chemistry	American Chemical Society	$1,395	$1,020	$375	137%
Journal of Mathematical Analysis and Application	Academic Press	$2,725	$2,094	$631	130%
Journal of Algebra	Academic Press	$2,475	$2,017	$458	123%
International Journal of Energy Research	Wiley and Sons	$1,795	$1,496	$299	120%
Journal of Physical Chemistry A*	American Chemical Society	$1,955	$1,673	$282	117%

*Indicated titles originated by a society or association that may still be involved with the publication

leadership to offset the extraction of revenue from members' dues by making a profit on scholarly publications.

Conclusion

This experiment yielded some very worthwhile results. First, the analysis provided statistically sound evidence that librarians and scholars should place little hope in the expectation that the electronic era will readily introduce the kind of change needed to diminish publisher monopoly power. European-based commercial publishers with a broad stable of titles are better positioned to introduce electronic counterparts to their print publications than scholars are to introduce new and competitive online titles. The former are aided by a well-funded infrastructure and an established editorial process; the latter must effectively start from scratch. Although not impossible, the commercial publishers have an edge.[21]

Second, it appears that publishers who blame exchange rate risk and production costs for the prices of their products may be using empty rhetoric. Although the study did not *prove* that a weakening dollar could not be blamed for price increases, it did show, within the short time frame covered, that risk is not a reliable predictor of price. In short, some price increases occurred despite the condition of the dollar.

Third, the experiment offered a powerful statistical tool for librarians to use to isolate the most egregious pricing as a selection criterion. Nearly all libraries base their selection of titles to acquire on a combination of three pieces of information: price, quality, and potential level of use. Experience, intuition, and guesswork play major roles in deciding both estimates. The model described here offers an opportunity to reduce the guesswork implicit in the price analysis.

Notes

1. This article was excerpted from the author's report, *Beating Publisher Price Discrimination* (San Antonio, Tex., 2000). For a complete report on the project, address queries to the author.

2. See: Association of Research Libraries. *Directory of Electronic Journals, Newsletters, and Academic Discussion Lists* (Washington, D.C.: ARL, 1997). For excellent overviews on the development of e-journals, see: Judy Luther, "Full-text Journal Subscriptions: An Evolutionary Process," *Against the Grain* 9/3 (June 1997): 18, 20, 22, 24; Liza Chan, "Electronic Journals and Academic Libraries," *Library Hi Tech* 17/1 (Jan. 1999): 10–16.

3. For a thorough overview of the economic framework, see: Richard W. Meyer, "Monopoly Power and Electronic Journals," *Library Quarterly* 67/4 (Oct. 1997): 325–49.

4. See, especially: H. Craig Peterson, "Variations in Journal Prices: A Statistical Analysis," *Serials Librarian* 17/1&2 (1989): 1–9; ———, "The Economics of Economics Journals: A Statistical Analysis of Pricing Practices by Publishers," *College and Research Libraries* 53 (Mar. 1992): 176–81; George A. Chressanthis and June D. Chressanthis, "The Determinants of Library Subscription Prices of the Top-ranked Economics Journals: An Econometric Analysis," *Journal of Economic Education* 25/4 (fall 1994): 367–82.

5. Roger Noll and W. Edward Steinmueller, "An Economic Analysis of Scientific Journal Prices: Preliminary Results," *Serials Review* 18 (spring/summer 1992): 32–37.

6. George A. Chressanthis and June D. Chressanthis, "Publisher Monopoly Power and Third-degree Price Discrimination of Scholarly Journals," *Technical Services Quarterly* 11/2 (1993): 13–36.

7. Edward Chamberlin, *The Theory of Monopolistic Competition* (Cambridge, Mass.: Harvard Univ. Pr., 1935).

8. George A. Chressanthis and June D. Chressanthis, "A General Econometric Model of the Determinants of Library Subscription Prices of Scholarly Journals: The Role of Exchange Rate Risk and Other Factors," *Library Quarterly* 64/3 (1994): 270–93.

9. This theory is based on the classic work: Abba Lerner, "The Concept of Monopoly and the Measurement of Monopoly Power," *Review of Economic Studies* (June 1934): 157–75.

10. Two variations in the dependent variable were attempted, including the index of monopoly power based on the work of Lerner. This second version of the Lerner index provided no additional predictive power to the model.

11. Chressanthis and Chressanthis, "Publisher Monopoly Power and Third-degree Price Discrimination of Scholarly Journals."

12. Ulrich's Periodicals Directory (New York: R. R. Bowker, 1996–1998).

13. For a very good summary of trends that relate to this issue as well as general pricing, see: Carol Tenopir and Donald W. King, "Trends in Scientific Scholarly Publishing in the United States," *Journal of Scholarly Publishing* 28/3 (Apr. 1997): 135–70.

14. Assumptions regarding these two issues were based on an earlier study of scholar demands for journal content in: Charles River Associates, *Development of a Model of the Demand for Scientific and Technical Information Services* (Boston: Charles River Associates, 1979).

15. Association of American University Presses, annual meeting, Austin, Tex., June 20–12, 1999.

16. See, for example: Michael Barr, " Where Does the Money Go?" *Newsletter on Serials Pricing Issues* 229 (July 13, 1999): 229.1.

17. For an explanation of price discrimination based on publisher effort to recover revenues lost to photocopying, see: S. J. Liebowitz, "Copying and Indirect Appropriability: Photocopying of Journals," *Journal of Political Economy* 93/5 (1985): 945–57.

18. Mark J. McCabe, "Academic Journal Pricing and Market Power: A Portfolio Approach." Revised Nov., 2000. Presented at the 2000 AEA meetings in Boston (under review at the AER). Available online at http://www.prism.gatech.edu/%7Emm284/JournPub.PDF.

19. Tenopir and Donald W. King, "Trends in Scientific Scholarly Publishing in the United States," *Journal of Scholarly Publishing* 28/3 (Apr. 1997): 135–70.

20. Bruce Kingma, personal correspondence with the author.

21. Programs such as the SPARC initiative and discipline servers such as that at Los Alamos probably offer more viable opportunities for new approaches to compete with the commercial establishment.