

# What Is in a Word or Two?

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## Abstract

To measure the impact of Bayesian reasoning, this paper investigates the occurrence of two words, “Bayes” and “Bayesian,” over 1970-2003 in journal articles in a variety of disciplines, with a focus on economics and statistics. The growth in statistics is documented, but the growth in economics is largely confined to economic theory/mathematical economics rather than econometrics.

Poirier (1989, 1992) described the penetration of Bayesian articles in econometrics and statistics journals. Data were collected by examination of individual articles and classifying each as “Bayesian” or “non-Bayesian.” Here the time period is expanded to 1970-2003 (when possible), and the number of journals is expanded to include journals in JSTOR (see Appendix) plus some from Elsevier [*Journal of Econometrics (JE)* and *Economics Letters (EL)*], the American Statistical Association [*Journal of Business & Economic Statistics (JBES)*], and Cambridge University Press [*Econometric Theory (ET)*]. Attention focuses (but not exclusively) on economics and statistics. The data collection exercise is “objectified” by using search engines to compute the annual proportion of journal “articles” containing in their text either the words “Bayes” or “Bayesian.” While not all such articles are “Bayesian,” their numbers provide an upper bound on the number of Bayesian articles, and they capture the impact of Bayesian thinking on authors.

Two qualifiers should be kept in mind. First, what constitutes an “article” differs across journals. Some journals [e.g., *Journal of the American Statistical Association (JASA)*] count comments and replies separately, whereas other journals [e.g., *Journal of the Royal Statistical Society, Series B (JRSSB)*] count them as part of the original text. Second, errata and corrigenda are not counted.

Table 1 contains the year of the publication of the first, fifth, tenth, and hundredth article using either word broken down by six disciplines for which there are a substantial number of such articles. The first reference is Bayes’ original article which appeared in a JSTOR general science journal. A philosophy article by F. Y. Edgeworth in *Mind* in 1884 predated the first JSTOR statistics journal by Karl Pearson in *Biometrika* in 1907. Political Science and Sociology were late to catch on with a 1950 article by M. A. Girshick and Daniel Lerner in *The Public Opinion Quarterly* (listed under both disciplines by JSTOR). Economics is somewhat in the middle with Warren Persons’ *Review of Economics and Statistics (REStat)* article in 1925. In all disciplines there was a substantial lag until the fifth article appeared.

Figure 1 contains graphs of the proportion of JSTOR articles containing these words across these six disciplines over the period 1970-98. Wide JSTOR coverage post-1998 is uneven,

so Figure 1 covers only this period. In statistics the proportion has tripled from .12 to .37, rising sharply post-1995 (probably reflecting the entrenched influence of the MCMC computational revolution). Growth has also occurred in economics and philosophy, but it has been more modest and by the end of the period their proportions (.10 and .06, respectively) are still below where statistics was in 1970. In the other three disciplines there has been little growth with proportions one tenth of the proportion in statistics. Notably at the bottom of the list is general science.

Figures 2 and 3 contain the graphs of proportions for nine of the thirteen statistics journals in JSTOR. Figure 2 contains more theoretically oriented statistics journals [*Annals of Statistics*, *Biometrika*, *JASA*, *JRSSB*, and *Statistical Science (StatSci)*], and Figure 3 contains less theoretically oriented statistics journals (*American Statistician*, *Applied Statistics*, *Journal of the Royal Statistical Society, Series A (JRSSA)*, and *The Statistician*). All nine journals are upward trending in their usage of “Bayes” and “Bayesian.” The higher rank of *StatSci* and *JASA* relative to *JRSSB* reflects the earlier mentioned fact that *JRSSB* does not separate comments from the main text, and the fact articles published with discussion are more likely to contain some Bayesian discourse in order to provoke debate. *The Statistician* has a peak in 1983 when a large issue devoted exclusively to Bayesian statistics was published.

Figure 4 breaks up the *JASA* proportion into proportions for its “Theory and Methods” and “Applications” sections, the latter being about 25% of the former in terms of numbers of articles (other minor sections are excluded). Both proportions are upward trending. Interestingly, the Theory and Methods proportion is higher early in the period, and the Applications proportion is higher more recently. At the end of the period, 58% of the articles in *JASA* contain at least one of the two words.

In economics a somewhat less rosy picture appears - something also apparent in my earlier studies. Figure 5 consists of four prestigious “all purpose” economics journals (*Econometrica (Emetrica)*, *Review of Economics Studies (REStud)*, *International Economic Review (IER)*, and *REStat*) that publish more than just statistical theory/methods articles. In particular *Emetrica* and *REStud*, and to a lesser extent *IER*, publish far more economic theory/mathematical economics than statistical econometrics (i.e., estimation and inference techniques for economic relationships). In Figure 5 all four journals are trending upward with *Emetrica* and *REStud* higher than *IER* and *REStat*. But the higher proportions for *Emetrica* and *REStud* reflect the increased Bayesian content of their economic theory/mathematical economics articles (arguably due to the renewed popularity of game theory in the 1980s) rather than in statistical econometrics. Once this is removed the upward trending in *Emetrica* and *REStud* disappears.

As evidence for this effect, Figure 6 plots the proportion of *Emetrica* articles that I have subjectively judged to be “econometrics” as opposed to “economic theory/mathematical economics” over 1970-2000. It fluctuates between .2 and .6 with a typical value of .4, and exhibits no trending over time. Figure 7 plots the proportion of each type of article containing “Bayes” or “Bayesian.” In the case of economic theory/mathematical economics the proportion is strongly trending up, and less so for econometrics. Noticeably, in the beginning of the period the proportion in econometrics exceeds that of economic theory/mathematical economics, and the exact opposite holds at the end of the period. Taken together, Figures 6 and 7 are evidence that the trend we saw for *Emetrica* in Figure 5 is driven by articles in economic theory/mathematical economics. Indeed, the role of mathematical economics/economic theory

relative to econometrics in Figure 7 is reminiscent of the role of “Applications” relative to “Theory and Methods” for *JASA* in Figure 4.

Figure 8 (*JE*, *Journal of Applied Econometrics*, *JBES*, and *ET*) consists of econometrics journals that publish mostly statistical methods articles. Searchable digital copies of *JBES* (pre-2000) and *ET* (pre-1998) are not available. In Figure 6 all four journals exhibit little trend. While the levels in Figure 8 are higher than in Figure 5, the absence of much trending is similar after removing the economic theory/mathematical economics article from Figure 5. The articles in the journal in both Figures 5 and 8 publish empirical articles except for *ET*.

In summary, Figures 3 and 4 suggest the modest upward trend for economics in Figure 1 is essentially due to the impact of Bayesian reasoning on economic theory/ mathematical economics, not the statistical side of economics. Apparently what is good for Bayesian agents in economic theories does not necessarily carry over to econometric theorists and empiricists - a point made in Poirier (1988).

Figure 9 considers various major economics (non-econometrics) journals which publish both theory and empirical economics, and rarely any econometric methods articles, except occasionally in *Economics Letters (EL)*. Surprisingly, the general readership journal, *Journal of Economic Literature (JEL)*, leads the pack. *JEL* contains mostly journal contents/bibliographies, and it publishes few articles. The peak in 1989 corresponds to five out of eight articles being Bayesian. Trends in Figure 9 are mildly upward, but much less so than the cases previously considered. Other than *JEL*, the levels are similar to the overall economics category of Figure 1.

Finally, as an indicator of what the future holds, Table 2 gives the years in which the earliest reference to MCMC (Markov Chain Monte Carlo) occurred across the six disciplines considered in Table 1 in JSTOR journals over 1970-98, also including *JE*. Since the growth of Bayesianism in statistics is largely the result of the computational revolution of the 1990s, this should indicate how soon the revolution will occur in disciplines other than statistics. The optimistic Bayesian might say that economics is in the early stages. The pessimistic Bayesian might say things have barely started in the other disciplines.

## References

Poirier, D. J., 1988, “Frequentist and Subjectivist Perspectives on the Problems of Model Building in Economics” (with discussion), *Journal of Economic Perspectives*, Vol. 2, 121-144.

Poirier, D. J., 1989, “A Report from the Battlefield,” *Journal of Business & Economic Statistics*, Vol. 7, 137-139.

Poirier, D. J., 1992, “A Return to the Battlefield,” *Journal of Business & Economic Statistics*, Vol. 10, 473-474.

### Appendix: JSTOR Journals

#### Economics

*American Economic Review*, 1911-2000  
*American Economic Association Quarterly*, 1908-1910  
*Publications of the American Economic Association*, 1886-1907  
*Brookings Papers on Economic Activity*, 1970-2000  
*Brookings Papers on Economic Activity, Microeconomics*, 1989-1998  
*Canadian Journal of Economics*, 1968-2000  
*Canadian Journal of Economics and Political Science*, 1935-1967  
*Contributions to Canadian Economics*, 1928-1934  
*Econometrica*, 1933-2000  
*Economic Geography*, 1925-1998  
*Economic History Review*, 1927-1998  
*Economic Journal*, 1891-1998  
*Economica*, 1921-1998  
*Industrial and Labor Relations Review*, 1947-1998  
*International Economic Review*, 1960-1998  
*Journal of Applied Econometrics*, 1986-1998  
*Journal of Economic History*, 1941-1998  
*Journal of Economic Literature*, 1969-2000  
*Journal of Economic Abstracts*, 1963-1968  
*Journal of Economic Perspectives*, 1987-2000  
*Journal of Human Resources*, 1966-2001  
*Journal of Industrial Economics*, 1952-1998  
*Journal of Labor Economics*, 1983-2001  
*Journal of Money, Credit and Banking*, 1969-1998  
*Journal of Political Economy*, 1892-2000  
*Journal of Risk and Insurance*, 1964-2001  
*Journal of Insurance*, 1957-1963  
*Journal of the American Association of University Teachers of Insurance*, 1937-1956  
*Proceedings of the Annual Meeting (American Association of University Teachers of Insurance)*, 1933-1935  
*Oxford Economic Papers*, 1938-1997  
*Quarterly Journal of Economics*, 1886-1998  
*RAND Journal of Economics*, 1984-1998  
*Bell Journal of Economics*, 1975-1983  
*Bell Journal of Economics and Management Science*, 1970-1974  
*Review of Economic Studies*, 1933-2000  
*Review of Economics and Statistics*, 1919-1998

#### General Science

*Philosophical Transactions: Biological Sciences*, 1990-1998  
*Philosophical Transactions of the Royal Society of London, Series B, Biological Sciences*, 1934-1990  
*Philosophical Transactions of the Royal Society of London, Series B, Containing Papers of a Biological Character*, 1896-1934  
*Philosophical Transactions of the Royal Society of London, B*, 1887-1895  
*Philosophical Transactions of the Royal Society of London*, 1776-1886  
*Philosophical Transactions (1683-1775)*, 1683-1775  
*Philosophical Transactions (1665-1678)*, 1665-1678  
*Philosophical Transactions: Mathematical, Physical and Engineering Sciences*, 1996-1998  
*Philosophical Transactions: Physical Sciences and Engineering*, 1990-1995

*Philosophical Transactions of the Royal Society of London, Series A, Mathematical and Physical Sciences*, 1934-1990  
*Philosophical Transactions of the Royal Society of London, Series A, Containing Papers of a Mathematical or Physical Character*, 1896-1934  
*Philosophical Transactions of the Royal Society of London, A*, 1887-1895  
*Philosophical Transactions of the Royal Society of London*, 1776-1886  
*Philosophical Transactions (1683-1775)*, 1683-1775  
*Philosophical Transactions (1665-1678)*, 1665-1678  
*Proceedings: Biological Sciences*, 1990-1998  
*Proceedings of the Royal Society of London, Series B, Biological Sciences*, 1934-1990  
*Proceedings of the Royal Society of London, Series B, Containing Papers of a Biological Character*, 1905-1934  
*Proceedings of the Royal Society of London*, 1854-1905  
*Abstracts of the Papers Communicated to the Royal Society of London*, 1843-1854  
*Abstracts of the Papers Printed in the Philosophical Transactions of the Royal Society of London*, 1800-1843  
*Proceedings: Mathematical, Physical and Engineering Sciences*, 1996-1998  
*Proceedings: Mathematical and Physical Sciences*, 1990-1995  
*Proceedings of the Royal Society of London, Series A, Mathematical and Physical Sciences*, 1934-1990  
*Proceedings of the Royal Society of London, Series A, Containing Papers of a Mathematical and Physical Character*, 1905-1934  
*Proceedings of the Royal Society of London*, 1854-1905  
*Abstracts of the Papers Communicated to the Royal Society of London*, 1843-1854  
*Abstracts of the Papers Printed in the Philosophical Transactions of the Royal Society of London*, 1800-1843  
*Proceedings of the National Academy of Sciences of the United States of America*, 1915-2001  
*Science*, 1880-1998  
*Scientific Monthly*, 1915-1957

### **Philosophy**

*British Journal for the Philosophy of Science*, 1950-1998  
*Bulletin of Symbolic Logic*, 1995-2003  
*Ethics*, 1938-2001  
*International Journal of Ethics*, 1890-1938  
*Journal of Aesthetics and Art Criticism*, 1941-2000  
*Journal of Philosophy*, 1921-1998  
*Journal of Philosophy, Psychology and Scientific Methods*, 1904-1920  
*Journal of Symbolic Logic*, 1936-1999  
*Mind*, 1876-1996  
*Noûs*, 1967-1998  
*Philosophical Perspectives*, 1987-1995  
*Philosophical Quarterly*, 1950-1998  
*Philosophical Review*, 1892-2000  
*Philosophy and Phenomenological Research*, 1940-1998  
*Philosophy and Public Affairs*, 1971-1998  
*Philosophy of Science*, 1934-2001  
*Political Theory*, 1973-2000  
*PSA: Proceedings of the Biennial Meeting of the Philosophy of Science Association*, 1970-1994  
*Sociological Theory*, 1983-2001

### **Political Science**

*American Journal of International Law*, 1907-2003  
*American Journal of Political Science*, 1973-2002  
*Midwest Journal of Political Science*, 1957-1972  
*American Political Science Review*, 1906-2000

*Asian Survey*, 1961-1999  
*Far Eastern Survey*, 1935-1961  
*Memorandum (Institute of Pacific Relations, American Council)*, 1932-1934  
*British Journal of Political Science*, 1971-1998  
*Comparative Politics*, 1968-1998  
*International Affairs (Royal Institute of International Affairs 1944-)*, 1944-1998  
*International Affairs Review Supplement*, 1940-1943  
*International Affairs (Royal Institute of International Affairs 1931-1939)*, 1931-1939  
*Journal of the Royal Institute of International Affairs*, 1926-1930  
*Journal of the British Institute of International Affairs*, 1922-1926  
*International Organization*, 1947-1998  
*International Security*, 1976-1999  
*International Studies Quarterly*, 1967-1998  
*Background*, 1962-1966  
*Background on World Politics*, 1957-1962  
*Journal of Conflict Resolution*, 1957-2000  
*Conflict Resolution*, 1957  
*Journal of Palestine Studies*, 1971-1999  
*Journal of Peace Research*, 1964-2000  
*Journal of Politics*, 1939-2000  
*Journal of Southern African Studies*, 1974-2000  
*Legislative Studies Quarterly*, 1976-1998  
*Mershon International Studies Review*, 1994-1998  
*Middle East Report*, 1988-1998  
*MERIP Middle East Report*, 1986-1988  
*MERIP Reports*, 1971-1985  
*Political Behavior*, 1979-1998  
*Political Research Quarterly*, 1993-2000  
*Western Political Quarterly*, 1948-1992  
*Political Science Quarterly*, 1886-1999  
*Political Theory*, 1973-2000  
*Proceedings of the American Political Science Association*, 1904-1913  
*PS: Political Science and Politics*, 1988-2000  
*PS*, 1968-1987  
*Public Opinion Quarterly*, 1937-1999  
*World Politics*, 1948-1995

### **Sociology**

*Academy of Management Journal*, 1963-1998  
*Journal of the Academy of Management*, 1958-1962  
*Academy of Management Review*, 1976-1998  
*Administrative Science Quarterly*, 1956-2000  
*American Journal of Sociology*, 1895-2000  
*American Sociological Review*, 1936-2001  
*Annual Review of Sociology*, 1975-1998  
*British Journal of Sociology*, 1950-1998  
*Comparative Studies in Society and History*, 1958-1998  
*Contemporary Sociology*, 1972-2001  
*European Sociological Review*, 1985-1998  
*Family Relations*, 1980-1999  
*Family Coordinator*, 1968-1979  
*Family Life Coordinator*, 1959-1967

*Coordinator*, 1952-1959  
*Gender and Society*, 1987-2000  
*Industrial and Labor Relations Review*, 1947-1998  
*Journal of Black Studies*, 1970-2000  
*Journal of Health and Social Behavior*, 1967-2001  
*Journal of Health and Human Behavior*, 1960-1966  
*Journal of Human Resources*, 1966-2001  
*Journal of Marriage and the Family*, 1964-1999  
*Marriage and Family Living*, 1941-1963  
*Living*, 1939-1940  
*Journal of Modern African Studies*, 1963-1998  
*Journal of Palestine Studies*, 1971-1999  
*Middle East Report*, 1988-1998  
*MERIP Middle East Report*, 1986-1988  
*MERIP Reports*, 1971-1985  
*Political Behavior*, 1979-1998  
*Public Opinion Quarterly*, 1937-1999  
*Social Forces*, 1925-2000  
*Journal of Social Forces*, 1922-1925  
*Social Psychology Quarterly*, 1979-2001  
*Social Psychology*, 1978  
*Sociometry*, 1937-1977  
*Sociological Forum*, 1986-1998  
*Sociological Methodology*, 1969-2001  
*Sociological Theory*, 1983-2001  
*Sociology of Education*, 1963-2001  
*Journal of Educational Sociology*, 1927-1963  
*Theory and Society*, 1974-1998

### **Statistics**

*American Statistician*, 1947-1998  
*Annals of Applied Probability*, 1991-1998  
*Annals of Mathematical Statistics*, 1930-1972  
*Annals of Probability*, 1973-1998  
*Annals of Statistics*, 1973-1998  
*Applied Statistics*, 1952-1999  
*Biometrics*, 1947-1998  
*Biometrics Bulletin*, 1945-1946  
*Biometrika*, 1901-1998  
*Journal of the American Statistical Association*, 1922-1998  
*Quarterly Publications of the American Statistical Association*, 1920-1921  
*Publications of the American Statistical Association*, 1888-1919  
*Journal of the Royal Statistical Society, Series A (Statistics in Society)*, 1988-1999  
*Journal of the Royal Statistical Society, Series A (General)*, 1948-1987  
*Journal of the Royal Statistical Society*, 1887-1947  
*Journal of the Statistical Society of London*, 1838-1886  
*Journal of the Royal Statistical Society, Series B (Statistical Methodology)*, 1998-1999  
*Journal of the Royal Statistical Society, Series B (Methodological)*, 1948-1997  
*Supplement to the Journal of the Royal Statistical Society*, 1934-1947  
*Statistical Science*, 1986-1998  
*Statistician*, 1962-1999  
*Incorporated Statistician*, 1950-1961

**Table 1: Earliest References in JSTOR to “Bayes” or “Bayesian”**

<b>Discipline</b>	<b>First</b>	<b>Fifth</b>	<b>Tenth</b>	<b>Hundredth</b>
Economics	1925	1941	1949	1970
General Science	1763	1922	1934	1982
Philosophy	1884	1937	1940	1971
Political Science	1950	1966	1969	1988
Sociology	1950	1963	1967	1986
Statistics	1907	1918	1921	1951

**Note:** Use of “Bayes” must refer to Thomas Bayes.

**Table 2: Earliest References in JSTOR to “MCMC”**

<b>Discipline</b>	<b>First</b>	<b>Fifth</b>	<b>Tenth</b>	<b>Hundredth</b>
Economics	1993	1998		
Including <i>JE</i>	1993	1996	1998	
General Science	1994	1998		
Philosophy				
Political Science	1999	2000		
Sociology	1997	2001		
Statistics	1992	1992	1994	1997

**Note:** Use of “MCMC” must refer to Markov Chain Monte Carlo.



Figure 1: Six JSTOR Disciplines

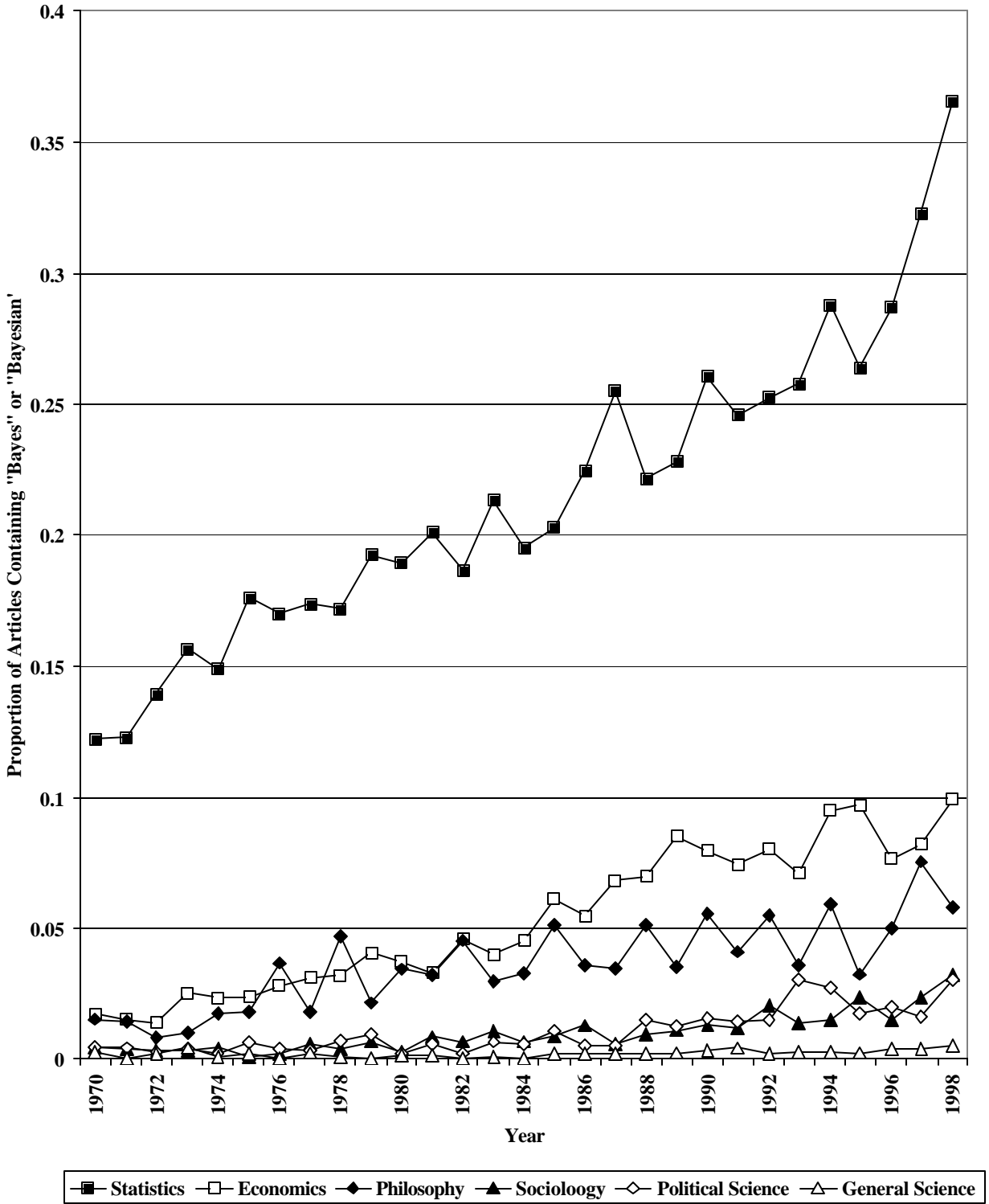


Figure 2: More Theoretical Statistics Journals

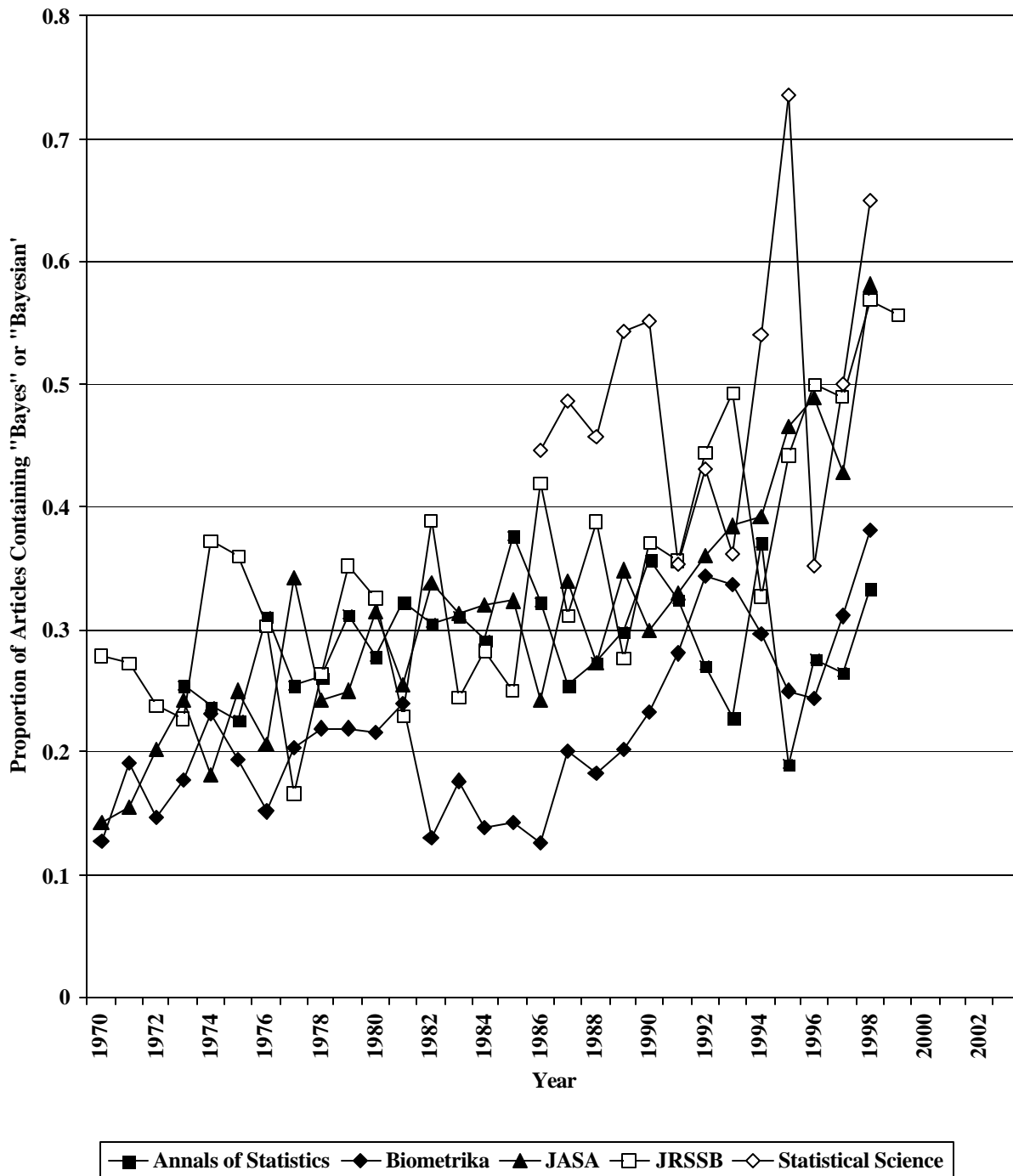


Figure 3: Less Theoretical Statistics Journals

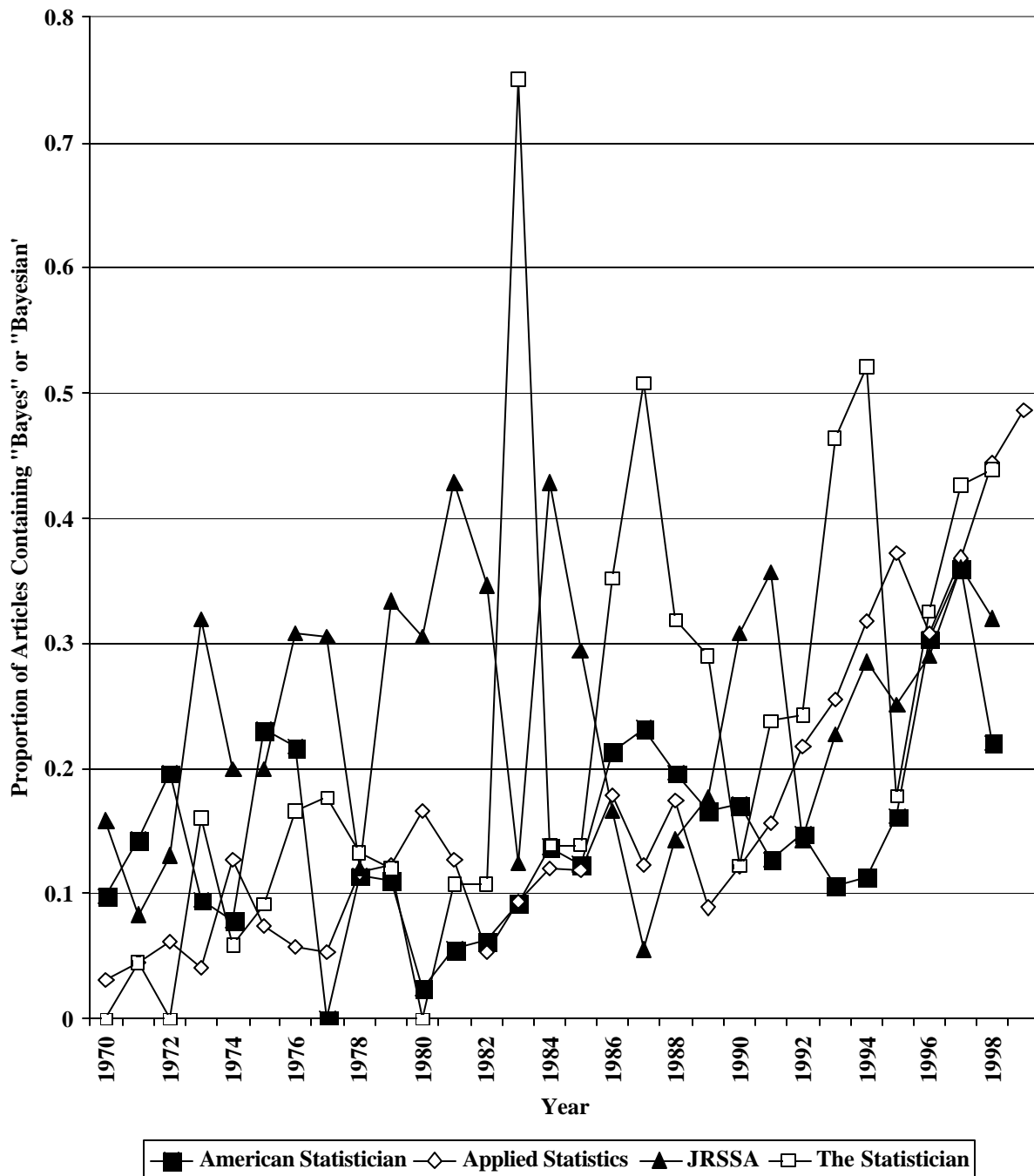


Figure 4: JASA

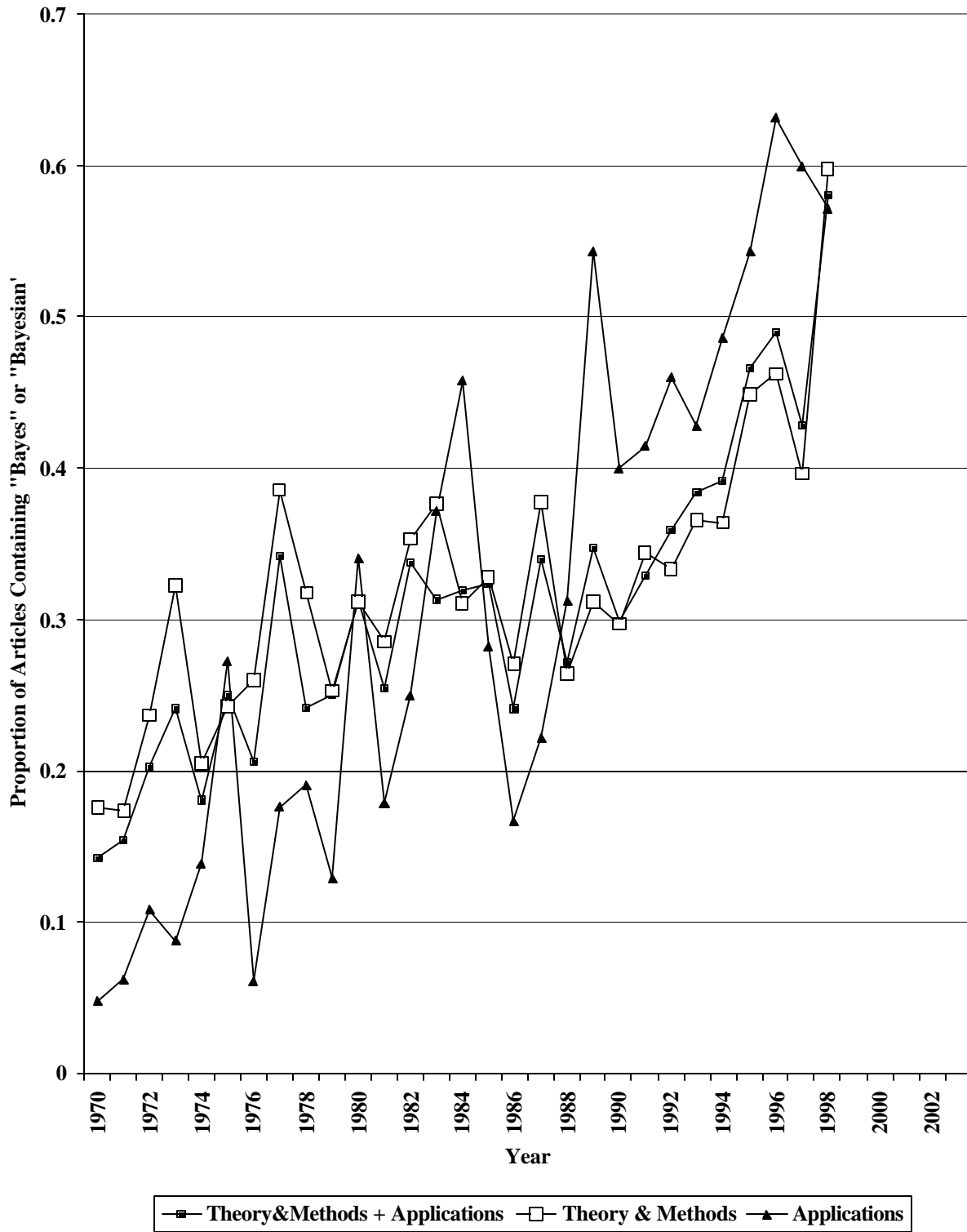


Figure 5: All-Purpose Economics Journals

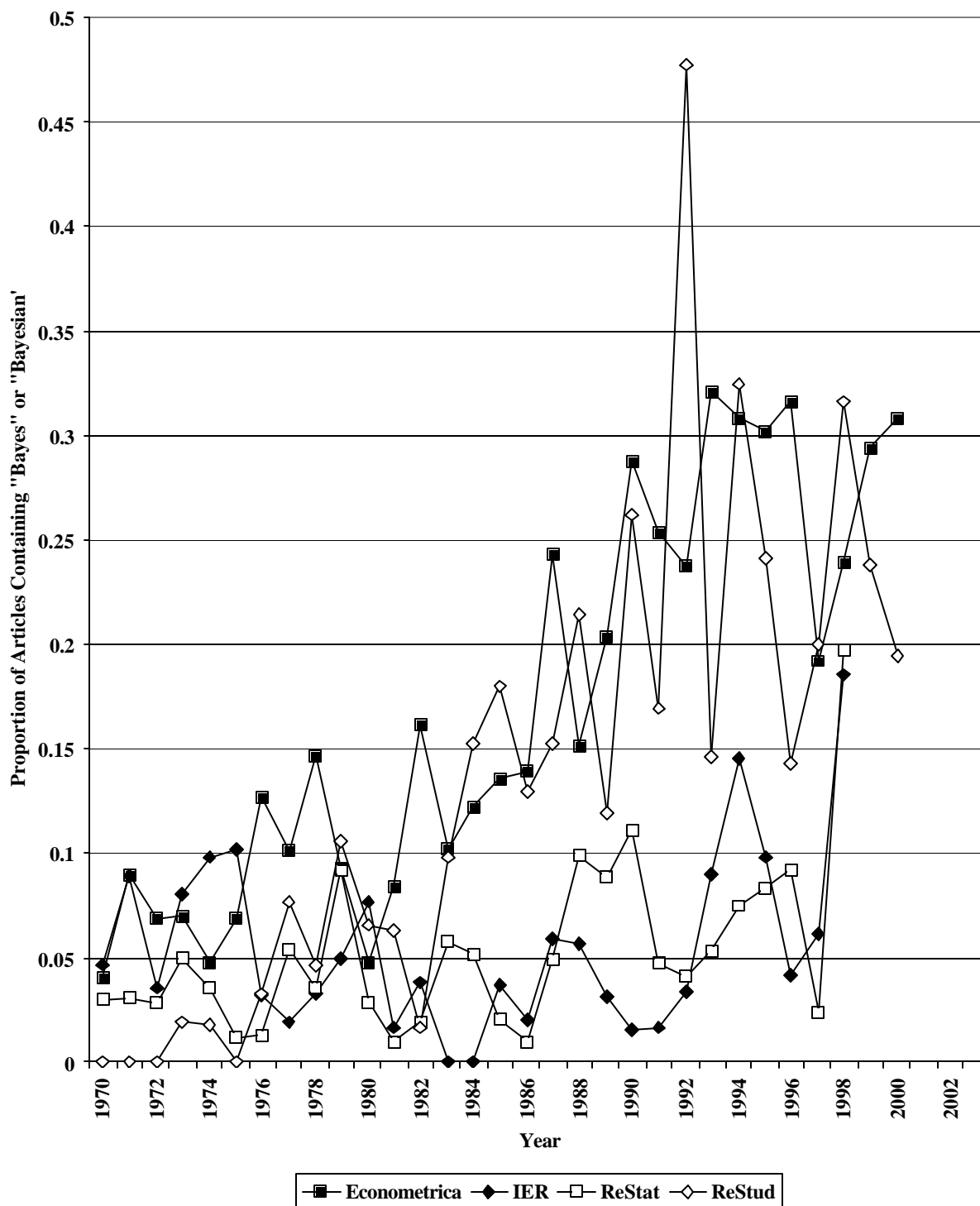


Figure 6: Econometrics Articles in Econometrica

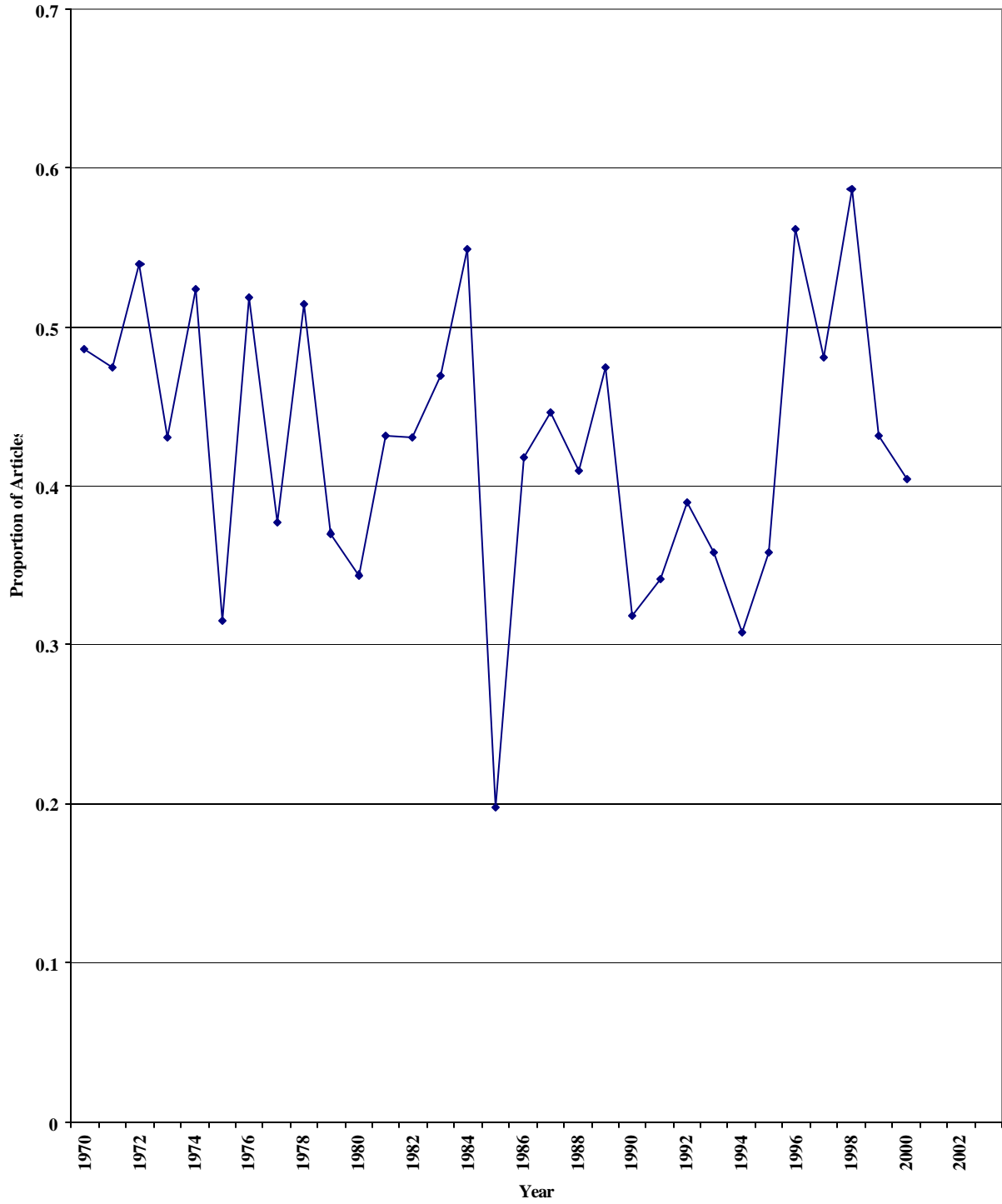


Figure 7: Use of "Bayes" or "Bayesian" in Econometrica

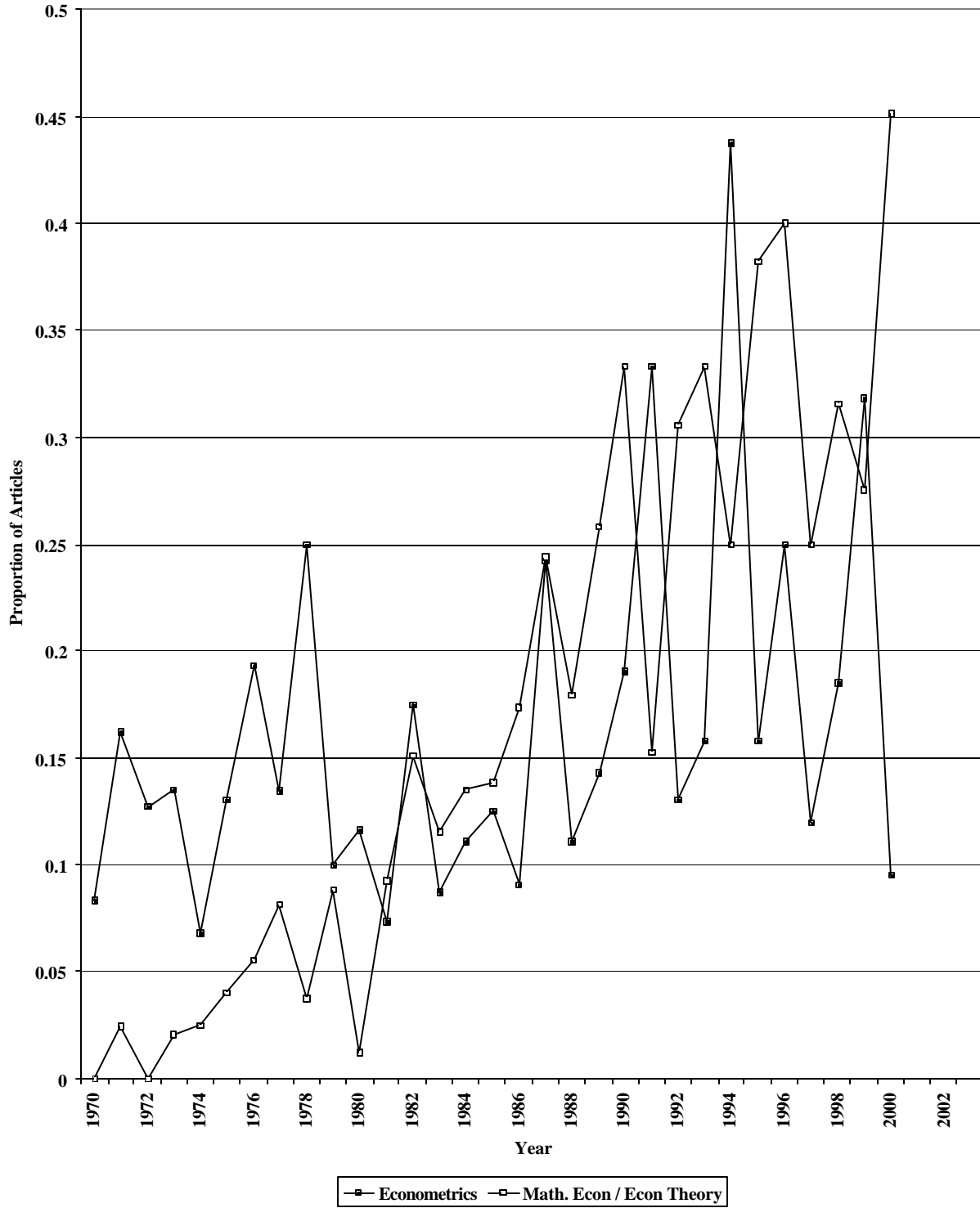


Figure 8: Econometrics Journals

