

The Iron Law of Important Articles*

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I. Introduction

The complaints of economists about the increasing flood of publications are not a new phenomenon. Lovell states that “if there is a ‘knowledge explosion’ in economics, it is at least a century old” [10, 27]. According to Borchardt this complaint can even be traced back to the 15th century [2], which means it is considerably older than our science itself.

In economic literature the attention of scientists has almost exclusively been attracted to the production side of publications. There exists a multitude of studies to assist potential authors, e.g., the prestige of suitable journals [1; 4; 7; 9; 11; 13; 15; 16], the criteria affecting the acceptance rates of articles [3], the publication-lags in economic journals [18], and the optimal order for submitting manuscripts [12]. On the other hand there exist almost no comparable studies to assist the potential consumers of those articles.

This paper attempts to point out some thoughts with respect to this neglected complex of problems which may prove instructive if not helpful for the consumers of scientific literature.

II. Basic Concepts and Methods

The starting point of our analysis is a statement by Knut Borchardt referring to an article by M. Kochen [8]: “. . . there is no doubt that the scientist has to invest a lot of time and effort to choose what he should read at all. This statement is even more valid if it turns out to be true that the number of scientifically significant articles increases to the extent of the square root of the total number of all published articles” [2, 488].

This statement induces the formulation of the following “law of important articles”: The number of important articles in a field of economic theory increases by the square root of the total of all articles published in this field.

To test this law, we have chosen modern growth theory as an appropriate field in modern economics. Starting with the famous article by R. F. Harrod in 1939 [6], growth theory can be regarded as fairly complete because the number of articles is steadily decreasing and considerable changes in the number of citations can hardly be expected. It covers a surveyable but not too short

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period and a sufficient number of publications is available to allow reliable statistical reasoning. Furthermore, modern growth theory is represented in all important linguistic areas and, last but not least, after World War II it has been one of the fields in economics with the highest scientific reputation.

To get a safe data basis for our test, we examined the total output of articles on growth theory in 46 journals¹ considered important among economists. From 1939 to 1986 this led to a total of 2,681 articles.

In order to sort out "important" articles, we operated in two different ways: Firstly, all articles indicated as important and/or worth reading in surveys, economic textbooks or readers on growth theory were listed. Secondly, independent of this procedure, the 2,681 articles were organized with respect to the number of times cited from 1939 to 1986 in journals covered by our sample. If an article received multiple citations in the same work, it was credited only with one citation. According to our definition, articles include also comments, replies and surveys, but not book reviews.

Prior to examining the data, papers cited 30 times or more were defined as being important. A comparison between the results of the two procedures showed that the articles indicated as important in textbooks and surveys, with four exceptions in the field of "growth and trade cycle theory," were a proper subset of the articles which were cited at least 30 times.

The listing of all articles on growth theory according to their frequency of citation within the reviewed period showed that 43.9 percent of the articles were not cited at all, 84.5 percent were cited 5 times or less and 92.2 percent were cited 10 times or less.

As shown in Figure 1,² the above figures became even worse, excluding self-citations.³

The distribution impressively shows that most of the articles on growth theory were of little or no interest to fellow economists. Though this problem is especially significant in economics, it is nevertheless not restricted to this discipline. De Solla Price showed that in physics, 35 percent of all articles of a given year received no references at all [5, 511].

In the examined period, the relative number of important articles compared to the total output is 2.01 percent, and without self-references, only 1.79 percent.⁴ This implies that on an average only each fiftieth article was worth reading in order to stay informed on the scientific developments in growth theory.

This result shows that there are only few really important articles among the total production of literature on growth theory. It does not show, however, how these articles are distributed over time. As our law is related to the development of important articles over time, the next step has to be an investigation of this time pattern.

1. Firstly we have chosen 20 journals which usually are ranked at the top of the quality scale of scientific economic journals. Then to obtain a better regional distribution, we added some European journals which are not sufficiently represented in American rankings. In the appendix you can find a list of all examined journals.

2. The abscissa shows the percentage of the cumulated articles arranged with respect to the number of received citations. The ordinate shows the percentage of cumulated citations covered by these articles.

3. Because the reviewed period ends in 1986, one could argue, especially, that articles published in the eighties have not had enough time to become well known and hence to receive enough citations. To quantify the relation between the age of an article and the number of received citations we computed several regression models. The best result was obtained with the following equation: $\ln(\text{number of citations}) = -1.18467 + 0.77745 \ln(\text{age of citations})$; correlation coefficient $R = 0.32$, $F(1, 1502) = 172.8$. As a next step we corrected the number of citations by means of this formula. As there were no significant differences to the original data with respect to substance and quantities, we will use for further argumentation the more easily interpretable original data.

4. It should be noted that one especially important article by F. P. Ramsey was published outside the analysed period (1928) [14], and therefore was not taken into consideration. Up to 1986 this article was cited 113 times.

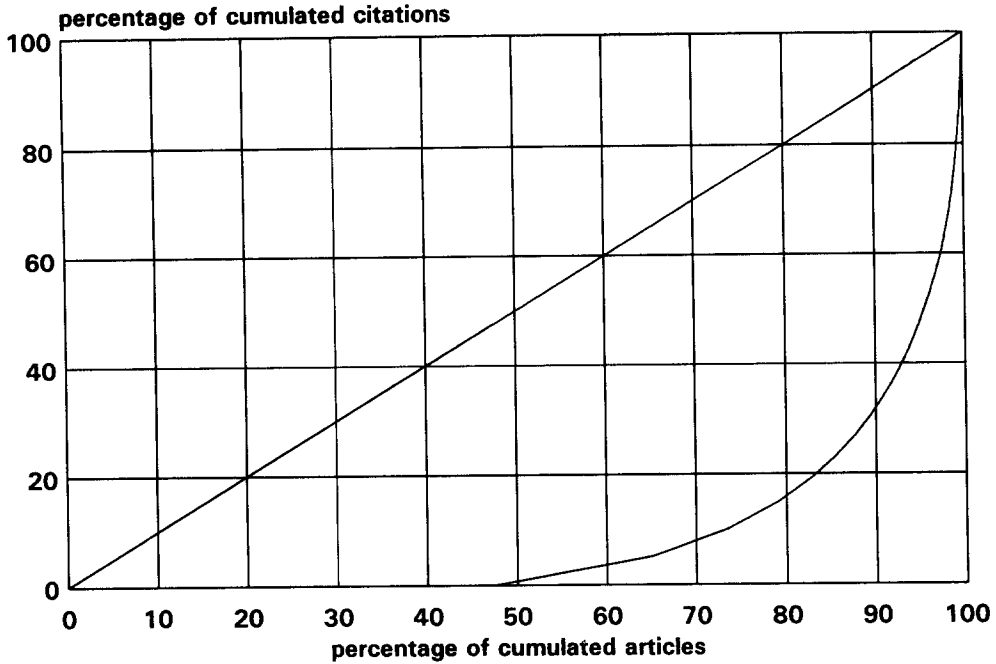


Figure 1. Percentages of Articles Compared to Percentages of Citations, Self-References Excluded

III. Empirical Results

At first we identified all growth theory articles up to 1986 cited at least n times. Equation (1) expresses the relationship between the total number of articles and articles with n citations published in period t or before, where t denotes the year of reference and n the citation-limit:

$${}_nX_t = a {}_0X_t^\alpha \tag{1}$$

Translating equation (1) into logarithms leads to the following linear equation (2) which was calculated for 18 different values of n :

$$\log {}_nX_t = \log a + \alpha \log {}_0X_t \tag{2}$$

Exponent α in equations (1) and (2) denotes the increase of cumulated articles of the respective citation-group in relation to the increase of the cumulated output of articles.

Plotting the value of α on the ordinate and the different citation-limits n (articles with n or more citations) on the abscissa we got the following empirical results (Figure 2).

Figure 2 shows the interdependence between α and n together with the 95 percent confidence interval. It can be seen that the growth rate of articles of each citation-group is less than the growth rate of total output. This already proves to be true for a citation-limit of $n = 1$. Figure 2 also implies that the higher the level of aspiration with respect to articles worth reading (expressed by n), the larger the gap between these articles and the total production of articles.

The essential point for the validity of our law of important articles, however, is that Figure 2 shows an α of 0.56 for important articles, defined as articles having been cited 30 times or more.

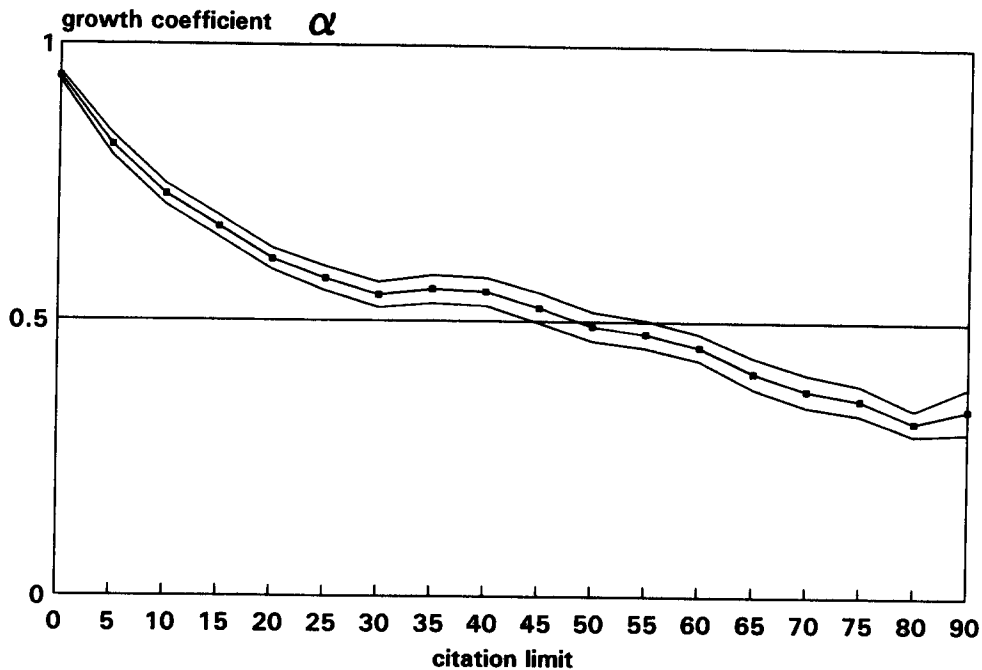


Figure 2. Growth of Cumulated Articles with N or More Citations in Relation to the Growth of the Cumulated Total of Articles

Considering statistical variations and the underlying rather wide definition of important articles this result is consistent with our law.

Furthermore, it turned out that the last important article on growth theory, according to the above definition, was published in 1970 [17]. At that time just 52 percent of the total output of growth theory articles and just 38 percent of the articles not cited at all were published. This implies that the following 1000 articles on growth theory published from 1971 to 1986 are of only little scientific importance if of any importance at all.

Is the Law Valid for High-ranked Economic Journals ?

A possible objection against the law of important articles could be based upon the choice of the underlying journals. Even if the law proves true for the economic journals as a whole, one could try to avoid it by selectively choosing just well-established journals with a high reputation, which are known to publish only articles of high quality.

There exists a considerable number of studies with respect to the ranking of journals [1; 4; 7; 9; 11; 13; 15; 16]. As far as the high-ranked journals are concerned, all these studies on international journals lead to the same results regardless of the method employed. Therefore, without restricting the generality of our analysis, we can concentrate on the pioneer study by Hawkins, Ritter, and Walter [7].

Selecting the 11 journals with the highest prestige,⁵ there remain 1,383 articles (or 52 percent

5. We excluded the *Journal of Economic Literature* because of its specialization on information about economic literature, and added the *International Economic Review* because of its importance with respect to the field of growth theory. This then totaled to 11 journals.

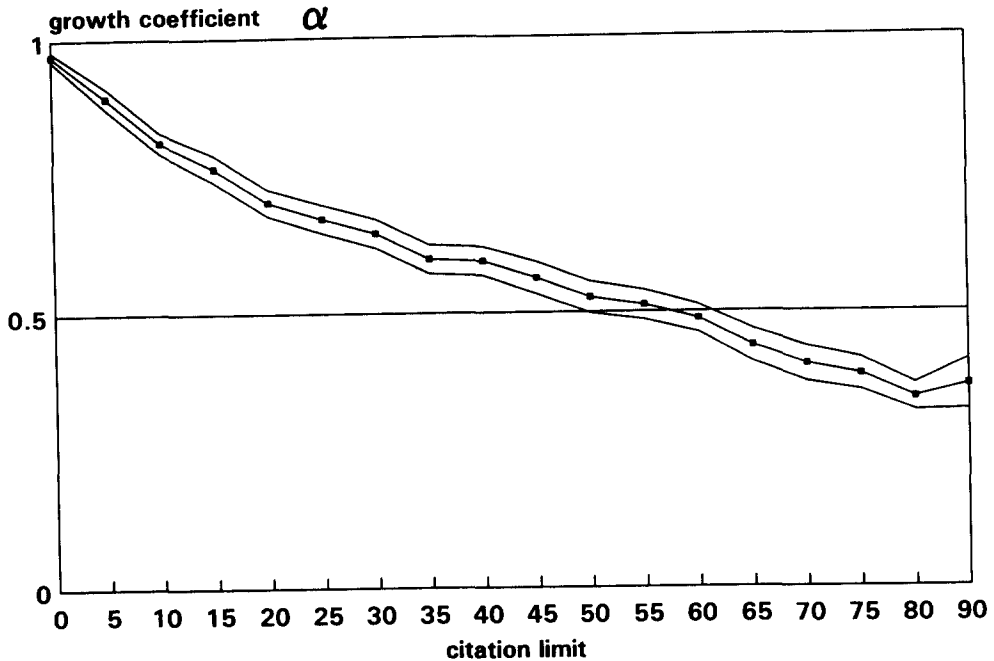


Figure 3. Range of Growth Coefficient α for the 11 Journals with the Highest Prestige

of the total output of articles on growth theory in 46 journals). Testing our law with the same methods as above, we obtained the empirical results shown in Figure 3.

Again there results a steadily decreasing α for increasing citation-limits, which is a necessary condition for the validity of our law. Actually, it could have been expected that the improved starting position with only 11 high-ranked journals would lead to a much better situation for the reader. However, the difference to the case of all 46 journals is only small. Although the reader has improved his situation somewhat, Figure 3 shows that the law of important articles is also compatible with the results of the reduced number of journals.

To overrule the further objection that this result could be improved by choosing even fewer but highest-ranked journals, we carried out the analysis with the 5 absolute top journals.⁶ Figure 4 shows that the empirical results corroborate our law even better than the results for the 11 journals.

Thus, we can state that our law is not only applicable to the total output of articles on growth theory in all economic journals, but, with small quantitative restrictions, also to ex-ante selections of especially highly qualified journals.

Is the Law Valid for Subsections of Growth Theory ?

Another possible strategy to avoid the law of important articles could be to concentrate on promising subsections of growth theory. In principle, such a subsection could contain all or at least most of the important articles. If one read only the articles of this subsection, the law could then be eluded.

6. These five journals are: *American Economic Review*, *Econometrica*, *Journal of Political Economy*, *Quarterly Journal of Economics*, *Review of Economics and Statistics*.

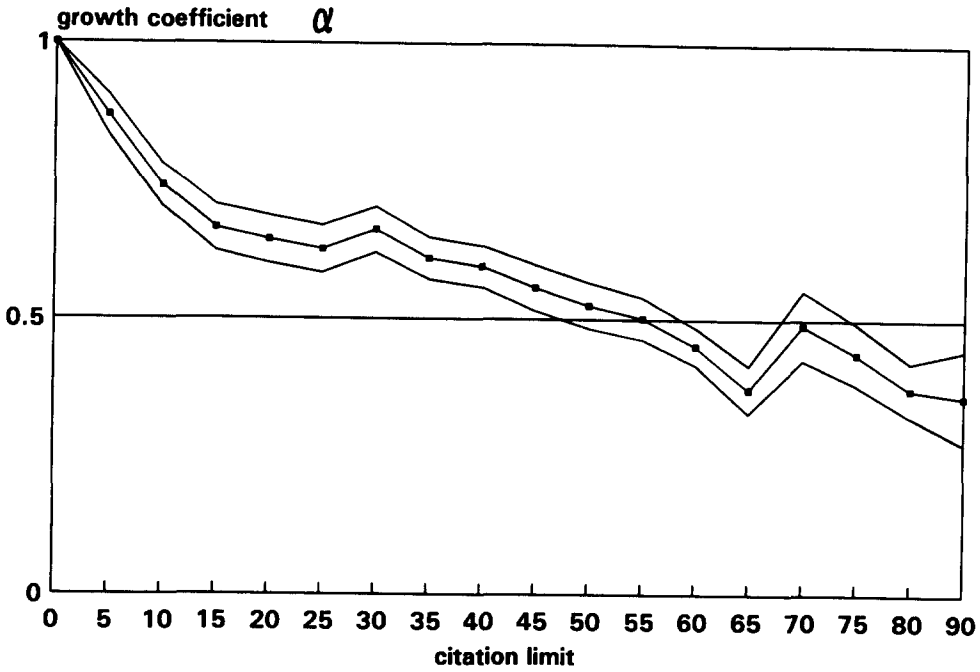


Figure 4. Range of Growth Coefficient α for the 5 Journals with the Highest Prestige

Table I. Articles in Subsections of Growth Theory (Articles Could Be Assigned to More Than One Subsection)

Subsection	Number of Articles	% of Total Output	Growth Coefficient α	Last Important Article Published
TRADE CYCLE AND GROWTH	301	11.20	.364	1964
FOUNDATIONS OF GROWTH THEORY	493	18.39	.515	1966
PRODUCTION FUNCTION AND CAPITAL CONTROVERSY	1,079	40.25	.576	1966
OPTIMAL GROWTH THEORY	658	24.54	.502	1967
N-SECTOR MODELS	526	19.62	.600	1967
MONETARY GROWTH THEORY	404	15.07	.637	1970
GROWTH AND INCOME DISTRIBUTION	631	23.54	.633	1966
DEVELOPMENT AND FOREIGN TRADE	668	24.92	.161	1965
LINEAR GROWTH MODELS	246	9.18	.345	1964
OTHER SUBSECTIONS	596	22.23	.309	1965

To test this strategy, the total of growth theory articles was subdivided according to the subsections to which they are related. Because a certain minimum of articles is necessary for the law to work, all subsections with less than 10 percent of the total output of articles were excluded.

Table I presents the percentage distribution of articles in the most important subsections of growth theory. It also shows the growth coefficient α for the articles in each subsection cited 30 and more times, and the year the last important article was published for each topic area.

The results of Table I can be summarized as follows: The law of important articles is nearly perfectly valid for the sections “foundations of growth theory” and “optimal growth theory”.

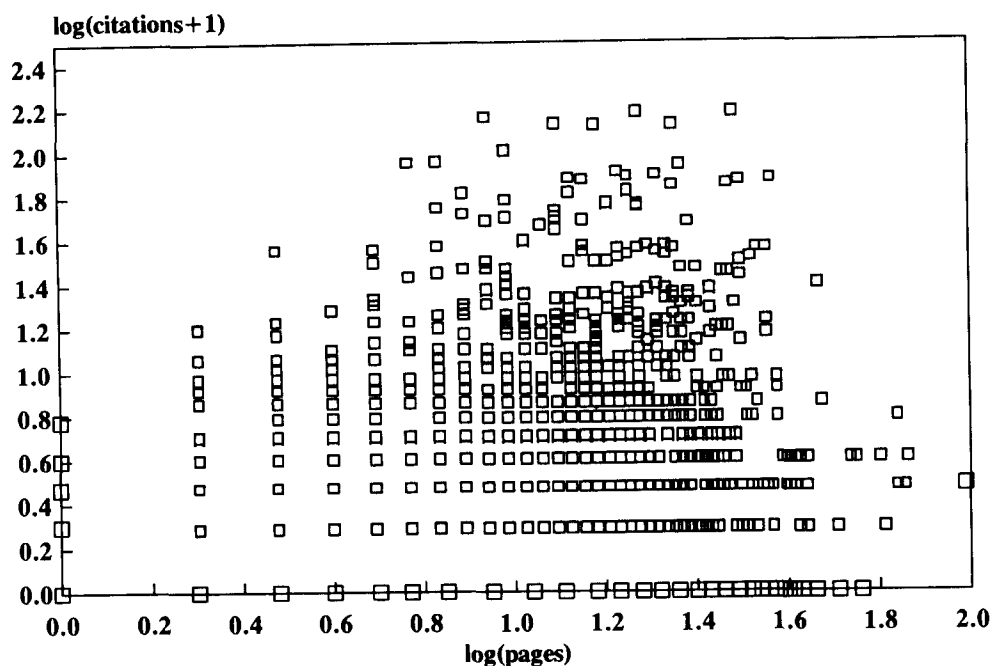


Figure 5. Scatter Diagram of Log Citations + 1) vs. Log(Pages) of Articles on Growth Theory

Other subsections such as “production function and the capital controversy”, “monetary growth theory”, “ n -sector models” or “growth and income distribution” display a somewhat higher growth coefficient α . But considering the 95 percent confidence interval, these subsections too are in the “feeding area” of the law. Some subsections, such as “trade cycle and growth,” “development and foreign trade” and “linear growth models,” present even worse results than the law would have predicted. Altogether, this implies that our law of important articles proves to be applicable also to the subsections of growth theory. For some of them it is even valid in a more rigorous way.

In a last step, we tested whether a connection exists between the number of pages of an article and its citation frequency. If such a connection exists, our law could be avoided after all by reading only articles of a certain number of pages.

Figure 5 shows the scatter diagram between the number of pages of articles and their citation frequency. This diagram directly illustrates that the citation frequency of an article does not depend on its number of pages.

Selecting an important article on the basis of authorship alone proves to be an inappropriate procedure too, for it would exclude relatively unknown authors whose articles nevertheless might become important some years later. As there seems to be no strategy to avoid the law, we may well denote it the “iron law of important articles.”

IV. The Consequences of the Law for the Reading Economist

In order to illustrate some consequences of the “iron law,” we pose the question: “How high is the probability that an economist finds at least one important article in the body of scientific

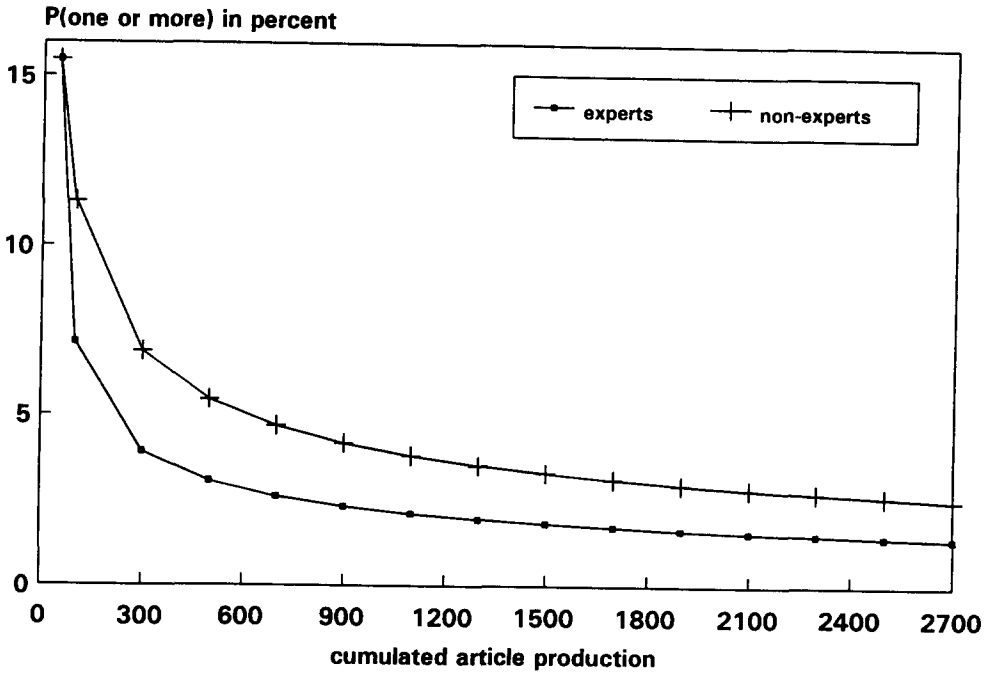


Figure 6. Probability of Accidentally Obtaining an Important Article

literature on growth theory he intends to read?" To answer this question, we first subdivided the potential readers into "experts" and "non-experts." The "experts" keep abreast of growth theory and therefore have to observe and read only the new articles published in each given year. The "non-experts" are expected to take into consideration all published articles on growth theory up to the given year.

Starting with the equation estimated for the total output of articles in growth theory

$${}_{30}X_t = 0.91 {}_0X_t^{0.54} \tag{3}$$

for "non-experts" the probability of accidentally finding an important article out of all articles quickly decreases from about 16 percent at the beginning of the observed period to less than 4 percent at its end. Experts are hit even harder by the law because the decreasing share of important articles along the time axis is based on the fact that the newly published articles contain an especially small share of important articles. Assuming an average production of 50 articles per year, the probability decreases from 16 percent at the beginning to less than 2 percent at the end. Figure 6 shows the courses of the two graphs.

Simple considerations disclose that in the end phase of a theory even hard-working economists (reading 30 articles per year) with very moderate pretensions (reading at least one important article per year) will be disappointed with relatively high probability (non-experts with about 40 percent, experts with about 60 percent). Intending only to keep track of growth theory and thus reading just about 12 articles per year, a scientist will find at least one important article every third to fifth year. Figures 7 and 8 show these probabilities for experts and non-experts.

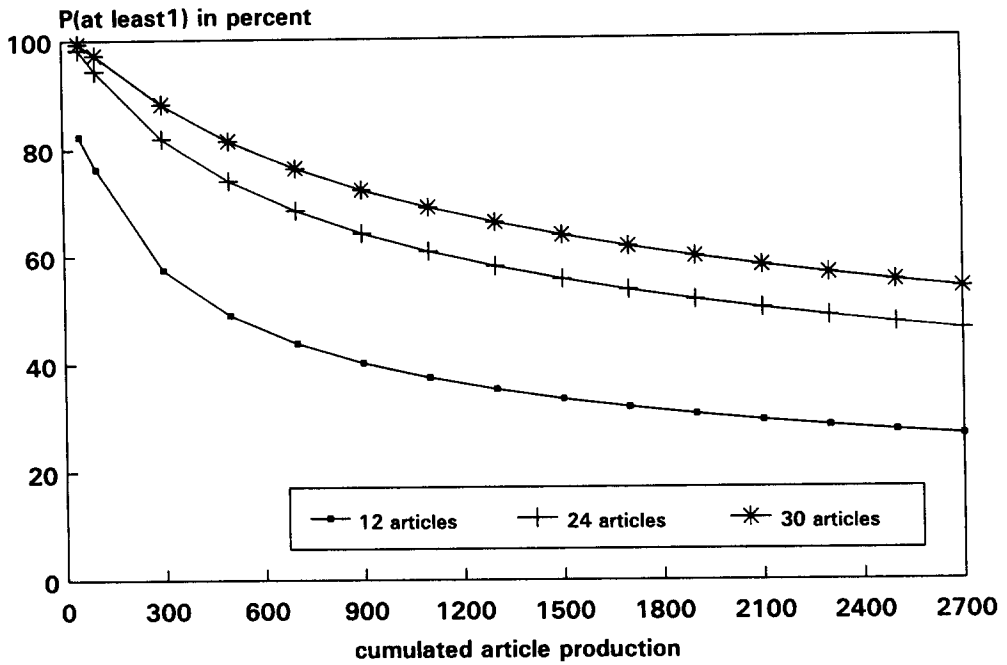


Figure 7. Probabilities of a Non-Expert Finding at Least One Important Article When Reading 12, 24 or 30 Articles on Growth Theory

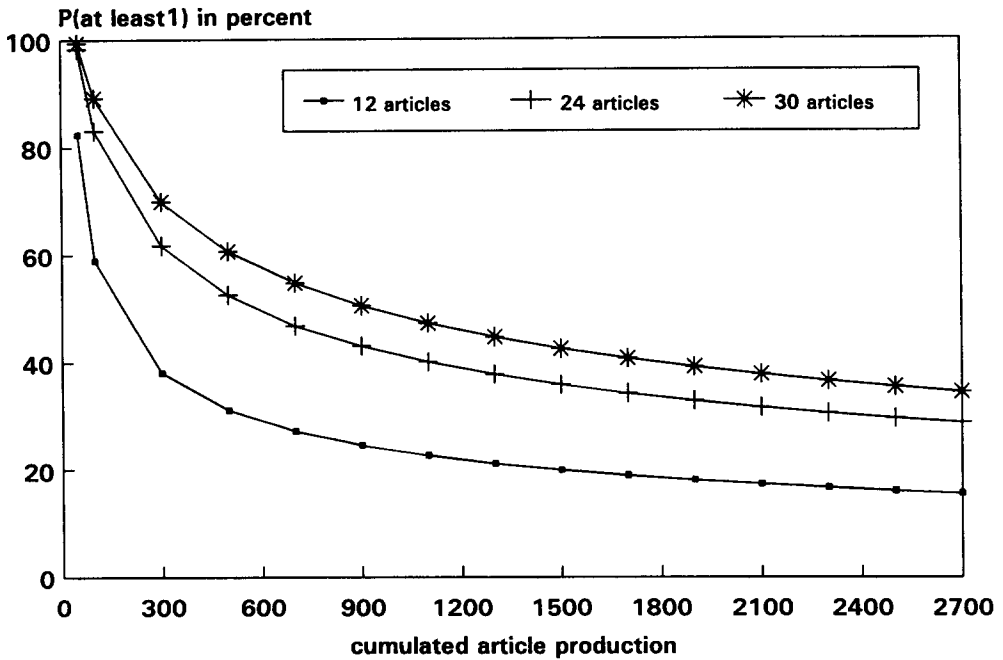


Figure 8. Probabilities of an Expert Finding at Least One Important Article When Reading 12, 24 or 30 Articles on Growth Theory

V. Concluding Remarks

The preceding reflections suggest some generalizing conclusions. If the role of scientific economic literature is communication of results of scientific works then the discipline is either failing or succeeding only in a most uneconomic manner. Therefore, if economists are rational producers of articles then they must be publishing for some other reasons.

One possible hypothesis is that, due to the doctrine of “publish or perish,” the classical function of informing the members of the scientific community about the state of the discipline has been taken over more and more by the role of publications as a filter of scientific careers. The fact THAT a scientist publishes, HOW MUCH he publishes, and especially WHERE he publishes, has become much more important than WHAT he is publishing.

The hypothesis of scientific literature as a selection criterion for scientific careers inevitably leads to a conflict between producers and consumers, i.e., between authors and reading scientists. While authors intend to maximize the number of published articles nearly regardless of their content, readers are interested in the production of only a small number of articles with a high marginal revenue of information.

As the output of scientific literature underlies the iron law of important articles, however, the readers are confronted with a decreasing probability of finding at least one important article in the developed subsections of our discipline.

After having stated this unpleasant truth, there remains the hope that the article at hand will be cited frequently enough to become one of those rare important works. Whether an article on important articles can number itself among important articles must be left to the reader.

Appendix

The analysed 46 journals were:

American Economic Review (+ *AER Papers and Proceedings*)
Applied Economics
Atlantic Economic Journal
Cambridge Economic Journal
Canadian Journal of Economics (= *Canadian Journal of Political Economy and Economics*)
Economie Appliquée
Economia Internazionale
Economic Modelling
Econometrica
Economica
Economic Journal
European Economic Review
Finanzarchiv
International Economic Review
Jahr für Sozialwissenschaft
Jahrbücher für Nationalökonomie und Statistik
Journal of Development Economics
Journal of Economic Issues
Journal of Economic Literature
Journal of Economic Theory

Journal of Finance
Journal of International Economics
Journal of Macroeconomics
Journal of Mathematical Economics
Journal of Money, Credit and Banking
Journal of Political Economy
Journal of Post Keynesian Economics
Journal of Public Economics
Konjunkturpolitik
Kredit und Kapital
Kyklos
Oxford Economic Papers
Quarterly Journal of Economics
Review of Economic Studies
Review of Economics and Statistics
Revue d'Économie Politique
Revue Économique
Southern Economic Journal
Schweizerische Zeitschrift für Volkswirtschaft und Statistik
Western Economic Journal (= Economic Inquiry)
Wirtschaftswissenschaftliches Studium
Das Wirtschaftsstudium
Weltwirtschaftliches Archiv
Zeitschrift für Nationalökonomie
Zeitschrift für die gesamte Staatswissenschaft
Zeitschrift für Wirtschafts- und Sozialwissenschaft

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