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SUMMARY:

The cost-effectiveness of STM journals has been compared in several subject areas, beginning with Henry Barschall's work with the physics literature in the late 1980s. A new cost-effectiveness metric is proposed and calculated for journals in several chemistry sub-disciplines.

Publisher and year-of-publication data for seminal journal articles assigned in a graduate level organic synthesis class are presented.

The effect of publisher policies, in establishing and enforcing differential subscription prices for European and non-European customers, on the rise of journal subscription costs, and possible exchange rate profiteering, is discussed.

KEYWORDS: Cost-Effectiveness, Chemistry, Journals, Foreign Exchange Rates, Organic Synthesis

COST-EFFECTIVENESS OF SOME CHEMISTRY JOURNALS

Henry Barschall's pioneering study on the cost-effectiveness of physics journals (1), prompted studies in a variety of other subject areas, especially in chemistry (2). Analysis of the cost-effectiveness of journals in very narrowly defined subject areas, that is also independent of use, has received very little attention. Developing a use-independent approach contradicts the assertion that "all researchers have agreed that a print journal's value cannot be assessed with content evaluation

alone"(2e). On the assumption that once a user group has identified their core journals, it should be reasonable to develop a use-independent metric for evaluating the cost-effectiveness of these titles.

The Californai Institute of Technology, in 1995, undertook a significant review of its journal holdings. Professorial faculty identified the journals which were essential to their research, and a funding mechanism was established to insure their continued availability. Each year, a review of the use of these titles is conducted, that results in some cancellations. Newly published titles are added, again with the understanding that they are essential for a specific faculty member's research. Established titles may also be added if the total ILL cost is sufficient to warrant subscription.

Beginning in 2000, with the transition from equivalent exchange rate subscription pricing for commercially published STM journals, it became obvious that annual 5-10% subscription price increases was not sustainable. Since a 10% annual price increase equates to a doubling time of about 7 years, it was obvious that a new review of commercially published journals was in order.

Establishing a cost-effectiveness metric, that can be used to compare journals publishing equivalent content, then should be of significant benefit to both librarians and library users. This is particularly true since the advent of large journal packages (e.g. Science Direct) and the recent recognition that there is a "true (STM publishing) market failure" (3). User demand for electronic access is rarely based on either price or quality considerations. Thus, a use-independent metric should be a very effective tool for assessing and prioritizing user demands.

As an aside, it should be obvious that each established journal enjoys a monopolistic position vis a vis its subscribers & readers but that the reverse is true with respect to its authors & editorial boards. This dichotomy is exemplified by libraries (subscribers) continuing to purchase obviously overpriced titles (4), at the insistence of its users (readers), on one hand, and the dramatic

resignations of editorial boards from established journals (5a), with the intent of re-establishing a cost-effective product, on the other.

The current extraordinarily high cost of many commercially published STM journals (5b) is based on a wide variety of factors but is not justifiable when compared with society STM journals. Publishers do not fund research, do not provide monetary advances to authors, and are not responsible for editorial selection of journal articles. Rapidly increasing automation of both article submissions and the mechanics of referring (6), suggests that a publisher's role will soon be (or should be) simplified to the that of providing minimal copy editing, maintaining an electronic infrastructure and hiring account managers to process subscriptions and advertisements. Disparities in both subscription prices and cost-effectiveness of journals, publishing equivalent information, should then be eliminated. Continuing disparities in price and cost-effectiveness must then be carefully examined and brought to the attention of librarians, readers, authors and editors.

In an attempt to formulate a new and more understandable metric for determining cost-effectiveness, the normalized cost per article per normalized ISI Impact Factor has been calculated for chemistry journals, publishing equivalent material, in 2001. The importance of comparing equivalent journals, when discussing costs and quality with faculty members or administrative staff, can not be underestimated. Previous studies on journal costs and effectiveness have focused on fairly general subject areas and did not highlight the differences between journals, of interest to individual research groups, that publish equivalent information.

This new 'Cost-Effectiveness' metric that is similar to Barschall's (1), Christensen's (2c) and Rouse's (2d) but differs in that both the cost/page and ISI Impact Factors are normalized to a baseline journal. Additional comparisons can easily be made simply by renormalizing to a different baseline.

It is interesting to note that, in the following table, there is generally a strong inverse relationship between subscription cost per page and ISI Impact Factor.

JOURNAL	C/P	NC/P	IP	NIP	NCP/NIP
Inorganic Chemistry	\$0.27	1.0	2.95	1.00	1.00
J. Chem. Soc. Dalton	\$0.64	2.37	2.82	0.96	2.47
Eur. J. Inorg. Chem.	\$0.65	2.41	2.48	0.84	2.87
Polyhedron	\$1.60	5.93	1.20	0.41	14.46
Inorganica Chim. Acta	\$1.96	7.26	1.39	0.47	15.45
J. Chemical Physics	\$0.20	1.0	3.15	1.00	1.00
Phys. Chem. Chem. Phys.	\$0.40	2.02	1.79	0.57	3.54
Chemical Physics	\$1.41	7.08	1.96	0.62	11.41
J. Chem. Soc. Perkin II	\$0.88	1.0	1.84	1.00	1.00
J. Physical Org. Chem.	\$1.75	2.64	1.30	0.71	3.72

TABLE 1. 2001 Cost per Page, Impact Factor and Cost-Effectiveness data for chemistry journals.

C/P = Cost/Page NC/P = Normalized C/P IP = 2001 ISI Impact Factor NIP = Normalized IP

NCP/NIP = Normalized Cost/Page/ Normalized Impact Factor = Cost-Effectiveness

Assuming that a normalized Cost/Page/normalized Impact Factor (NCP/NIP) is an effective cost-effectiveness metric, one could conclude, for example, that (in 2001) inorganic information in the ACS' *Inorganic Chemistry* was over 15 times as cost-effective as 'inorganic' information packaged in

Inorganica Chimica Acta. Similarly, 'chemical physics' information packaged in the AIP's *Journal of Chemical Physics* was 11 times more cost effective than that in *Chemical Physics* and 'physical organic' information packaged in *J. Chem. Soc. Perkin II* was 4 times more cost effective than that in *Journal of Physical Organic Chemistry*.

Additional comparisons are made by renormalizing the Cost-Effectiveness measure. For example, 'inorganic' information packaged in *J. Chem. Soc. Dalton Trans.* was nearly 6 times as cost-effective as that in *Polyhedron*. Similarly, 'chemical physics' information in *Physical Chemistry Chemical Physics* was 3 times as cost-effective as that in *Chemical Physics*.

The fact that *Inorganic Chemistry* is 15.45 times as cost effective as *Inorganica Chimica Acta* also suggests that the 2001 subscription cost of *Inorganica Chimica Acta* would need to have been priced at \$436 (instead of \$6726) to be as cost-effective as *Inorganic Chemistry*.

These examples are particularly galling, in that at approximately the print package subscription price paid by large academic libraries, *Inorg. Chem.*, *J. Chem. Phys.*, *Phys. Chem. Chem. Phys.* and *JCS Perkin II* all provide multiyear site-wide electronic access, while subscriptions to *Polyhedron* & *Chemical Physics* include only one year rolling window site-wide electronic access and *J. Phys. Org. Chem.* provides one-seat extended year electronic access at a 5% premium.

The dramatic differences, in page costs, impact factors, cost-effectiveness and electronic access, between society journals and those of some commercial publishers, are easily understandable. Societies generally operate as non-profit entities, albeit with a small journal subscription profit going to other society activities, while some large commercial publishers seemingly have no restraint, other than an attempt to balance subscription costs with cancellations, on their profitability (9).

DATA FOR SEMINAL ORGANIC SYNTHESIS ARTICLES

In addition to the development of a new cost-effectiveness metric, it is also interesting to compare the title by title distribution of references, to seminal organic synthesis articles. The comparison, in Table 2, is based on the 225 journal articles assigned in Caltech's (Fall 2002) graduate level Chem 242 - Chemical Synthesis class. It is interesting to note that 74% of the articles were published in Society or Society sponsored journals and only 26% were published in commercial journals.

J. Am. Chem. Soc. - 98	(43.5%)
J. Org. Chem.- 25 / Org. Lett. - 3	(12.5%)
Chem. Rev. - 9 / Accts. Chem. Res. - 3	(5.3%)
Tet. Lett. - 29 / Tetrahedron -7 / Tet. Asymmetry - 1	(12%)
Angew Chem. Int. Ed. - 19	(8.4%)
Org. Rxn. - 8 / Org. Syn. - 2	(4.4%)
Synthesis - 6 SynLett -1	(3.1%)
J. Chem. Soc. - 2 / Chem. Commun. - 4	(2.7%)
Eight miscellaneous titles - 1 each	(3.5%)

TABLE 2. Source journals for assigned readings - Chem 242-Chemical Synthesis (225 articles)

It is also interesting to note the increasing number of published articles from society/society sponsored journals in the five year segments since 1982. Table 3 suggests that the frequency of publication of seminal articles in non-society related journals is sharply decreasing.

	1983-87	1988-92	1993-97	1998-2002
ACIEE/ACIE	4	2	1	11
ACS	19	24	17	15
Tet./Tet. Lett.	11	6	1	4

TABLE 3. - Distribution of publication dates for selected titles (1983-2002)

US\$ SUBSCRIPTION PRICES & FOREIGN CURRENCY EXCHANGE RATES

One largely misunderstood factor in the cost per page disparities (shown above) has been the effect of foreign currency fluctuations, beginning in the early 1970s. Since many commercial publishers of scientific journals are based in Europe, fluctuations in the US\$ cost of continental European currencies, combined with what appears to be exchange rate profiteering, must be clearly understood. Figure 1 gives the year to year average cost of Dutch Guilders (NLG) since 1970 (10).

***** see attached

In 1970, a Dutch Guilder (NLG) could be purchased for \$0.276 and, for example, a 1000 Guilder subscription would have been billed at \$276. Contrast this with the years from 1971 to 1980, when the cost of a Guilder steadily increased to about \$0.503 and, with all other factors being equal, a 1000 NLG subscription would have increased to \$503. This was the first 'serials crisis' and

generally resulted in libraries canceling duplicate subscriptions, reducing book purchases, etc. In contrast, however, from 1981 to 1985, the cost of a Guilder steadily decreased to about \$0.301, which should have resulted in a steadily decreasing subscription rates. This rise and fall of exchange rates is a widely understood phenomena and with some institutional investment flexibility can be accommodated, to some degree.

During the 1981-1985 period, as the purchasing power of the US\$ was dramatically increasing, it obviously would have been a substantial benefit, to US subscribers, ignoring inflation, to have the NLG1000 base rate remain in effect thru 1985, as this would have resulted in a lowering of the US\$ subscription rate to \$301

However, in actual fact, as the US\$ cost of the Guilder dropped in the years 1981 to 1985, Guilder subscription rates were increased to maintain a relatively constant US\$ subscription rate. The net effect was to artificially lock in an additional ~67% to the base subscription rate. This increase is a continuing annual cost, and had a significant multiplier effect when the US\$ cost of the Guilder began increasing again in mid-1985.

By year end 1986, the US\$ cost of the Guilder had a one year increase of ~30% (from \$0.301 to \$0.408), which was only the beginning of a second dramatic rise in the US\$ cost of a Guilder, that by 1995 increased to \$0.624. This second 'serials crisis' was devastating, because of the significant increase in base subscription rates during the 1981-1985 period and because of the confusing difference between the cost of the Guilder and the value of the US\$.

Exchange rate quotations, in the popular press, are generally given in terms of the number of Guilders one can purchase for a US\$, rather than the more useful (for librarians), US\$ cost of a Guilder. The confusion is best exemplified by comparing a change from 3.2 Guilders/US\$ to 1.6

Guilders/US\$. This is generally described as a 50% decrease in the value of the US\$, but in actual fact it is a 100% increase in the US\$ cost of a Guilder (\$0.3125 vs \$0.625).

During 1996, the Guilder again began declining (as one would expect from the cyclic nature of foreign exchange rates), but presumably because of the already excessive Guilder subscription rates, publishers could not substantially raise Guilder rates to maintain a relatively constant US\$ rate.

In 1999, most European commercial publishers adopted a new tactic for the 2000 subscription year. This time, instead of raising the NLG price to maintain the US\$ price, they adopted a new policy that invoices non-European customers in US\$ (except for YEN in Japan), using the 1999 US\$ price as a base and not allowing subscriptions to be entered with European agents at the 'exchange rate NLG' price, as had previously been possible.

This policy was a complete reversal from previous years (11) and US library subscribers, instead of benefiting from continuing Guilder exchange rate declines in 2000 and 2001, were only promised that the US\$ subscription rates would increase by less than 10%. These new US\$ subscription rates appear to be completely disconnected from the NLG/EURO rates (12), and deny US\$ subscribers the savings that would have resulted from previous pricing policies based on exchange rates. While the effect was not as dramatic as prior years, it did result in what one might describe as substantial exchange rate profits. The new 'Millennium' subscription rate policy is exemplified in the following example:

Tetrahedron (including: Tetrahedron Asymmetry):

Year	NLG price	Exch rate / US\$ price	'New' US\$ price	Exch Rate Profit / %
2000	NLG 22899	\$0.50 / \$11449	\$11624	\$175 / 1.5%
2001	NLG 24440	\$0.455 / \$11120	\$12406	\$1286 / 11.56%
2002	NLG 26030	\$0.406 / \$10568	\$13212	\$2644 / 25%

2003 NLG 27983 \$0.407 / \$11389 \$14203 \$2814 / 24.7%

TABLE 3: Exchange rate profits for Tetrahedron, 2000-2003. Please note that although the NLG has been replaced by the EURO, a fixed NLG to EURO exchange rate of 2.20371/1 is still in effect.

In conclusion, the cost-effectiveness analysis corroborates both Bensman's major finding(13), "that little relationship ... exists between scientific value and the prices charged libraries for scientific journals", and Hahn & Faulkner's observation(2e) that "What a publisher charges for a particular journal does not necessarily reveal anything about its relative value." In addition, it should be obvious that the escalating price increases of commercially published journals can not be sustained. Given the general excellence of society and society sponsored journals, these are obviously the titles that must be retained and less cost-effective titles must be identified and subject to review for further action.

1a. H.H. Barschall, "The Cost of Physics Journals," *Physics Today* 39, no.12 (December 1986): 34-36.

1b. H. H. Barschall, "The Cost-Effectiveness of Physics Journals," *Physics Today* 41, no.7 (July 1988): 56-59.

1c. H.H. Barschall, "Cost-Effectiveness of Physics Journals", *Physics Today* 42, no.3 (March 1989): 15-16.

2a. M.M. Case, " Measuring the Cost Effectiveness of Journals: The Wisconsin Experience",
<http://www.arl.org/newsltr/205/wisconsin.html>

2b. G. Soete, "**Measuring the Cost-Effectiveness of Journals**: Ten Years After Barschall",
<http://www.library.wisc.edu/projects/glsdo/cost.html>

This reference includes 'The Article' as well as data tables for physics, economics and neuroscience. Selected Sources (for other studies) are listed at the end of 'The Article'.

2c. J. G. Christensen, "Chemistry Journal Costs at One University," *Serials Review* 18, no.3 (Fall 2000), 19-34.

2d. K. Rouse, " Chemistry Journal Cost Study".
<http://www.library.wisc.edu/libraries/Chemistry/cost.htm>

2e. Hahn, K.L. and Faulkner, L.A., "Evaluative Usage-based Metrics for the Selection of E-journals." *College and Research Libraries* 63, no.3 (May 2002) 215-227.

3a. R. Poynder, "A True Market Failure", *Information Today* 19, no.11 (December 2002), 1,56,58.
<http://www.infotoday.com/it/dec02/poynder.htm>

3b. Cornet, M. and B. Vollard, "Tackling the Journal Crisis", *CPB Working Paper* 121 (March 2000).
<http://www.cpb.nl/eng/pub/werkdoc/121/> CPB Netherlands Bureau for Economic Policy Analysis,
The Hague, The Netherlands

4a. D. Bradley, "Journal Publishers to Police Themselves", *Information Today* 16, no.21 (October 28, 2002)
http://www.the-scientist.com/yr2002/oct/prof2_021028.html

4b. Reed-Elsevier Financial Highlights (for the six months ended June 30, 2001)

<http://www.reedelsevier.com/investors/2001/interim2001.pdf4>

4c. Morais, R., "Double Dutch No longer; Amid a media recession, Crispin Davis is coining money at Reed Elsevier. How did he pull that off? *Forbes.com* (11/11/01)

<http://www.forbes.com/global/2002/1111/044.html>

5a. Buckholtz, A., "Returning Scientific Publishing to Scientists." *Journal of Electronic Publishing* 7, no.1 (August 2001). <http://www.press.umich.edu/jep/07-01/buckholtz.html>

5b. A notable exception is Thieme Medical Publishers, Inc. publishers of SynLett and Synthesis.

Kurz, Kristina, "Pricing of Chemistry Journals -- A Comparison of Journals Published by Not-for Profit Organizations and Commercial Publishers." *Newsletter on Serials Pricing Issues* 249 (June 16, 2000). 249.5

6. "ACS Paragon System; new journal manuscript submission system." *Chemical & Engineering News*. 80, no.49 (December 9, 2002), 9.

7. Because of the wide variety of pricing models, the print subscription cost of each journal was used. This has the disadvantage of penalizing the Royal Society of Chemistry and the American Institute of Physics, since they include electronic access at no additional charge. This is in marked contrast with commercial publishers, who require additional payment for comparable electronic access. Societies are at an additional disadvantage, since they also provide package discounts. Further analysis to compensate for these differences is required.

The calculation of the cost-effectiveness factors is obviously open to debate. However, every effort was made to provide a fair comparison. For example, pages were assumed to be equivalent although the print density of commercial journals is often less than that of society journals.

8. "The Impact Factor." Institute for Scientific Information.

<http://www.isinet.com/isi/hot/essays/journalcitationreports/7.html>

9a. Robert Maxwell (former owner of Pergamon Press, who died in 1991) is reported to have said, "that even if all libraries, save one, cancelled their subscriptions to his journals, he could still make money by raising the price of that last subscription very, very high."

9b. Garfield, E., "Why Scientific Journals should be Audited." *Essays of an Information Scientist* 14 (1991) 354-355. <http://www.garfield.library.upenn.edu/essays.html>

10a. *International Financial Statistics Yearbook*, 1995. Washington, D.C., International Monetary Fund, c1995.

10b. Oanda.com (The Currency Site). <http://www.oanda.com/convert/fxhistory> (12/11/02).

11a. Roth, D. "US Dollar vs Dutch Guilder." *Newsletter on Serials Pricing Issues* 200 (January 29, 1998). 200.2. <http://www.lib.unc.edu/prices/1998/PRIC200.HTML#200.2>

11b. Tagler, J. "Reply: Newsletter on Serial Pricing Issues, No. 200." *Newsletter on Serials Pricing Issues* 204 (March 13, 1998). 204.1

<http://www-mathdoc.ujf-grenoble.fr/NSPI/Numeros/1998-204.html>

12. Haank, D. "New Elsevier Science Journal Pricing Policy to accompany Transition from Print to Digital Delivery." *Newsletter on Serial Pricing Issues*, no. 227 (June 14, 1999). 227.2.

<http://www.lib.unc.edu/prices/1999/PRIC227.HTML>

13. Bensman, S.J., "The Structure of the Library Market for Scientific Journals: The Case of Chemistry." *Library Resources & Technical Services* 40, no.2 (April 1998) 145-170.

Additional Resources:

P. Brueggeman, "Impact of Scientific Journal Costs",

<http://scilib.ucsd.edu/sio/guide/prices/>

SPARC, "Declaring Independence", Appendix B

<http://www.arl.org/sparc/DI/appendixB.html>

D.L. Roth, " Pricing of Chemistry Journals", *Newsletter on Serials Pricing Issues*, no. 253, 9/22/2000.

<http://www-mathdoc.ujf-grenoble.fr/NSPI/Numeros/2000-253.html>