ON A SUBSET OF RANKED CONTRIBUTORS TO FINANCE LITERATURE

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Abstract

Our premise is that ancient India's intellectuals, from at least 400 A.D., were proficient in advanced mathematics, and it is this heritage which acts as the driving force enabling India-born scholars in finance to reach the coveted ranks. In order to elaborate the premise, we examine the background data of 59 ranked researchers of Indian origin identified from the ***Top 1000*** *in finance. Our limited analysis shows that the majority, having obtained their first degree in science and technology, transited to graduate degrees in finance, and continued to be sufficiently productive to be ranked. This finding is consistent with Katzner's hypothesis (2003) relative to the entry of mathematicians into economics. Our focus on one sub-group is subjective, nontheless it allows comparative studies with other sub-groups.*

INTRODUCTION

It is a generally held assumption that Asian-Indians excel in mathematics. This assumption may not be unfounded considering the high proportion of scientists, technologists and financial experts employed at *Fortune 500* and major American research universities. As noted by Sutter, Kocher and Mrsic (2002), whether American, European or Asian scientists exert the greatest impact on the progress of various fields of science is a vital issue in the political debate as well as in the scientific community. In light of this observation, we have subjectively narrowed the scope of our inquiry to one field of knowledge, namely finance, and one subset of scholars, namely, finance academics of Indian origin. Realizing other numerous possibilities, we frame the research question in the paper as follows: "*Why do India-born academics excel in finance*?"

This question is significant in the 21st century knowledge economy for many reasons. We cite two: (1) China and India are now in the vanguard of industrial and scientific progress. By 2010-12, China is likely to be the largest exporting nation, and India is to set to emerge as the world's knowledge base for technology and science. Such rapid progress is as much a matter of relief as one of concern to the United States—relief in geopolitical and world economic sense. (2) There is also an increasing concern among the G-7 nations in terms of their domestic employment and educational attainment of their youth especially in mathematics and science[1]. The most widely recognized concern in the United States is about mathematics and science education at the high-school level. At the level of higher education, as expressed by the President of a major research University, the concern is about innovative research. "The American university is a major

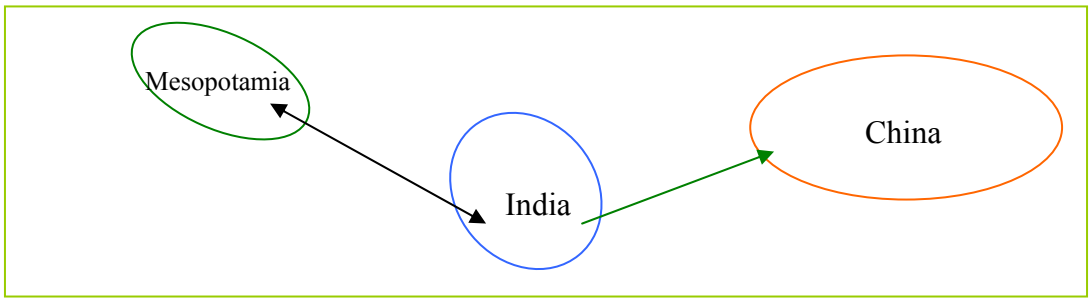
engine of innovation…We depend upon talented international students as partners in discovery…" (Skorton and Davisson, 2005). Both of these paramount issues are beyond the scope of this paper.

The *purpose* of our paper is to provide the backgrounds of the sub-group of 59 ranked contributors to the finance literature. The criterion for being included in the **Top 1000** was the quantity of published research, or output, in the sixteen core finance journals[2] (1990-2002) measured in terms of *Journal of Finance*-equivalent pages. The remainder of the paper is organized as follows: Some Historical Antecedents, the Katzner (2003) perspective, Bibliometric Studies, Data and Analysis, Discussion and Conclusion.

SOME HISTORICAL ANTECEDENTS

"Histories of ancient civilizations such as those of China, Egypt and India are shrouded in mystery" (Srinivasiengar, 1967). However, the 20th century archeological research has shed enough light on the mysteries so as to generate a sort of a consensus that the civilizations existing on the banks of great ancient rivers—Euphrates, Nile, Indus/Saraswathi, and Yangtze—fostered nascent intellectualism. The Sumerian numbering system (Circa 1700 B.C.) was one such contribution as evidenced by some 20,000 cuneiform [clay] tablets. "The earliest evidence of enumeration in China consists of oracle bones—dated around 1200 A.D.–used for divination or fortune telling" (Joseph, 2000, p. 130). The mathematics of irrigation and of altar construction in Mesopotamia and Indus/Saraswathi Valley and China were engineering accomplishment of the time. Also, trade between ancient Magan (now Bahrain) and the ancient Harappan region (then in India and after 1947 in Pakistan) has been well documented. Trade meant not only exchange of goods but also of ideas including mathematical concepts. The flow of ideas appears to have been in the directions suggested in Figure 1. As Ascher (2002) observes,

Figure 1.



"Among those who study the history of mathematics, there has been a growing understanding that what is generally referred to as modern mathematics is, itself, built upon contributions from people in many cultures". In brief, the development of mathematics, or mathematical ideas, in India was first and foremost a concomitant of ancient religious practices and customs which warranted an accurate calculation of the times of festivals, and of the times auspicious for the performance of the acts of worship, celebration, and sacrifice. An accurate knowledge of arithmetic, plane and spherical

geometry was also a *sine qua non* for calculating sunrise and sunset, solar and lunar eclipses, and floods. Knowledge was often transmitted orally. Thus the mathematics of irrigation and of altar construction exemplify early developments.

The altar construction required a knowledge of the properties of triangles, rectangles and squares, and properties of similar figures. However, whether people in ancient India had a solution to the Pythogorean problem (the construction of a right-angled triangle whose sides are all integers so that $a^2+b^2=c^2$) is debatable. Yet, the literary references to the altars of worship can be found in the *Rig Veda*. The knowledge of constructing the altars followed the oral tradition. Centuries later, written instructions—*Sulva Sutras*—for the construction of altars appeared. *Sulv* is to measure. *Sulva* came to represent Geometry in India just as *Ganita* literally meant the science of calculation—the "Hindu term for mathematics that occurs copiously in the Vedic literature" (Datta and Singh, 1935, p.7). Contributors to the early medieval number theory included many luminaries[3]. In addition to the Hindu-Arabic numbers, 1 to 9, the integer '0', akin to the notion of nothingness or the null set in Hindu philosophy, appears to have spread from India in the directions indicated in Figure 1.

Seife (2000) attributes the westward spread of zero in the fourth in century B.C. to the Greeks when Alexander invaded India with his Persian troops. The eastward spread seems likely in that the merchants traversing the silk road from India could have carried zero into China. Even perhaps Buddhist and Hindu travelers to China brought zero with them. That '0' existed before 200 B.C. is demonstrated by Halstead (1912). Datta and Singh (1935, p. 86) state "The use of a symbol for zero is found in Pingala's *Chandah-sutra* as early as 200 B.C." Rotman (1993) asserts that zero was invented by Hindu mathematicians and then exported into Europe via Arab mathematicians.[4] In the early developments in mathematics in ancient India (Circa 200 B.C.- 400 A.D.), foremost were the Jainas who used in their religious and philosophical works, "the decimal place notation, the '0' [and] algebra" (Joseph, 1992, p. 218).

"The *Jainas* went to the extent of regarding mathematics as an integral part of their religion. A system of *Jaina* literature, named *Ganitanuyoga*, literally means the system of calculation" (Srinivasiengar, 1967, pp. 2-4). Religious mathematical works of Jainas such as *Surya Prajnapati* are dated c. 300-100 B.C. The existence of a school of mathematics at Kusumapura (near Patna) and Ujjain is well documented. Earlier work on formulae such as the circumference of a circle = $\sqrt{10}$ x diameter, an approximation of the value of $\pi=\sqrt{10}$, is traced to Jainas who had used them in connection with their cosmography. During the ensuing millennia Hindu mathematicians evidently developed numerous algorithms which, in their refined forms, are extensively in use in economics and modern finance literature in which optimization remains as the cardinal notion. Optimization appears to be the core concept around which economist Katzner develops his perspective on the why of mathematics in economics.

THE KATZNER PERSPECTIVE

While Weintraub (2002) explained "how" economics was transformed as a mathematical science, Katzner (2003) explicates "why" economics became a mathematical discipline in his discussion of the "kinds of motivations [that] might have propelled economists in the mathematical direction" (p. 564). Other social sciences have

incorporated mathematics in some of their analytical methods. But, as Katzner insists, "none has incorporated mathematics as extensively or as completely as economics [has]" (p. 564). Three motivations, according to Katzner, could have inspired economists to introduce mathematics in their analytical work. The *first* is to utilize the [then] existing human capital, that is, mathematically trained individuals. There were scores of them in 19th century Europe. Prominent mathematicians who left their profession and entered the realm of economics were Augustine Cournot (1801-1877) and Leon Walras (1834-1910). Such an infusion subsequently provided incentives for economists to acquire advanced mathematical knowledge in order to apply in their own professional work. The *second* motivation was probably the quest for scientific respectability on the part of economists. As Katzner puts it, "The use of mathematics adds an aura of the scientific to economics in its enhancement of precision in the articulation of concepts and results" (p. 564). The *third* factor has been the quest for epistemological security—feelings of security with respect to the findings of original research and to claims of truth in the scientific sense. The driving force, we surmise, could have been the notion of optimization—originated by Italian mathematician Paolo Frisi (1728-1784). Since then, "optimization", says Katzner, "has become the cornerstone of models that purport to explain the behavior of individual consumers and firms" (p. 568).

While one may not concur with the Katzner Hypothesis, it is useful to consider questions such as how and why the field of finance carries more weight in business schools or why managers and executives with formal training in finance perform better and receive higher compensation. The meta-finance literature has a primary focus upon the contributors to new vistas to "optimization". Cooley (1994) identifies meta-finance as "Critical analysis of the nature, structure and behavior of finance". Critical analysis, in general, entails content analysis. Bibliometrics, a type of content analysis, is generally defined as the study, or the measurement, of texts and information. To recall, Katzner identifies the early contributors to the mathematization of 28-1784)9(i)-1.0(cs by na84)9(e)-5(and)

A BRIEF REVIEW

(2005) provide a valuable perspective on 17,573 authors in all 72 finance journals who averaged 2.91 article appearances over the 50-year period, 1953-2002. Our paper slightly departs from the focus upon the institutional and the individual contributions, and its main purpose, as noted earlier, is to identify the sub-group of India-born doctorates in finance who are ranked among the **Top 1000.**

DATA AND ANALYSIS

Our focus is upon one sub-group of ranked authors, namely the scholars who themselves, or their parents, were born in India. This is a working definition. It is generally assumed that foreign-born intellectuals and professionals have made significant contributions to higher education in the United States in science and mathematics as well as medical- and information-technologies. Among the business school offerings, doctoral level education in accounting and finance is often considered a noteworthy accomplishment. Especially the field of finance requires superior conceptual and mathematical skills.

The mathematical notion of optimization has become a central aspect of economic and finance phenomenon in the modern world. And, as noted at the outset, it is believed that India-born students are somehow better equipped and motivated to pursue such time-consuming mathematical skills. Many have, as a glance at the faculty listing of a graduate school in the United States would attest. There were, according to the Carnegie Foundation Report of 1994, one hundred fifty-one public and eighty-five private universities that offered doctoral degrees. One could assume that a vast majority of these institutions offer doctorates in economics or financial economics, and a number of graduate schools of business offer doctorates in finance. Our educated guess is that, in 2005, there were at least five hundred India-born Ph.D.s in finance, or financial economics, on the faculties of the U.S. graduate schools. It is reasonable to assume that 20 per cent in this group could be rank-quality.

Among the Top 1000, we could identify 92 as India-born, our sub-group. We might have missed one or two, but not too many, since India-born educated persons, in at least 95% of the cases, can identify the Sanskrit or Dravidian words that constitute the names of their counterparts. We obtained the biographies of the sub-group from the public domain. The rankings of the 92 scholars ranged from **2** (output = 355.78 J-F equivalent pages) to **976** (output = 39.07 pages). However, only 59 of the 92 biographies were complete; thus our n = 59. Unfortunately, not all of them provided a complete background of the individual (including the second ranked A. Subrahmanyam). We examined the limited data of 59 persons available in the public domain from the perspective of the following questions: In what academic field did they obtain their undergraduate or first degree? (See Table 1) Which U.S. universities awarded them the doctorate degrees and where are they currently employed? (See Table 2).

In India, not unlike the United States, entry into college is a competitive endeavor. After World War II the number of colleges

faculty members have had their first college degree in mathematics or hard sciences. The remaining individuals tended to be *honors* students in economics, commerce, or related subjects.

TABLE 2. Ranked, India-born Finance Doctorates (n=59) by Year of Doctorate Award and the name of the University

Name	Year	Rank (Top 1000)	University
Ike Mathur	1974	138	University of Cincinnati
Marti G. Subramanyam	1974	419	M.I.T
Raj Aggarwal	1975	274	Kent State University
Dilip B. Madan	1975	683	University of Maryland
Dilip Ghosh	1976	789	State U. of New York-Buffalo
Tarun K. Mukherjee	1977	413	Texas Tech University
Sudipto Bhattacharya	1978	877	M.I.T
Anjan Thakor	1979	3	Northwestern University
Suresh Sundaresan	1980	37	Carnegie-Mellon University
Anil K. Makhija	1980	515	University of Wisconsin
Kuldip Shastri	1982	489	UCLA
Ravi Jagannathan	1983	187	Carnegie-Mellon University
M.P. Narayanan	1983	421	Northwestern University
Prem C. Jain	1984	392	University of Florida
Gautam Kaul	1985	121	University of Chicago
Reena Aggarwal	1985	164	University of Maryland
Ramesh R. Rao	1985	254	Texas Tech University
Atul Gupta	1985	420	University of Texas
P.R. Kadapakkam	1985	453	University of Michigan
Lalatendu Misra	1985	766	University of Texas
Aswath Damodaran	1985	801	UCLA
Raman Kumar	1985	897	University of Pittsburgh
Omesh Kini	1986	104	Purdue University
Mai Iskandar-Datta	1986	107	University of Missouri
S.P. Kothari	1986	165	University of Iowa
Anup Agrawal	1986	280	University of Pittsburgh
Chinmoy Ghosh	1986	855	Pennsylvania State University
Narasimhan Jegadeesh	1987	20	Columbia University
S. Viswanathan	1987	43	Northwestern University
Anand Mohan Vijh	1987	55	Univ. of California-Berkeley
Jayant R. Kale	1987	459	University of Texas
Raj Varm	1987	785	Pennsylvania State University
S. Nagajaran	1987	817	Northwestern University
Asim Ghosh	1987	930	University of Kentucky
Mohammad Najand	1988	641	Syracuse University
Nandakumar Nayar	1988	758	University of Iowa

S. Venkataraman	1988	909	University of Massachusetts
Saudip Datta	1989	122	State University of New York
Raman Uppal	1989	195	University of Pennsylvania
Bhagwan Chowdhry	1989	215	University of Chicago
Vasantilak Naik	1989	291	University of California
Asani Sarkar	1989	754	University of Pennsylvania
Vikram K. Nanda	1990	86	University of Chicago
Sanjay Nawalkha	1990	166	University of Massachusetts
M. Nimalendran	1990	273	University of Michigan
Utpal Bhattacharya	1990	562	Columbia University
Ravi Bansal	1990	648	Carnegie Mellon University
Sugato Bhattacharyya	1990	877	Harvard University
Raghuram G. Rajan	1991	81	M.I.T
Narayan Naik	1991	851	Duke University
Gurdip S. Bakshi	1992	108	University of Wisconsin
Anil Shivadisani	1992	162	The Ohio State University
Vijay Singal	1992	414	University of Michigan
Tarun Chordia	1993	103	UCLA
Allaudeen Hameed	1993	606	University of North Carolina
Partha Gangopadhyay	1993	870	University of Iowa
Latha Ramchand	1993	976	Northwestern University
Bhaskran Swaminathan	1994	145	UCLA
Manju Puri	1995	189	New York University
Sunil Wahal	1995	305	University of North Carolina
Kumar Venkataraman	2000	922	Arizona State University

The information in Table suggests that among the 59 authors 25 of them received their doctorate from Private Universities and 34 from Public Universities.

DISCUSSION AND CONCLUSION

The assumption of this paper is that ancient India's mathematicians, from at least 400 A.D. have left behind a rich mathematical heritage. During the 400-1150 A.D. formalism could have entered religion and mathematics in India concurrently. Later developments in higher mathematics appear to have endowed a few select social classes in India, for example Jainas or Saraswathi Brahmins, with a unique propensity for learning and advancing mathematics.

Previous meta-finance literature studies in the late 20th century have examined the institutional affiliation of the ranked authors, their quantity of output, and the impact of their published research. Deviating from such previous studies, we have focused on one small group of financial academics—whom we labeled as India-born—that were listed among the **Top 1000** Financial Academics. With the limited data, we analyzed their formal collegiate education in terms of their bachelor's degree, master's degree, and the doctoral degree. Two of our findings are noteworthy and deserve some discussion.

The *first* is that the majority of high-ranking India-born finance academics were, contrary to our expectation, science and technology graduates. India, under the British, had established several major universities in the states as well as the provinces. But after India's independence in 1947, based on the model of the M.I.T., Institutes of Technologies were established by India's Central Government. Their administration was centralized, and the admission standards have remained exceedingly high compared with other institutions of higher learning. Thus, the graduates of the Indian Institutes of Technologies were a few but among the brightest. There were other bright students in enrolled possibly in the honors programs in certain social and natural sciences elsewhere. Our data suggest that the ratio of the former to the latter, among the ranked India-born financial academics, is 4:1. The caliber of the students as well as the mathematical rigor of the courses probably account for the endowment of the ranked India-born finance academics. Beyond their technology degrees, the majority of them pursued the M.B.A. or its equivalent. Some of them also had industrial or managerial experience. However, this observation should not be construed as countering the value of economics as an educational pursuit. Rather, instead of mathematics being the only tool of rigor for financial academics, technological knowledge including problem-structure and simulation may have provided a second set of tools to conceptualize real-world financial issues and problems.

The *second* finding is that, among those listed in Table 2, the very top ranked India-born authors were awarded their doctorates at Chicago, Columbia, M.I.T., Northwestern, and at U-C, Berkeley in the time frame 1979-1987. While this finding is not unexpected, it is noteworthy that the other ranked authors received their doctorates from well-known private universities as well as publicly funded universities in the United States in the ratio of 25:34.

In conclusion, while it is not possible to fully answer the initial question—*Why do India-born academics excel in finance*?—based on our limited data, recalling the plausible developments in Indian mathematics, we would infer that the graduates mostly of the Indian Institute of Technology acquiring further academic degrees in business and finance, during the 1980s, have succeeded in being ranked among the top. Likewise, we surmise that mathematics entered into the realm of finance because there was ample knowledge capital in India after World War II, model-building and rigorous testing had become the hallmark of sound research, and the newly established technological institutes had to emulate and be on par with the likes of M.I.T., or Carnegie-Mellon. To sum up, the argument of this paper is rather simple. Mathematics as a language was culture-bound. Historically, India was one of the few countries that possessed a rich mathematical heritage. Both English and mathematics have now emerged as the lingua-franca of business and commerce. Becoming proficient in both at an early age is harder if one does not have a mathematical heritage as have people hailing from countries such as India or China.

ENDNOTES

[1]The Governor of Michigan signed a legislation in April 2006 requiring all public school students to take four credits each of mathematics and English, and three credits each of science and social studies.

[2]The sixteen journals were: Financial Analysts Journal, Financial Management, Financial Review, Journal of Banking and Finance, Journal of Business, Journal of Business Finance and Accounting, Journal of Finance, Journal of Financial and Quantitative Analysis, Journal of Financial Economics, Journal of Financial Intermediation, Journal of Financial Research, Journal of Financial Services Research, Journal of Futures Markets, Journal of International Money and Finance, Journal of Portfolio Management, Review of Financial Studies.The T**op 1000** list is available from Professor J. Chan: http://www.wku.edu/~johnny.chan/

[3]For example, Amara Sinha (400 A.D.), Bhaskara I (520 A.D.), Brahmagupta (628 A.D.), Mahaviracharya (850 A.D.), Aryabhatta (950 A.D.), Bhaskaracharya II whose *Lilavathi* is said to be a seminal work (1150 A.D.) and Nilakantha (1500 A.D.)

[4]As Miller (2004) notes, " The consequences for modern mathematics and sciences of the invention of zero were enormous," since the zero made possible algebra. The term algebra is derived from Al-Kwarzimi's book—*Hisab al-jabr w'al-muqabalah* (725 A.D.—in which "al-jabr" means "combining like terms to solve an equation" Anglin, 1994, p. 119). Al-Kwarzimi's second book was translated into Latin as *Algorithmi de numero indum.*

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REFERENCES

Anglin, W.S. (1994). *Mathematics: A Concise History and Philosophy*. New York: Springer-Verlag.

Ascher, Marcia (2002). *Mathematics Elsewhere*. Princeton, N.J.: Princeton University Press.

Carnegie Foundation Report (1994). New York: Carnegie Foundation

Chung, Kee H. and Cox, Raymond A.K. (1990). Patterns of Productivity in the Finance Literature: A Study of the Bibliometric Distribution. *Journal of Finance*, XLV (1): 301-309.

Cooley, Philip L. (1994). Survival Strategies for a Fledgling Finance Professor. *Financial Practice and Education*, 4: 8-17.