

FORECASTING THE NUMBER OF PUBLICATIONS OF PAPERS ON ENTREPRENEURSHIP IN ACADEMIC JOURNALS

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ABSTRACT

Research on entrepreneurship has been growing very rapidly. The question of how long this growth process would continue may be very important to those involved in research and education on entrepreneurship. The objective of this paper is to forecast publications of papers on entrepreneurship in academic journals. Through this forecasting, we attempt not only to forecast publications of papers on entrepreneurship but also to shed light on the growth process of research on entrepreneurship. For research data, this research used online web databases. Using the data from the databases, we constructed a time series representing the number of papers on entrepreneurship in academic journals for the period 1961-2004. We fitted an S-shaped curve or the Fisher-Pry model to this time series data. The estimated forecast indicates that the number of papers on entrepreneurship in academic journals would grow at an accelerating rate through 2013, and the growth process would continue through 2026 at a significant rate. Then the growth rate would become marginal through 2037. Forecast indicates that after 2037 the growth may be near zero. However, the average number of publications of professional papers on entrepreneurship in years 2038-2060 would remain at a level greater than four times of that of 2004. This research has a number of limitations regarding its validity, including the assumptions made, database used to collect data, and adoption of the bound for the forecast model. These kinds of limitations are inevitable in forecasting to some extent. Nonetheless examinations on the publications on the past trend and future directions of research and education activities on entrepreneurship seems to be consistent with the results of this paper, supporting the validity of this research. This research appears to be the first one of this kind and may play a role as a reference data for researchers and educators in the area of entrepreneurship.

Keywords: Entrepreneurship, entrepreneurship research, research paper, forecasting, number of publications.

I. INTRODUCTION

Entrepreneurship research has been one of the most rapidly growing disciplinary areas of management science in recent years. As such there are considerable works on reviewing past trends, and suggesting future directions in the area of entrepreneurship research (Dean, Shook and Payne, 2007; Low and MacMillan, 1988; Busenitz, West, Shepherd and Nelson, 2003). Also papers concerning the past and the future of the education of entrepreneurship have been published (Katz, 2003; Brush, C. G. et al., 2003). One of many possible conclusions that can be drawn from these works on entrepreneurship research and education is that research and education on entrepreneurship is still in the early stage of its development in the long range perspectives.

In this context one of our natural queries is the future of entrepreneurship. In particular, it should be one of our genuine interests to make long term prediction on the development of entrepreneurship research and education. However, there is no published material on the long term projection on entrepreneurship research and education. We may be interested in how long this growth process would continue. With regard to the growth of research and education in entrepreneurship, we may raise following questions.

- How long will the discipline of entrepreneurship continue to grow?
- What stage of the whole growth process are we in now?
- What would be the saturation level if there would be one?
- When will the saturation take place?

This type of question may be of particular importance to those who consider initiating professional new projects in relation to entrepreneurship education and research such as developing new graduate programs or establishing research institutions in this field. Information about the future of entrepreneurship research and education may be of interest also to those graduate students who are looking for their areas of specialization because it would be related to job market in this field.

The objective of this paper is to forecast the number of papers on entrepreneurship in academic journals (NPEAJ). NPEAJ is taken as a measure that represents the level of research activities on entrepreneurship. Through this forecasting, we attempt not only to forecast publications of papers on entrepreneurship but also to shed light on the growth process of academic research and education activities on entrepreneurship.

For research data, we use EBSCOhost web database which indexes article from most of the professional journals written in English world widely. Using the data from the database, we construct a time series NPEAJ for 44 years covering the period 1961-2004. In Section II, we examine the overall trend of NPEAJ for the period 1961-2004. In Section III, we build a statistical model to be used for forecasting. In Section IV, this model is used to forecast NPEAJ for the period 2005-2060 which is 56 years, and we examine the forecast data and discuss the implications of the forecast.

II. OBSERVATIONS ON THE PUBLICATIONS OF ENTREPRENEURSHIP RESEARCH PAPERS IN ACADEMIC JOURNALS

2.1. Data

One of the very important decisions for this type of research is defining the population from which the sample for this research would be taken. In other words, we need to select the database that covers most of important academic journals that publish research papers on entrepreneurship. In this regard we evaluated several databases including EBSCOhost, ProQuest, and Blackwell. Among these databases, EBSCOhost seems to be the most appropriate one for our research considering the number of journals indexed, the area of coverage, and time span of coverage. In academic premier search in EBSCOhost, more than 4,000 academic journals in the areas of management, economics, social sciences and applied sciences are covered. Since entrepreneurship research has tendency of multidisciplinary studies, the database that covers wide range of disciplines seems to be the most appropriate one.

We counted the NPEAJ for the period 1961-2004 in the EBSCOhost web database which is subscribed by Dongguk University, Seoul, Korea as of December 2005. In order to designate the area of entrepreneurship, we used the keyword "entrepreneurship" in the EBSCOhost web

database. Among the EBSCOhost research databases, we used the "Academic Search Premier" database and applied the following limits to our search.

- "Scholarly (peer reviewed) Journal" (This option excludes, for instance, book reviews.)
- Publication Type: "Periodical" (This option excludes newspaper, and books.)
- Number of Pages: "All"
- Article with Images: "All"
- Period of search: 1961-2005 (45 years)
- Academic Journals: Number of Papers on Entrepreneurship

2.2 Overall Observation

The NPEAJ that resulted from our search is tabulated in Table 1. Plotting the data in Table 1, we obtained a graph as shown in Figure 1. We can divide the time-series data in Figure 1 into three stages with distinctive features: (1) Introduction stage, (2) Early growth stage, and (3) Rapid growth stage.

1) Introduction Stage (1961-1982): The period of 1961-1982 may be called the "Introduction Stage" because it is a period in which publications on entrepreneurship began to appear in academic journals (Kent, Sexton and Vesper, 1983). During this period, NPEAJ in a year did not exceed 10. It may be worth noting that for some years (1962, 1964, 1965, 1969, and 1977), the number was zero as shown in Table 1 and Figure 1. Such a small number of publications on entrepreneurship during this period appear to be surprising when it is compared with worldwide research activities on entrepreneurship of recent years. At that time the research activities on entrepreneurship did not appear to get some momentum to grow. However, changes in socioeconomic conditions seem to have played a role to stimulate such activities afterwards.

2) Early Growth Stage (1983-1999): During the period of 1983-1999, we see that NPEAJ shows a trendy growth as in Figure 2. During this time many graduate education programs on entrepreneurship were established in the United States and other parts of the world, and academic journals for article on entrepreneurship were initiated (Katz, 2003).

Table 1. Number of Papers on Entrepreneurship in Academic Journals (1961-2004)

Year	NP*	Year	NP*	Year	NP*	Year	NP*	Year	NP*
1961	1	1971	2	1981	3	1991	18	2001	69
1962	0	1972	2	1982	4	1992	24	2002	84
1963	4	1973	2	1983	2	1993	22	2003	150
1964	0	1974	4	1984	5	1994	40	2004	188
1965	0	1975	8	1985	9	1995	37		
1966	3	1976	1	1986	11	1996	30		
1967	0	1977	0	1987	7	1997	40		
1968	2	1978	2	1988	6	1998	51		
1969	0	1979	5	1989	19	1999	64		
1970	2	1980	3	1990	12	2000	81		
Total	12	Total	29	Total	78	Total	407	Total	491

NP*: NPEAJ

Figure 1. Plot of the Number of Papers on Entrepreneurship in Academic Journals (1961-2004)

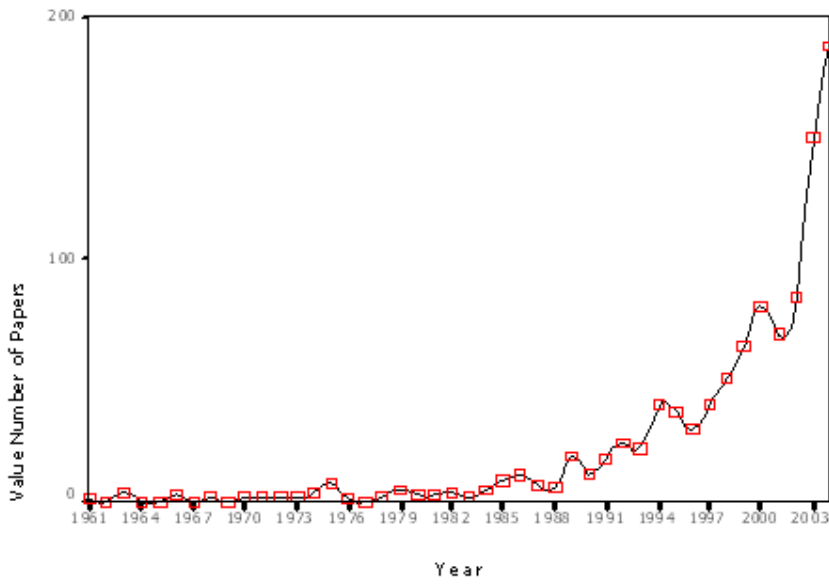


Figure 2. Plot of the Number of Papers on Entrepreneurship in Academic Journals (1961-1982)

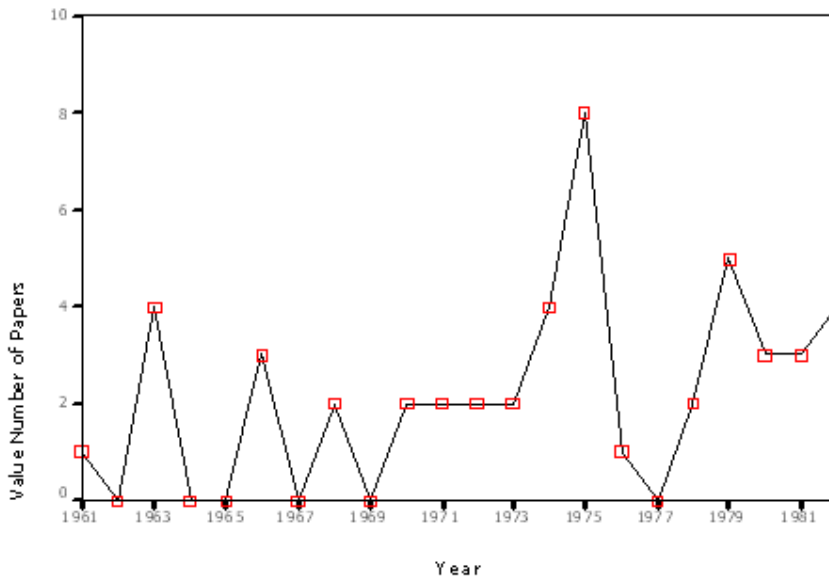
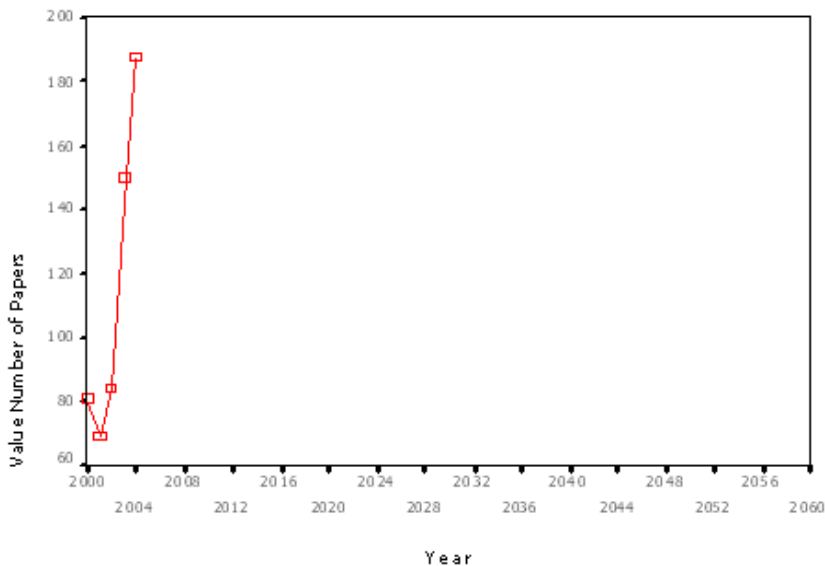


Figure 3. Plot of the Number of Papers on Entrepreneurship in Academic Journals (1983-1999)



3) Rapid Growth Stage (2000-2004): From 2000, the rate of growth of NPEAJ became greater than that in the previous years and the slope became steeper Figure 4. The growth pattern during the period of 2000-2004 or the Rapid Growth Stage is contrastingly different from that of the period of 1983-1999 or the Early Growth Stage. The former appear to be exponential while the latter followed a linear trend. This change in NPEAJ can be explained with new establishments of academic journals and research activities in educational and research institutions.

Figure 4. Plot of the Number of Papers on Entrepreneurship in Academic Journals (2000-2004)



III. MODEL BUILDING

3.1 Fitting the Fisher-Pry Model

In this section, we build a statistical model to represent the pattern in the time-series data in Table 1 or Figure 1. In order to define a model that will fit to the data, we may follow the following logical steps.

- It may be generally assumed that NPEAJ would follow a growth process with a certain limit. This assumption is very natural because without this assumption NPEAJ data would explode in the long run.
- A general model describing a growth process with a limit is an S-shaped model.
- Considering this, we see that the data in Figure 1 appear to follow the initial stage of an S-shaped curve or a typical growth curve with a limit.
- Hence, we can attempt to fit an S-shaped curve to NPEAJ.
- There are typically two types of S-shaped curves. One is a growth model that is also called the Fisher-Pry model, the other is a mortality model or the Gompertz model (Porter et al., 1999). Relating the characteristics of the two models to the growing nature of NPEAJ, it appears reasonable to use the growth model or the Fisher-Pry model to fit the data.

In order to build the Fisher-Pry Model we define the following terms. The fraction of the potential market penetration, f ,

$$f = N / L$$

where L is the upper bound for growth of the variable N which is NPEAJ in our case.

The fundamental assumption in this approach is that the rate of change in the market share f over time is proportional both to the current market share f and inversely to the remaining portion of the market or $(1 - f)$. Expressing this assumption in mathematical form, we have

$$df / dt = b[f / (1 - f)] \tag{1}$$

Solving the differential equation in Equation (1) for f yields

$$f = 1 / [1 + c \exp(-bt)] \tag{2}$$

Equation (2) is referred to as the Pearl Curve (after Raymond Pearl, refer to Porter et al., 1999). However, the name "Fisher-Pry Curve" is commonly used for the model in Equation (2) (Porter et al., 1999).

Equation (2) may be transformed as follows.

$$z = \ln[(1 - f) / f] = \ln(c) - bt \tag{3}$$

Equation (3) may be rewritten as a linear regression form for time series data as

$$\begin{aligned} z_t &= \ln[1 - f_t] / f_t \\ z_t &= \ln(c) - bt \end{aligned} \tag{4}$$

Fitting Procedure

Step 1: Assume a value for L

Step 2: Compute $f_t = N_t / L$, where N_t is NPEAJ in year t for $t = 1961, 1962, \dots, 2004$.

Step 3: Compute $z_t = \ln[(1 - f_t) / f_t]$, for $t = 1961, 1962, \dots, 2004$.

Step 4: Fit a regression model

$$Z_t = b_0 - bt \tag{5}$$

to the data set (Z_t, t) for $t = 1961, 1962, \dots, 2004$,

obtaining estimates for intercept and the slope, \hat{b}_0 and \hat{b} , respectively.

From Equations (4) and (5), we obtain $c = \exp(\hat{b}_0)$ from $\ln(c) = \hat{b}_0$.

Substituting $f_t = N_t / L$ in Equation (2) and solving for N_t , we obtain the forecast model for N_t

$$N_t = L/[1 + c \exp(-bt)] \quad (6)$$

Substituting $c = \exp(\hat{b}_0)$ and $b = \hat{b}$

Step 5: Compute

$$\begin{aligned} \hat{N}_t &= L/[1 + \exp(\hat{b}_0) \exp(-\hat{b}t)] \\ &= L/[1 + \exp(\hat{b}_0 - \hat{b}t)] \end{aligned} \quad (7)$$

\hat{N}_t for $t = 1961, 1962, \dots, 2004$ represents fitted values for N_t .

The sum of squares of errors between the observed value N_t and estimated value \hat{N}_t is computed as

Step 6: Compute the error sum of squares as

$$SS_E = \sum_{t=1961}^{t=2004} (N_t - \hat{N}_t)^2$$

Repeat Steps 1 through 6 for different values of L . We used SPSS for statistical computation.

3.2 Selection of the Adequate Model

The major factor that affects validity of the Fisher-Pry model is the value of the upper limit L (Porter et al., 1999). Possible alternatives to determine the value of L are multiple. However, there is no general rule to determine the value of L .

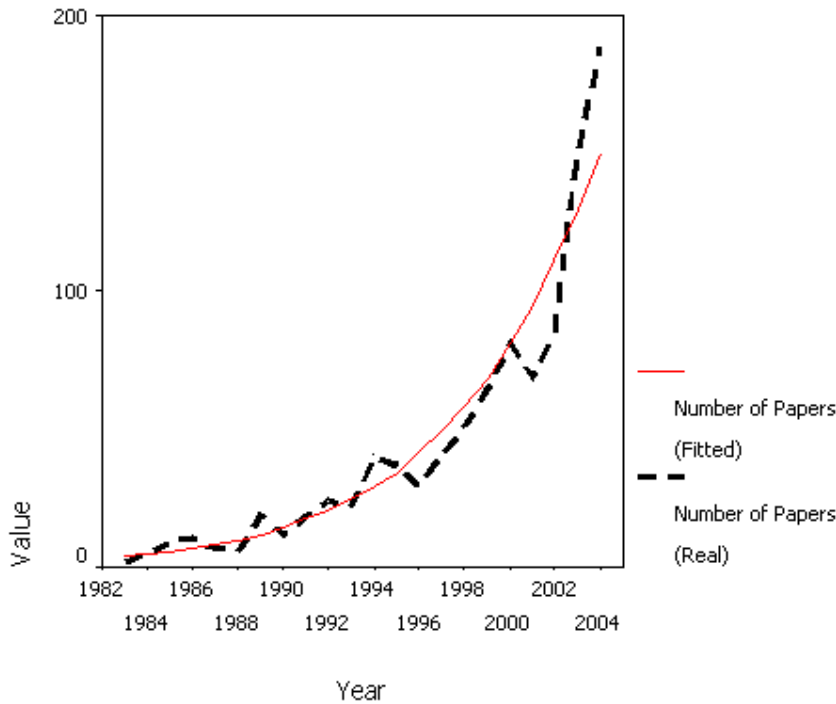
We used the criteria of the minimization of the sum of squares of errors for $t = 1983, 1984, \dots, 2004$ ($SS_E = \sum_{t=1983}^{t=2004} (N_t - \hat{N}_t)^2$). In order to find the value that minimizes SS_E , we tried various values of L , including 770, 780, 790, 800, and 810.

The SS_E is minimized at $L = 790$. We use the data only for the period 1983-2004 because the data for 1961-1982 appear to be irrelevantly long past for the S-shaped model under consideration. The final model we obtained using NPEAJ for the data of 1983-2004 is

$$\hat{N}_t = 790/[1 + \exp(364.172 + 0.181t)] \quad (8)$$

Based on the historical data for the period 1983-2004 and estimated values using the model in Equation (7), we obtain the plots shown in Figure 5. The dotted line in Figure 5 shows the real values and the continuous line shows the values estimated from Equation (8). The estimated line appears to represent the pattern of the real data quite well. Thus, it appears that our selection of the S-shaped model for the data is adequate.

Figure 5. Plot of the Number of Papers on Entrepreneurship in Academic Journals (1982-2004)



IV. FORECASTING

4.1 The Forecasting Model

Forecasts of NPEAJ for the period $t = 2005, 2006, \dots, 2060$ can be obtained using the model in Equation (8)'.

$$\hat{N}_t = 790 / [1 + \exp(364.172 + 0.181t)] \quad (8)'$$

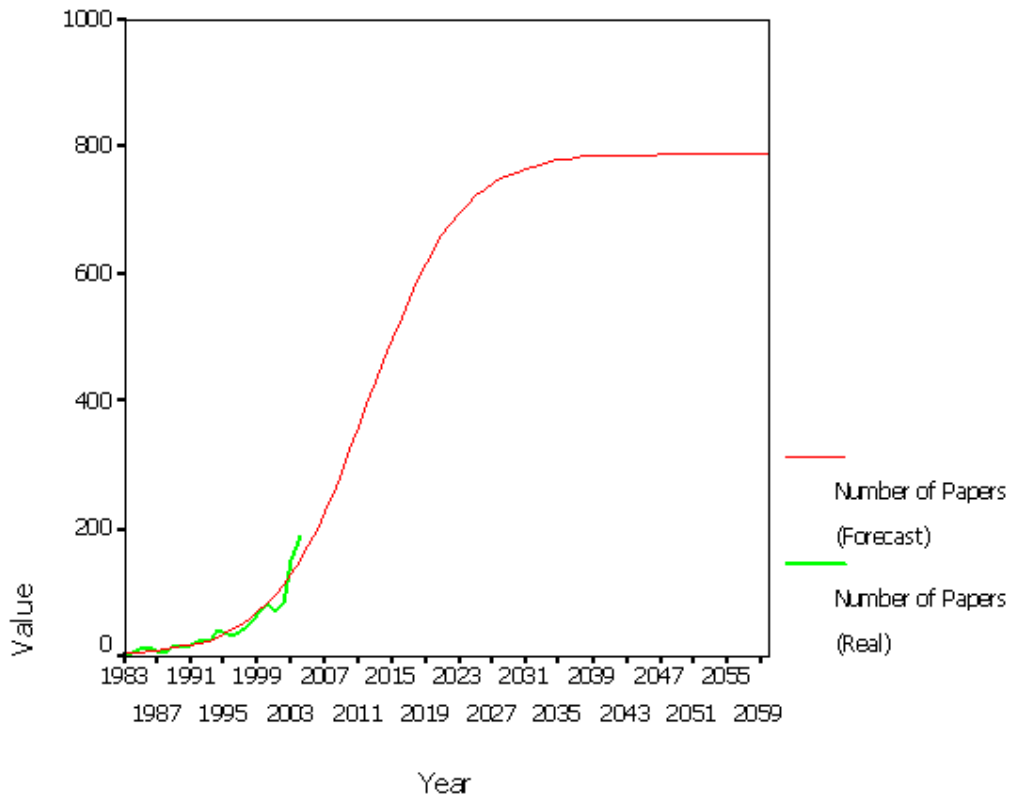
for $t = 2005, 2006, \dots, 2060$.

4.2 Overall Trend

Figure 6 shows NPEAJ for the period 1983-2060. The plots for 1983-2004 in Figure 6 are the same as those in Figure 5. (Plots for the period 1983-2004 in Figure 6 show both real and estimated values, and those for 2005-2060 are forecast values).

The plots for the period 2005-2060 in Figure 6 are forecast values. Figure 6 shows the whole process of a typical S-Shaped curve. The forecast value converges to the upper limit of 790 as time approaches 2060. It is noted that the rate of growth of NPEAJ decreases significantly after 2030. We will examine changes in the growth process more closely in Sections 4.2 and 4.3.

Figure 6. Plot of the Number of Papers on Entrepreneurship in Academic Journals (1983-2060)



4.3 Short-term Forecasting

Using the model in Equation (8)', we can obtain the forecast values for the period 2005-2009. NPEAJ continues to grow for this period. The growth rate NPEAJ based on the forecast values for years 2005-2009 are 14.9% (2005), 14.7% (2006), 14.6% (2007), 13.2% (2008), 12.4% (2009), 11.7% (2010) and 10.8% (2011) and 10.0% (2012), respectively. It may be noted that the growth rate for this period are two-digit Table 2.

The net increases of NPEAJ for each of these years are 23, 25, 29, 30, 32, 34, 35 and 36. The magnitude of annual growth measured in the increase of NPEAJ is greatest in 2012 and 2013, when the annual increase of NPEAJ is 36.

4.4 Long-term Forecasting

Forecast values of NPEAJ for the period 2013-2060 are shown in Table 2. After 2040, changes in NPEAJ are less than one or very small. Although after 2013, the magnitude in the annual increase of NPEAJ becomes smaller than before, the annual increase of NPEAJ remains greater than or equal to 11 or a two-digit until 2026. Based on these observations, we may divide the 56 years (2005-2060) into four periods as follows:

1) Accelerating Growth Period (2005-2013): During this period, NPEAJ is expected to grow at an accelerating rate, where the accelerating rate means that the net increase of NPEAJ of the current year over that of the previous year is greater than that of the previous year. For instance, according to the forecast values, the increase of NPEAJ in 2005 over 2004 is 23. Similarly, the annual increases of NPEAJ in the following years are 25, 29, 30, 32, 34, 35, 36, and 36, respectively. This accelerated growth pattern continues through 2013 reaching a peak of 36 Table 2. It should be noted, however, that the growth rate during this period does not follow

the same pattern. Actually the growth rate during this period decreases at a slow rate.

Table 2. Forecast Values of the Number of Papers on Entrepreneurship in Academic Journals (2005-2060)

Year	NPF*	Increase	Growth** (%)	Year	NPF*	Increase	Growth** (%)
2005	174	23	14.9	2023	695	16	2.4
2006	199	25	14.7	2024	709	14	2.0
2007	228	29	14.6	2025	721	12	1.7
2008	258	30	13.2	2026	732	11	1.5
2009	290	32	12.4	2027	741	9	1.2
2010	324	34	11.7	2028	749	8	1.1
2011	359	35	10.8	2029	755	6	0.8
2012	395	36	10.0	2030	761	6	0.8
2013	431	36	9.1	2031	765	4	0.5
2014	466	35	8.1	2032	769	4	0.5
2015	500	34	7.3	2033	773	4	0.5
2016	532	32	6.4	2034	776	3	0.4
2017	562	30	5.6	2035	778	2	0.3
2018	591	29	5.2	2036	780	2	0.3
2019	616	25	4.2	2037	782	2	0.3
2020	640	24	3.9	2038	783	1	0.1
2021	660	20	3.1	2039	784	1	0.1
2022	679	19	2.9	2040	785	1	0.1
				2041 -2059	786 ~ 789	< 1	
				2060	790		

NPF*: Forecast Values of NPEAJ

$$\text{Growth}^{**}(\text{year}) = [\text{NP}(\text{year}) - \text{NP}(\text{year} - 1)] / \text{NP}(\text{year} - 1) * 100$$

2) Significant Growth Period (2014-2026): During this period, the annual increase of NPEAJ is forecast to decrease after the peak year of 2013. However, the annual increase of NPEAJ may be said to be "significant" because it is still a two-digit growth. This significant growth continues for 13 years, marking 35 in 2014 and 11 in 2026 Table 2.

3) Marginal Growth Period (2027-2037): According to the forecast, the annual growth of NPEAJ during this period is forecast to be nine in 2027 down to two in 2036 Table 2.

4) Near Zero Growth Period (2038-2060): The annual increase of NPEAJ during this period is expected to be one or less. However, this should not be mistaken as 'no activities'. This simply means the 'growth' is minimal while the level of NPEAJ remains at that of the previous year.

4.5 Implications of the Forecast

Results of the forecasting of NPEAJ make it clear that NPEAJ would increase for some decades in the future. This implies that the research and education activities on entrepreneurship will increase accordingly. This seems to be a favorable condition for the research and education institutions on entrepreneurship to grow.

If we apply the law of inertia to the research and education activities on entrepreneurship, the growth pattern would continue for some, and the current accelerating pattern of growth would continue for some time. This hypothesis is consistent with the forecast result we obtain in this research.

V. Conclusions

It is generally observed that research and education activities on entrepreneurship have grown significantly since early 1960s. Interest in entrepreneurship of people not only in academic institutions but also of those in economic policy area appears to grow. The growth pattern does not indicate any significant deceleration in any time soon. This growth pattern observed stimulates our interest in the future of research and education activities on entrepreneurship.

We take NPEAJ as one of reasonable measures that represent the level of research and education activities on entrepreneurship adequately. The objective of this paper is to forecast NPEAJ. Thus, this paper is an attempt to forecast the level of research activity on entrepreneurship in the future.

This paper deals with NPEAJ for 100 years covering the period of 1961-2060. We examine the historical data of NPEAJ for the period 1961-2004. In particular, we build a forecast model based on the NPEAJ data of 1983-2004. To these historical data, we fit a Fisher-Pry S-shaped model. The bound for the model is estimated to be 790. With the model obtained, we forecast NPEAJ for the period 2005-2060.

The overall observation on the forecast is that the growth of NPEAJ would continue to year 2060. The time period for which this paper makes forecast may be divided into four periods: Namely, accelerated growth period, significant growth period, marginal growth period, and near zero growth period.

During the accelerating growth period (2005-2013) NPEAJ is expected to grow at an accelerating rate. In particular, the net increase of NPEAJ of the current year over that of the previous year is greater than that of the previous year. During the significant growth period (2014-2026) the annual increase of NPEAJ is forecast to decrease after the peak year of 2013. However, the annual increase of NPEAJ is "significant" because it is still a two-digit growth. This significant growth of NPEAJ continues for 13 years, marking increase of 35 in 2014 and 11 in 2026.

During marginal growth period (2027-2037) the annual growth of NPEAJ is forecast to be nine in 2027 down to two in 2036. During the near zero growth period (2038-2060) the annual increase of NPEAJ is expected to be one or less. However, this should not be mistaken as 'no activities'. This simply means the 'growth' is minimal while the level of NPEAJ remains at that of the previous year.

A suggestive remark with regard to opportunities in the area of entrepreneurship research and education is that the opportunities are expected to grow for some decades. Therefore, it

seems to be no late to initiate new projects on entrepreneurship research and education such as new education programs and establishing a new research institution.

This research has a number of limitations with regard to its validity, including the assumptions made for model building, database from which data is collected, and adoption of the bound for the model. These are, however, some of the inevitable problems we encounter when we attempt to make forecast. Nonetheless examinations on the publications on the past trend and future directions of research and education activities on entrepreneurship seems to be consistent with the results of this paper, supporting the validity of this research.

This research appears to be the first one of this kind. Further research activities in this direction may be necessary for professionals in research and education, and practitioners of entrepreneurship.

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