

The Influence of Freedom on Growth of Science in Arabic-Islamic and Western Civilizations

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Abstract: The two important factors in science development are the social economy (gross domestic product, GDP) and freedom. In order to follow the development of science for both old Arabic-Islamic and Western civilizations, a statistical method is used to trace the variation of scientists' population with time. The analysis shows that: 1- There is a growth in Arabic-Islamic sciences for a period of three centuries (AD 700-1000). Then it is followed by period of declination. The decay time is about of eight centuries. Major factor behind that decay in science activities and the block of the science thoughts may be attributed to religious thoughts domination, and cultural or thoughtful problems, in addition to the normal social problems like wars, disasters..etc. 2- The growth in western civilization started approximately in AD 1200 and remains in its growing. It looks that the wars, political problems have no serious effect in western sciences growth. The growth behaviour has a natural growth form. That may prove that, the secular society is quite perfect for such activities. For present time Arab-Islam societies have no distinguished contributions. The most important factor for that catastrophic retardation is the absence of the freedom of thought and believes. The obtained curve has similarities with world GDP curve.

1. Introduction

The present natural sciences are based on the achievements and developments of sciences during last four centuries; when the roots of the knowledge extended for too deep era in history. One of the roots of science is of an Arabic-Islamic origin. Historically speaking, The Arabic-Islamic' sciences are the nearest achievements to the modern sciences than that of Graeco-Romans period. The modern science achievements are mainly western. Therefore the present study is interested in the two civilizations (Arabic-Islamic and Western). The study is interested in natural sciences only (mathematics, geometry, medicine, astronomy, chemistry, and physics). In a society, the appearance of scientists as groups in a certain era will formulate a phenomenon and may show an indication for the existence of scientific activities and scientific environment. Any scientific environment may be attributed to presence some features like:

- The freedom of thought.
- Freedom of getting knowledge from different sources.
- Freedom of debating and mutual respect for others (people or ideas).
- Social respect and acceptance for such works.
- Existence of work centers for such activities.
- Financial supports. That depends on the gross domestic product (GDP) of the society.
- Good work income.

Most of these features are of sociological bases, which are influenced by political, or religious and economical effects. These features are related to two important factors;

freedom and economy. So any variations in science development may be considered as good indicators to demonstrate the effects of those factors.

In modern societies, GDP and science-technology activities are of mutual effects, whereas for the past old era GDP was the dominant and science financial requirements were not costly. The freedom is the other vital factor in science progress either in the past or in modern time. The freedom was playing quite vital role in the past and more effective than GDP role.

The aims of the present work are to trace the science development, through the accumulation of top scientists, and study the pattern of that development of the two civilizations focusing on the freedom influence.

2. Method and analysis

The study depends on a statistical approach to trace the science development through centuries. In order to formulate the estimation of the science development in a quantitative manner, the top scientists' population is considered with time. The accounting of distinguished scientists is accomplished according to many references in history of science and science encyclopedias related to Arabic and western civilizations [1,2,3,4]. The arrangement of work is as follow:

1-The study concerns the period AD 700- 1900.

2- The considered scientists are those of mathematics, geometry, medicine, astronomy, chemistry, and physics. They were from different nations and religions but they were working and living in the two main different cultures.

3- The numbers of collected scientists are 163 Arabic-Islamic scientists and 372 western scientists for this period. These numbers are not of exact accuracy, where there is no good agreement among the references about the famous top scientists. But it gives a good rough estimation.

4-The scientists are grouped in classes according to the centuries of their existence. Statistically, this process is called frequency distribution.

5- The life span of some scientists was between two centuries. Those scientists are referred to a century, which most of their life spent in. Owing to that case there is an error of about 30 years, but these cases are few so that error effect is negligible.

6-The data are arranged in two series for Arabic-Islamic and for western scientists.

3. Result and Discussion

The results are depicted in figure (3-1). The Y axis represents the number of scientists whereas the X axis represent the time (AD). The broken curve represents the distribution of Arabic-Islamic scientists and the other for western scientists.

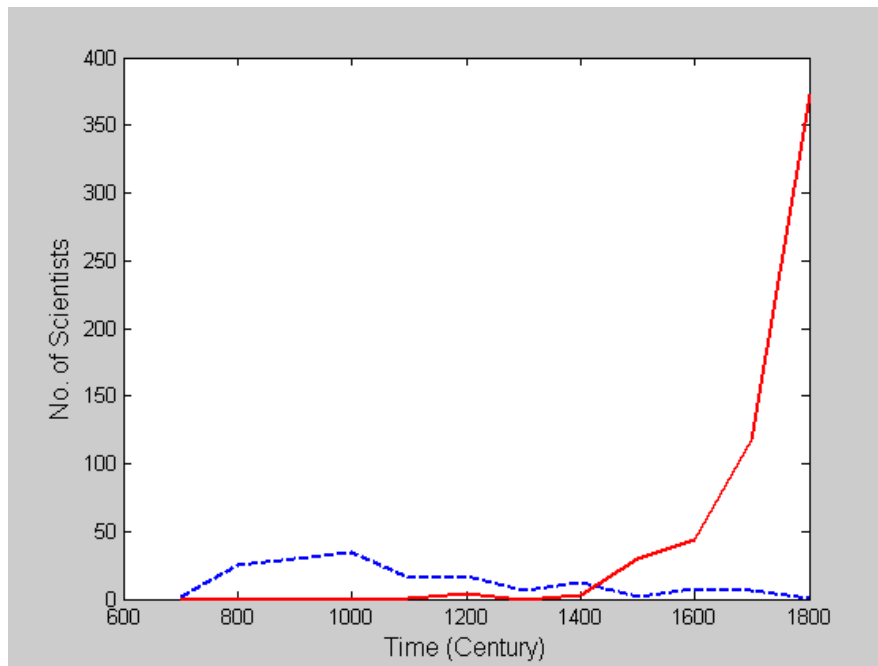


Figure (3-1) The top scientists' distribution. Blue broken curve for Arabic-Islamic' scientists, and the red for western scientists.

The variation in the curves behavior is quite obvious. Those variations in the behavior may be related to the variation in science environments. Accordingly, the discussion is trying to refer the variation of the curve to probable historical events.

3.1. Arabic-Islamic civilization

- 1- The growth in scientists' number starts after the conquest of Spain (AD 711) and in the beginning of the Abbasids caliphate (AD 750) in Baghdad. It looks as a beginning of new establishment in all branches of culture and life.
- 2- The growth continues with good establishment of the Arab states. In 830 Bayt Al Hikma (House of Wisdom) was established in Baghdad as a research center, for the translation of Greek and Syriac works into Arabic; and in 970 the University of Cordoba was founded. A similar university was established in Toledo. The translations of the Graeco-Romans's and Syriac's literatures to Arabic were raised in this period. Arabs translated and developed the works of the predecessors. At that time Arabs had a great acceptance for the culture of the others nations. The social freedom was quite wide in that time. The scientists were from different nationalities and religions. There were wide ranges of Islamic thoughts and active philosophical debates. The libertine (poetry) arts were acceptable. The freedom was quite distinguishable, and Islam was not against it. The society was included many types of believes like Christianity, Judaism [5]... . These new dynamical activities are appeared as there was a sort of Arabic-Islamic renaissance period.
- 3- The growth is expected to accumulated more (as will be discussed later), but became slower between AD 850-1000. This period was started by Al-Mutawakkil (821 – 861) the tenth Abbasids caliph. This caliph was not interested in knowledge, and was against different groups of thinkers. The interest in knowledge (science) became less than before. The restrictions started in this era, but the accumulation was continued.

- 4- In 909 Fatimid Caliphate appeared in North Africa, and there were good interests in knowledge. In eleventh century (1000) the slow growth reached its maximum. This peak is the accumulation of the renaissance period of Abbasid, Andalusia, and Fatimid Caliphates.
- 5- In this century many small states papered to get an independency from the control of Abbasid caliphate. In Andalusia the state was divided into petty emirates. Each of those fragmented tiny states tried to developed and encouraged scientists. But in same time they were weaken the systems of their societies by internal and external wars and many types of political and religious problems. In the period of AD 945-1055 the Sunni-Shi'ite divide in Islam became fully established [6]. Then, Arabs lost Toledo (1074) and Sicily (1091). Al-Ghazali (1058-1111) one of the famous Muslim thinkers had turned the thinking direction against the philosophy, and caused a big obstruction for the Islamic free thought . In addition to that the first Crusade started in 1095. This century shows the decline in science activities clearly. It is the time of the real starting of declination in Arabic-Islamic sciences.
- 6- The Mongol sack of Baghdad in 1258, which was the end of the Abbasid caliphate and the eighth Crusade, was in 1270. This invasion was a consequence of the declination.
- 7- The declination in scientists' population was continued after the raising of Ottoman Empire in 1288 and the fall of Granada in 1492.

3.2. West civilization

For the west, one may note another pattern of development for the same period of history. The curve in figure (3-1) shows:

- 1- There are no distinguished scientists during the medal ages (700-1100).
- 2- After the captured of Toledo (1085) by King Alfonso VI, a great and unlimited acceptance of the Arabic-Islamic culture had been begun, and waves of translations from Arabic literature have been started. The arch- bishop of Toledo started the efforts of translation from 1125 to 1151 [7]. The whole period of translation efforts toke about 155 years. During the period of Roger II (1111-1154) "Sicily function as a kind of cultural melting-pot" [7].
- 3- The Holy roman emperor Frederick II (1194-1250) spoke fluent Germany, French, Italian and Arabic [8], and supported the translation efforts. In 13th century, the establishment of universities was spread in Europe, Paris University in 1200, Oxford University in 1214, Padua University in 1222, Naples University in 1224, and Cambridge University in 1231. In this century some western scientists mentioned Arab scientists in their works, like Roger Bacon (1214-1292). In spite of the domination of the theological studies the science found a suitable place to grow up in those universities.
- 4- In the 15th century and after the occupation of Constantinople by Ottoman emperor (1453), the renaissance that might be started in Florence was supported by the emigration of the Constantinople's scholars and scientists. The influence of renaissance started to spread in Europe, where "Renaissance Italy was not cut off from the rest of Europe" [9]. In this century the growth in scientists' population is quite obvious.
- 5- The growth continued nonlinearly, and a great number of scientists appeared in 19th century.

4. Conclusions

In a previous study [10] the growth of human activities is considered as sort of growth of instability in the social activities, in a similar way as the instability of magnetohydrodynamics (MHD). A spiky behaviour of the instability may explain the Kuhn's scientific revolutions [11]. Accordingly the revolutions may be regarded as a sort of instability in social changes and science activity. In physics (fluid dynamics for example), the growth of instability has an exponential form.

The form of growth or decay in a system can be represented mathematically by an exponential form

$$N = N_0 \exp \pm \gamma T$$

Where N is the number of growing units after time T (year), N_0 is the initial number, positive γ is the growth rate and negative γ for decay rate. This form can be applied for social models [12], so as the science growth.

Growth of top science in western civilization (figure (3-1)) seems to follow that form approximately. From figure 1 the values of γ are approximately:

- $\gamma_w \sim + 1 \times 10^{-2} \text{ year}^{-1}$ which is the growth rate of western top scientists, and
- $\gamma_A \sim - 8 \times 10^{-3} \text{ year}^{-1}$ the decay rate of Arabic-Islamic top scientists. These figures show a relative slow decay and fast growth.

For the present time and according to this model there may be more than 10^3 top western scientists, and no contribution from the Arabic-Islamic societies.

However, only three centuries was the period of the growth of Arabic-Islamic's science. The exponential form is not clear in this period. That may be owing to the insufficient data or due to a real reason started to affect the normal growth, and that is much expected (the problem of 850). This long period of decay is a strange phenomenon.

The declination in Arabic-Islamic's science may be attributed to the domination of the theological thoughts and studies or the domination of the clerical influence on the society.

Owing to that domination, the interest in science and philosophy became less in comparison with the theological interests and most of or all of the schools were only for theological or linguistics studies and researches. Not just the science was facing that declination, but the philosophy as well. The theological and linguistics studies still favourable, and have great influence in the modern Arab-Islam societies. This serious role for these types of studies is related to the deep effect of the last ten centuries. Sort of cultural or thoughtful problems have been created, and blocked the science thoughts and activities. However this phenomenon may need further investigations.

The growth in western civilization started from AD 1200 and remains in its growing. It looks that the wars, political problems have no serious effect in western sciences growth. The growth behaviour of the natural growth form fits the western growth.

The main reasons behind that natural pattern of growth were:

- 1- The Renaissance periods. The Renaissance of the 12th century and the Renaissance Italy in the 15th century.
- 2- Major advances were taken place and support the freedom of thought was the separation of the church and state of Martin Luther in 1517 and Henry VIII in 1530. Since that separation had been taken place in

the Roman Catholic Church, the effect of that separation is quite obvious in western Latin science growth.

As conclusion both of science and religion are based on two different type of logic; so controlling each one of the other will cause a serious damage for the controlled one.

The problem in the Arabic Islamic civilization was owing to the domination of comprehensive theology thoughts all parts of life. The freedom of thought, work and believe looks as it has the important role in the growing of science and technology. There is no selectivity in development of social activities.

The GDP was playing unimportant role in science development before the industrial revolution. But the science development has more influence on GDP. The economy may give another picture of social development. Figure (4-1) shows the historical development of the world gross domestic product per capita [13]. The curve may have some similarity with curves of figure (3-1).

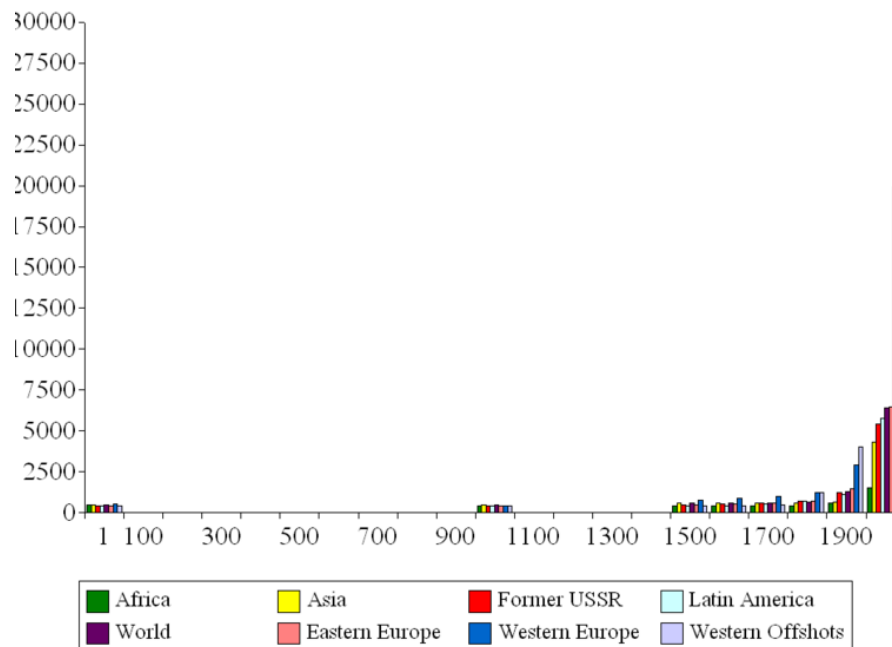


Fig. 2 World GDP/Capita AD 1-2003 [13].

Note the period of science development (Fig (3-1)) and the period of appearing and development of GDP (Fig.(4-1)).

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