

(i). **Objective:**

In this exploratory data analysis we would try to answer three basic questions from the data sets available to us:

How do the patent frequencies change over time

- (a) In terms of Filed, published and approved patents.
- (b) In terms of commercial value.
- (c) In terms of how patents are distributed amongst Companies, research organizations and independent researchers.

(ii). **Data:**

Our data base comprises of nine excel spreadsheets consisting of data collected from Australia, United States of America, Canada, Germany, Europe, Japan, India, China and South-Korea. Data was collected on the following variables:

PCT filing number: Nominal data indicating the patent filing number.

Patent Number: Nominal data indicating the patent number.

PCT filing date: Date of filing of patent

Title of invention: Nominal data indicating the title of invention

Owner Name: Nominal variable indicating name of organization owning the patent

Organization: Categorical data indicating whether the patent belongs to Individual, Research Organization or Companies.

Owner Country: Nominal variable indicating name of Country to which the owning body belongs to.

Inventor Name: Nominal data indicating name of inventor(s).

Inventor Country: Nominal data indicating the nationality of inventors.

Invention Aspect: Nominal data stating the aspect of invention.

Types of mechanism: Nominal data indicating the mechanism of the invention.

Plant used: Nominal data indicating the name of plant used if any.

Treatment: Nominal data indicating the target disease.

Commercial status: Categorical data used to indicate whether a particular patent has been commercialized or non-commercialized.

Grant date: Dates indicating the exact date of granting.

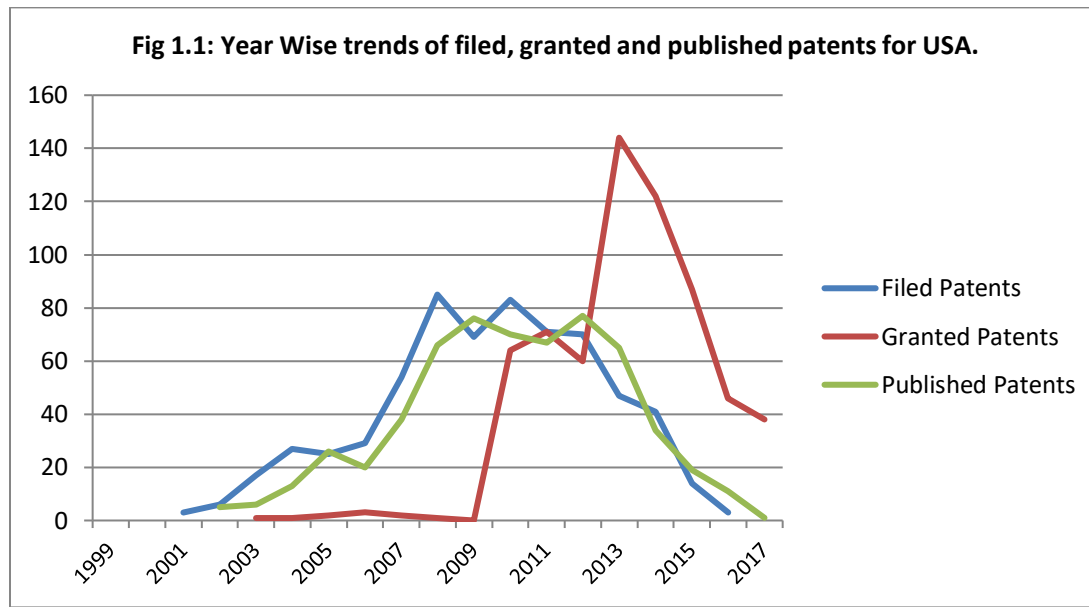
PCT publication date: Date of publication of patents

International Patent Classification: IPC code for unique identification of patents.

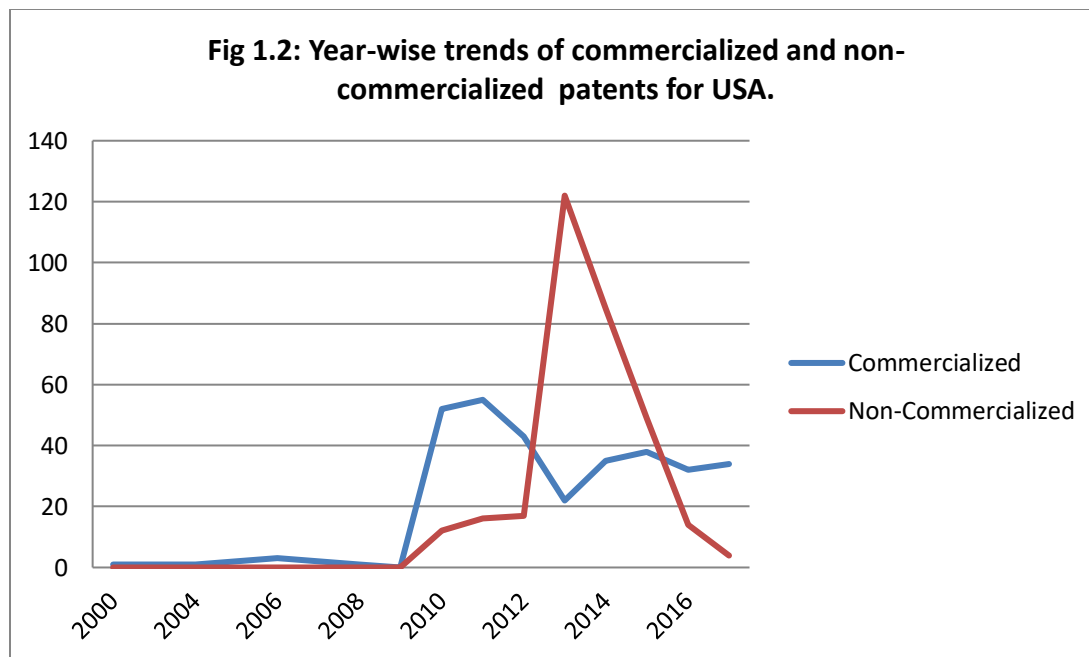
(iii). **Methodology:** We have used excel for cleaning and visualizing the data. We generated secondary data using excel's inbuilt filter function. Then we used the 2-D line from Line feature under Insert on the task bar and acquired the following results.

(iv). **Results and Conclusions:**

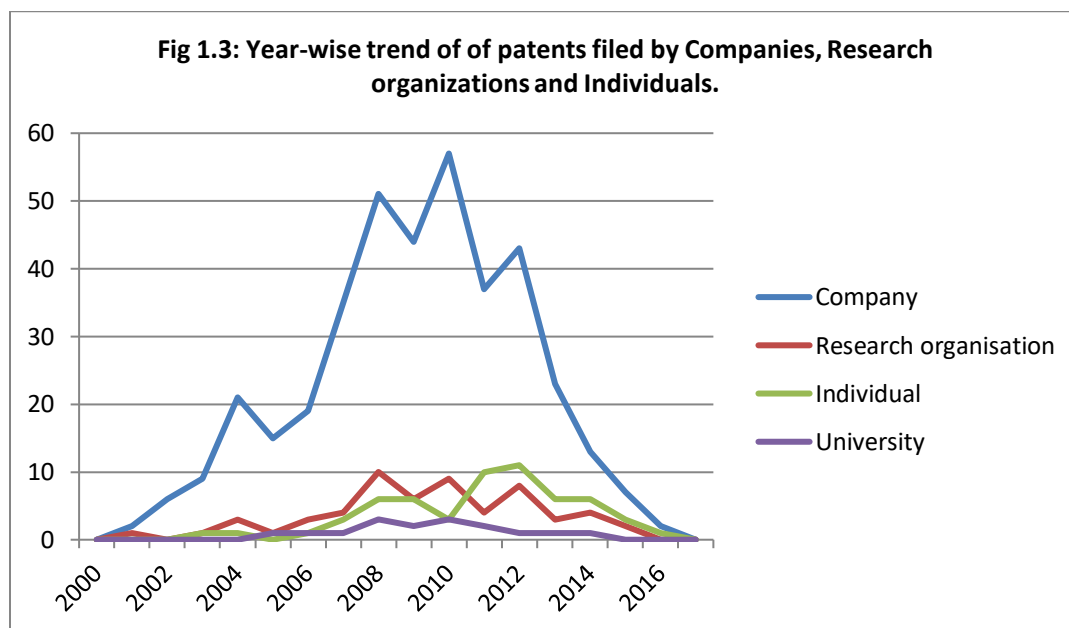
1). United States of America:



From figure 1.1 we observe that the total number of filed patents were low in 2001. It gradually increased over the years and peaked in the year 2008 and starts to show a decline there after. A similar pattern could be seen in case of the published patents as well with 2007 observing the highest number of published patents. The number of Granted patents shows a rather unusual trend with a sharp increase in 2013 followed by a sharp decline. It is worth observing that the low frequency of all three variables could be attributed to an abnormal behavior in the economy, e.g. an economic recession.

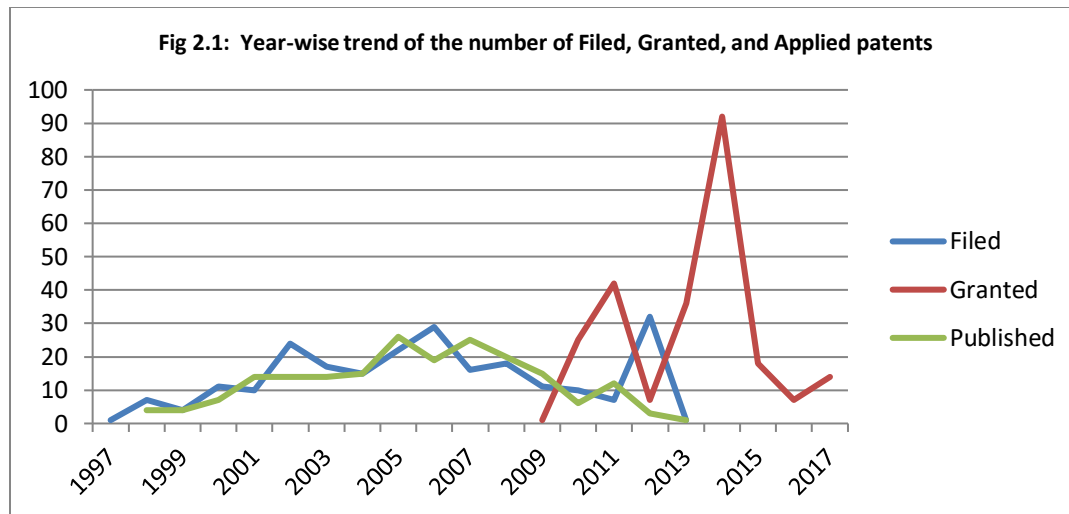


From figure 1.2 we observe that there is a spike in the frequency of non-commercialized patents in the year 2013, followed by a fairly linear decrease. It may be observed that the commercialization process kicked off somewhere near 2009.

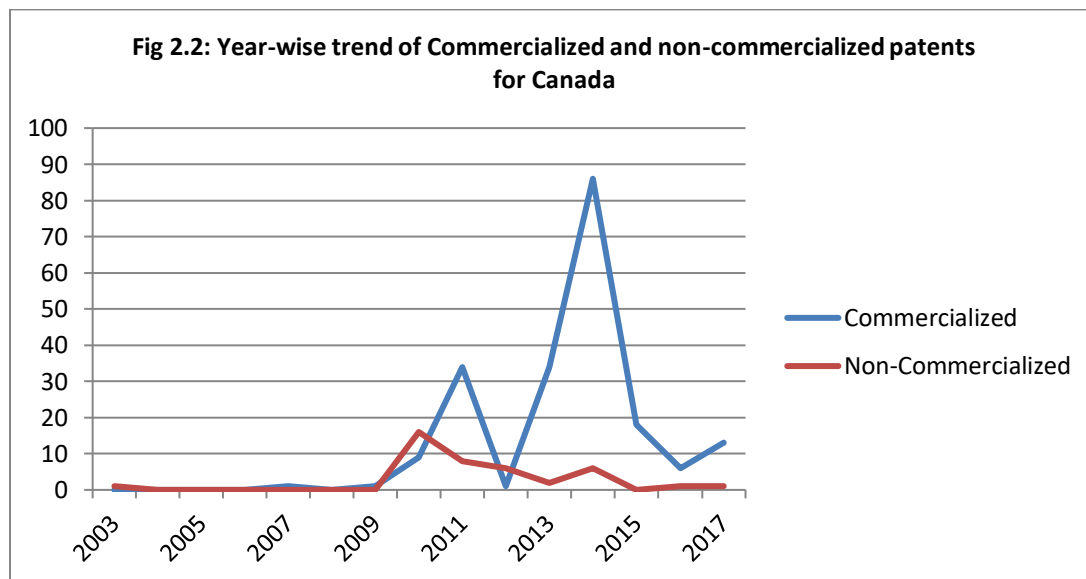


From figure 1.3: we observe that companies are clearly dominating the market for herbal patents in the United States. The research organizations and independent inventors are doing more or less similar with the inventors showing slightly better numbers 2011 onwards. It can be observed that all 4 curves show a bell shaped trend with peaks in the period of 2008 and 2012.

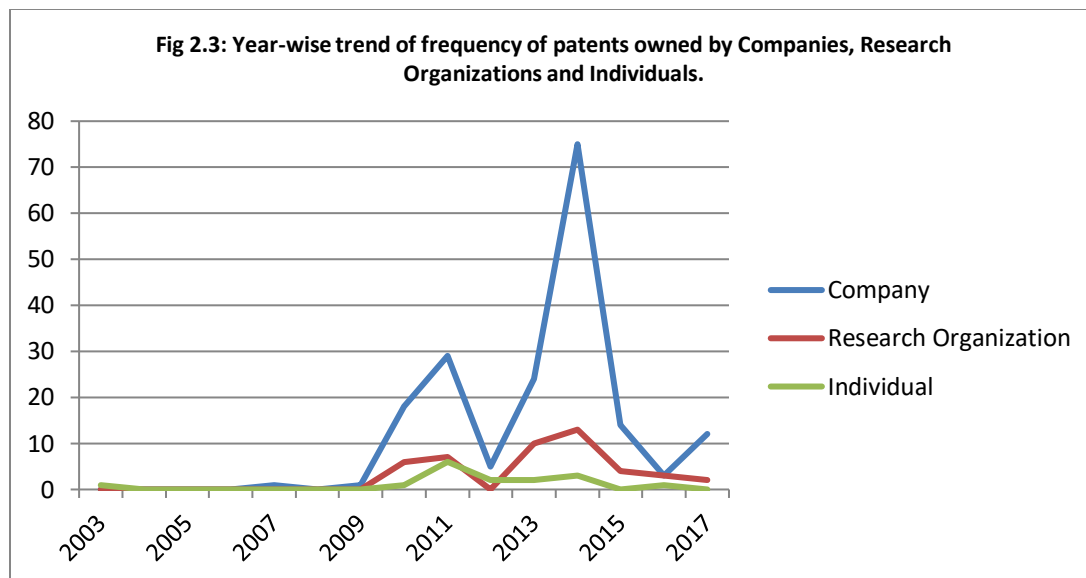
2). Canada:



The number of filed and published patents tends to increase from 1997 to 2006 and then decreases. The data corresponding to frequency of granted patents are missing before 2009 and hence haven't been plotted. But we observe a steep frequency in 2014. This indicates overall growth in terms of the number of patents.

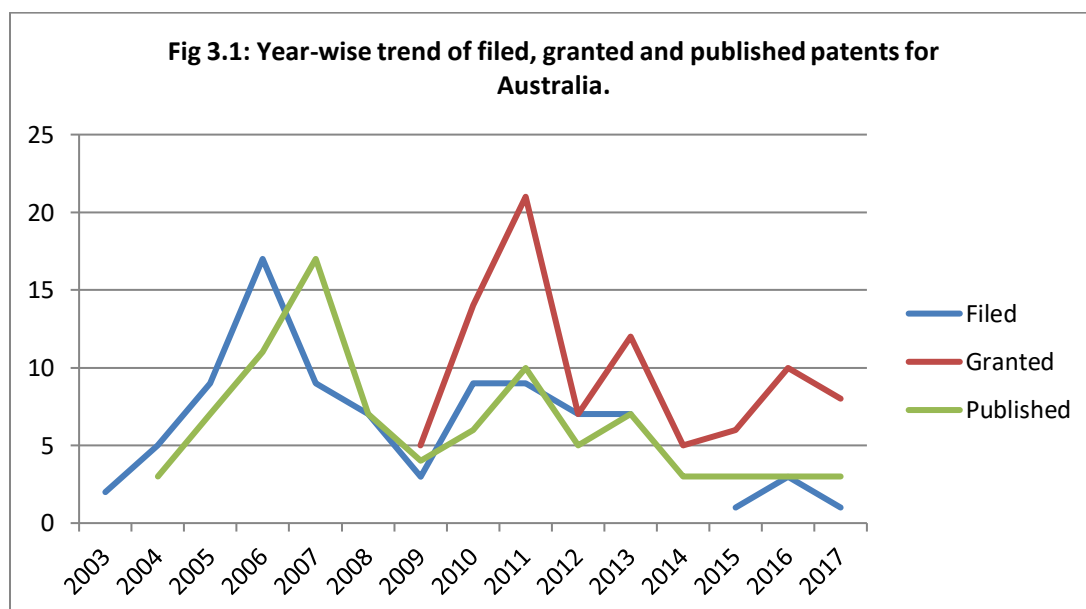


From figure 2.2 it is clear that the ratio of number of commercialized to the number of non-commercialized patents have increased over the years. Frequency of Commercialized videos reached its peak in 2014 followed by a steep decrease in growth.



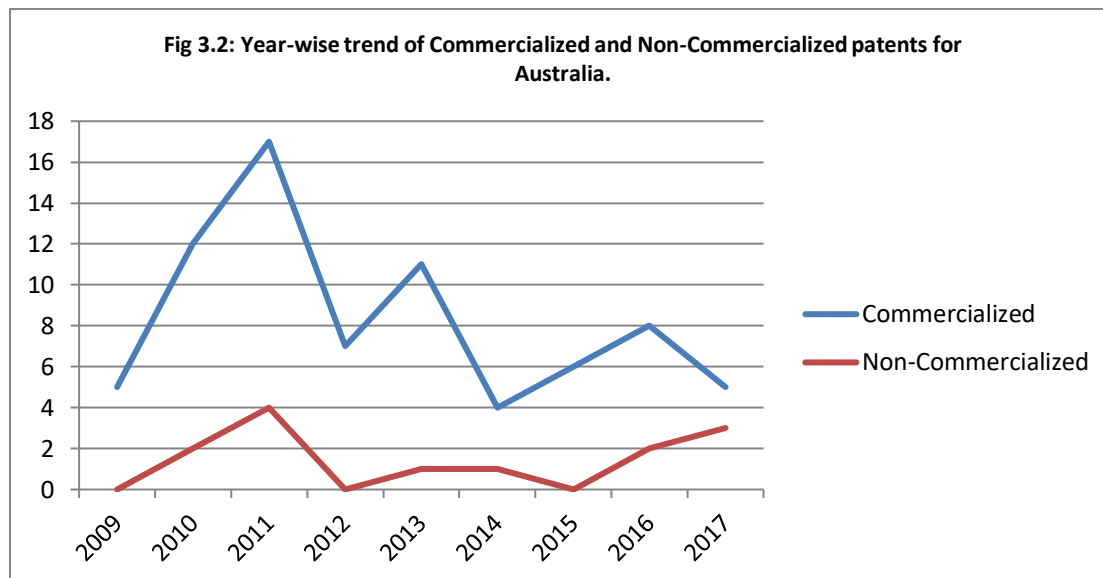
From figure 2.3 we observe that much like the USA companies dominate the patent ownership battle, followed by research organizations and individuals respectively. The proportions were comparably low till 2009 after which we observe a sharp increase in patents owned by organizations and corporations. A steep increase is observed in 2014 in the frequency of patents owned by Companies, after which the frequency plummets. The research organizations' frequency peaked in 2014 after which it behaves similarly. The individuals performed worst in terms of number of patents owned.

3). Australia:

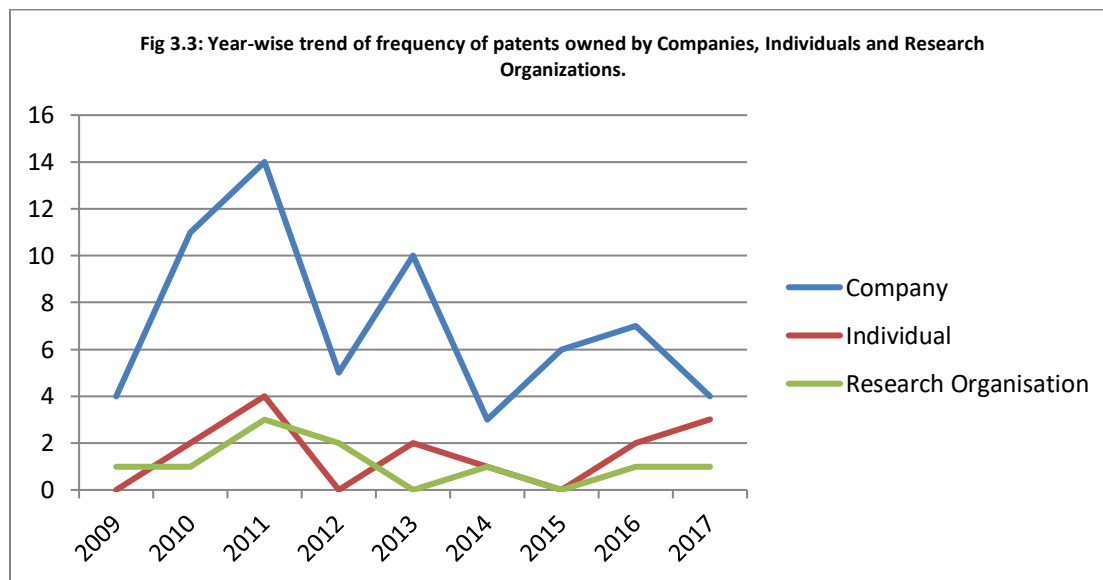


From figure 3.1 we observe that patents filed from 2003 to 2006 was more than the number of published patents. From 2006 to 2009 the proportion of patents that were published was more than the proportion of filed patents. The data on the frequency of granted patents are missing for the period

between 2003 to 2009. After 2009 we observe that the granted patents are high in number than the number of either published or filed patents. The overall data has hints of seasonal variations.

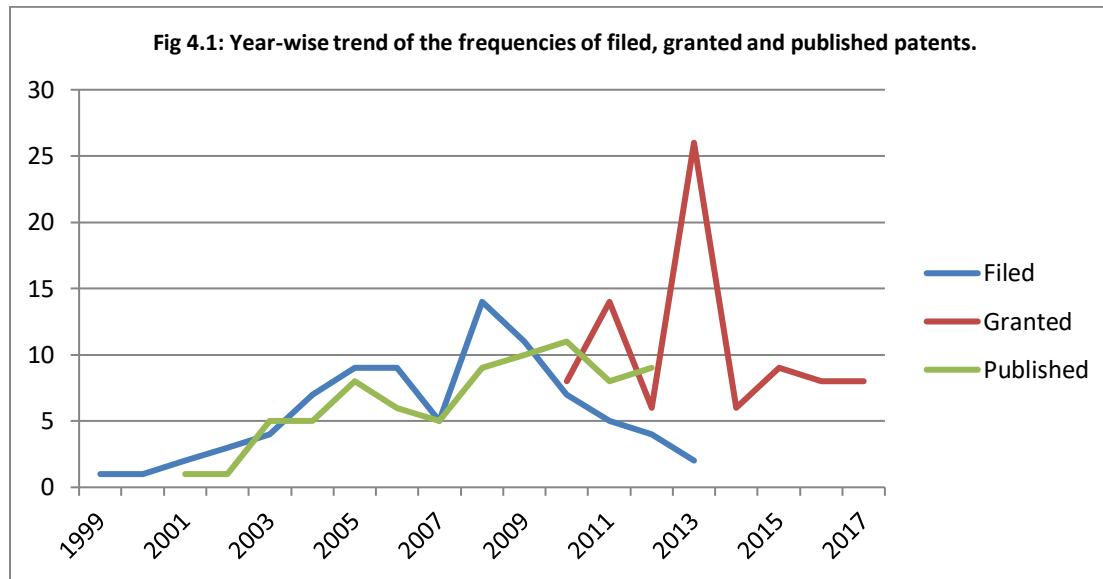


The data is indicative that of the total number of patents approved each year, the frequency of patents commercialized is has been on an average more than number of non-commercialized patents. Although there is a decreasing trend from 2011 onwards, the lacks of more data points make it difficult to say more. The data has hints of seasonal variations.

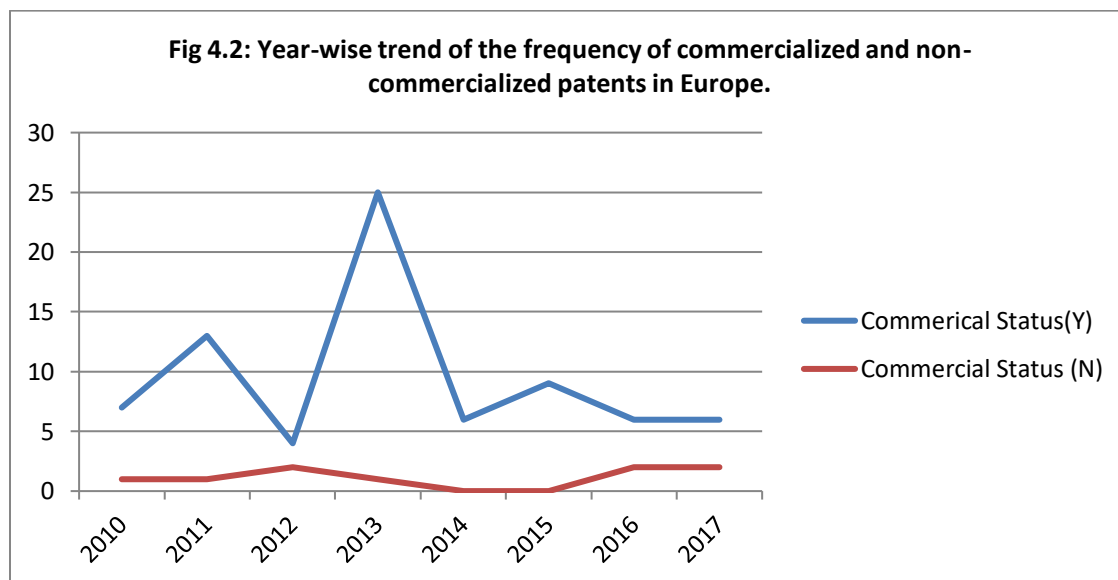


From figure 3.3 we observe that companies have been dominating the total number of patents owned over Research Organizations and individuals. It is quite evident that the total number of patents recorded was the highest in 2011, with companies with Companies owning most of these, followed by Individuals and research organizations respectively. There is an underlying downward trend in all three cases with hints of cyclic variations.

4). Europe:



From figure 4.1 we observe that there is an increasing cyclic trend in the published patents attaining the highest value in 2011. Due to presence of insufficient data for the granted patents the same could not be said for granted patents. The filed patents increase from 1999 to 2005 and then have a slight dip in 2007. It attains maximum frequency in the year 2008. There seems to be a huge spike in the frequency of granted patents in 2014, but due the absence of more data points corresponding to it we cannot conclude anything.



It is clear from fig 4.2 that of the total number of patents, those with commercial applications heavily outperform those with non-commercial applications. The trend seems to be a cyclic one with a peak in the year 2013.

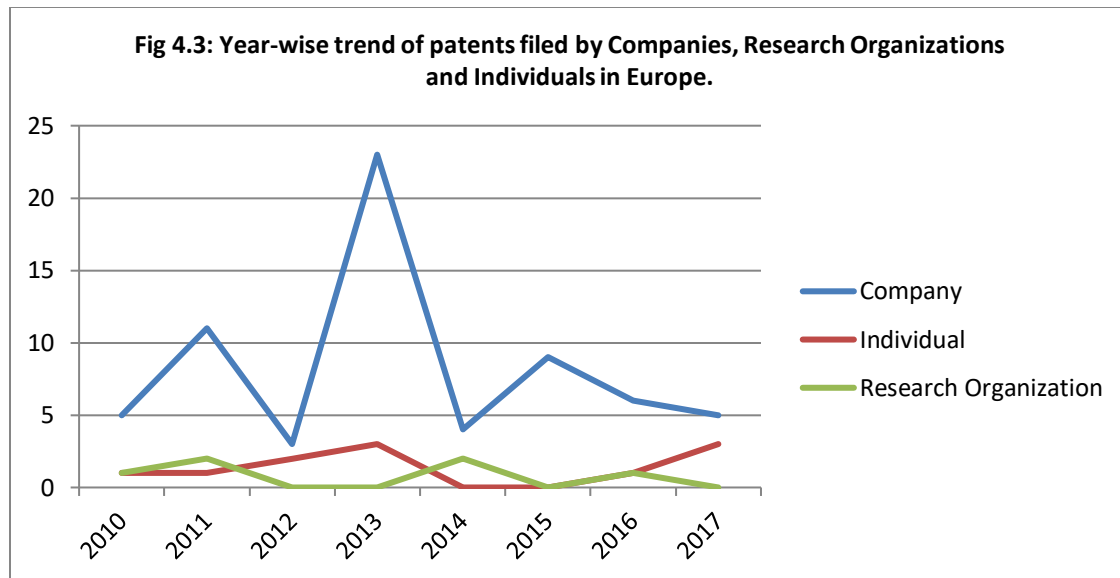
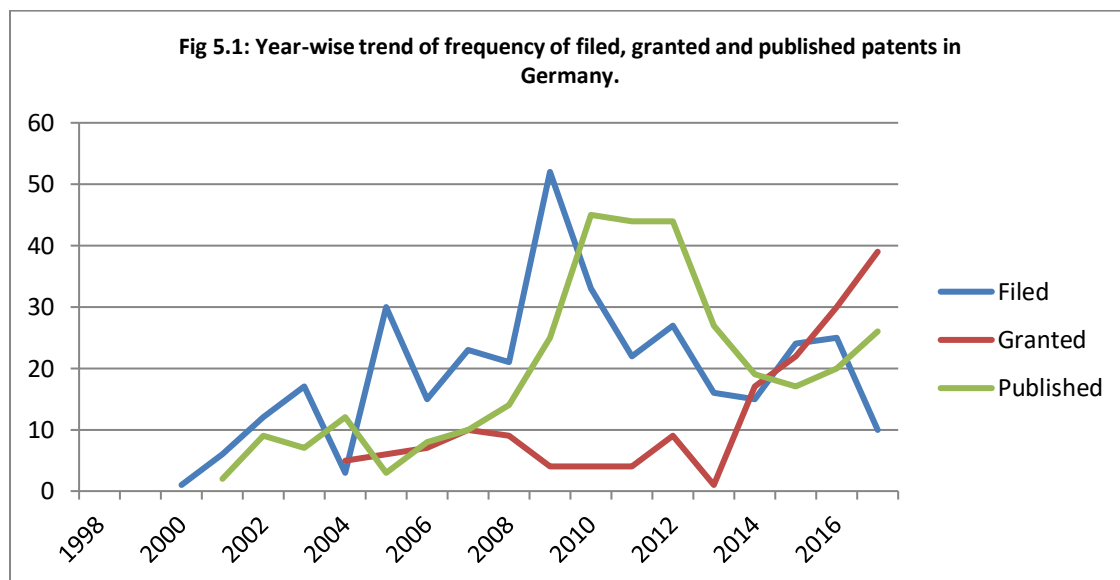


Figure 4.3 shows a clear dominance on part of the private companies in terms of innovation in the field of herbal technology as is indicated by the larger frequency of patents owned by companies in comparison to research organizations and independent inventors. The highest recorded number of patents owned by companies is in the year 2013. Research organizations seem to be doing poorly. Individuals have been contributing significantly and seem to be catching up with companies as observed near 2017.

5). Germany:



From figure 5.1 we observe that the incidences of filed, granted and published patents seem to be reflecting a positive linear trend over the years.

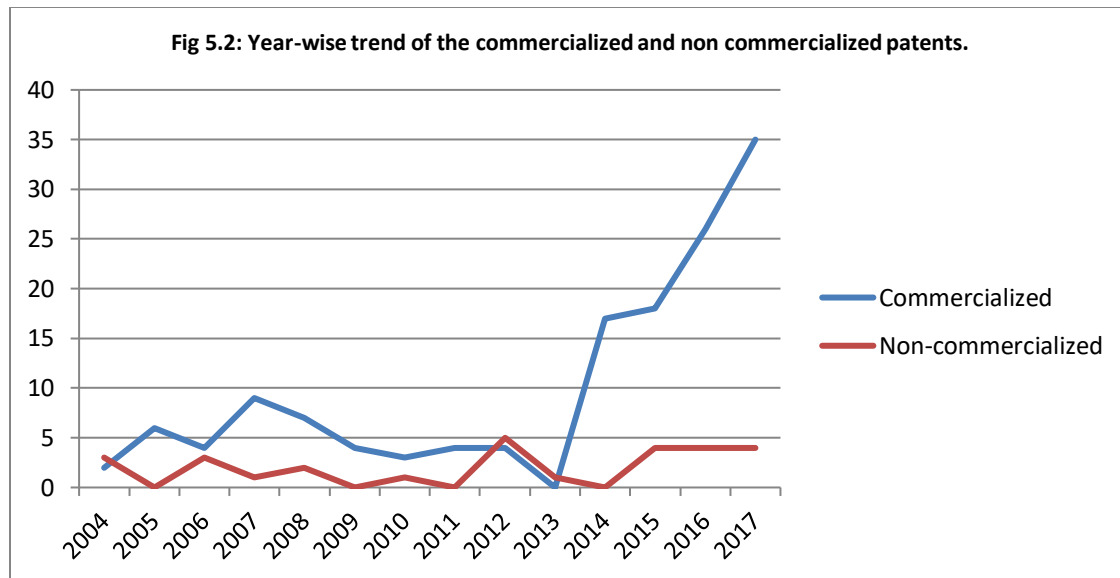
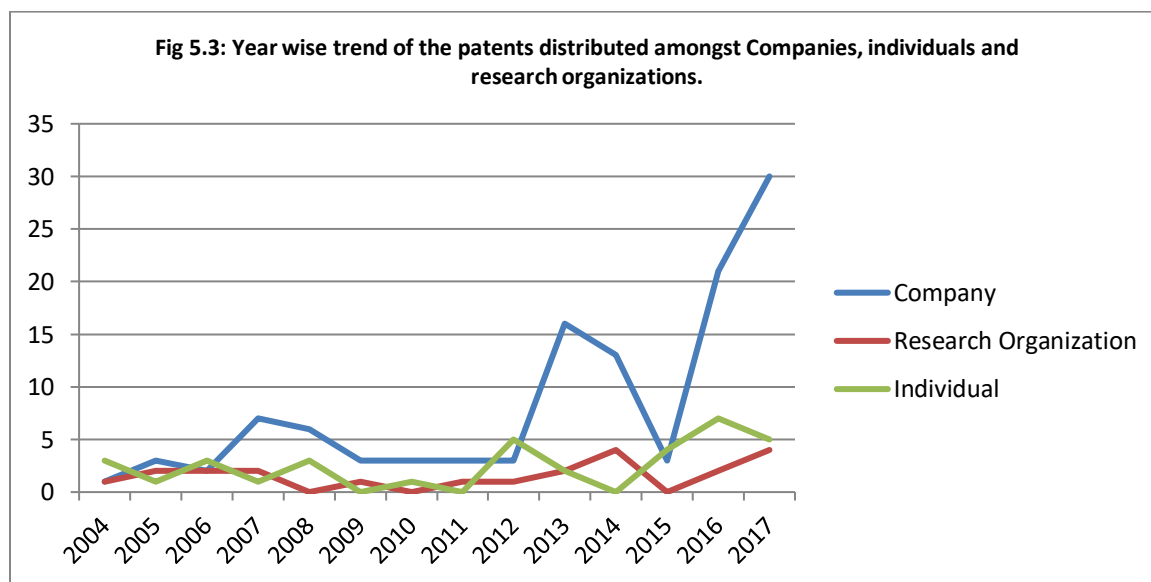
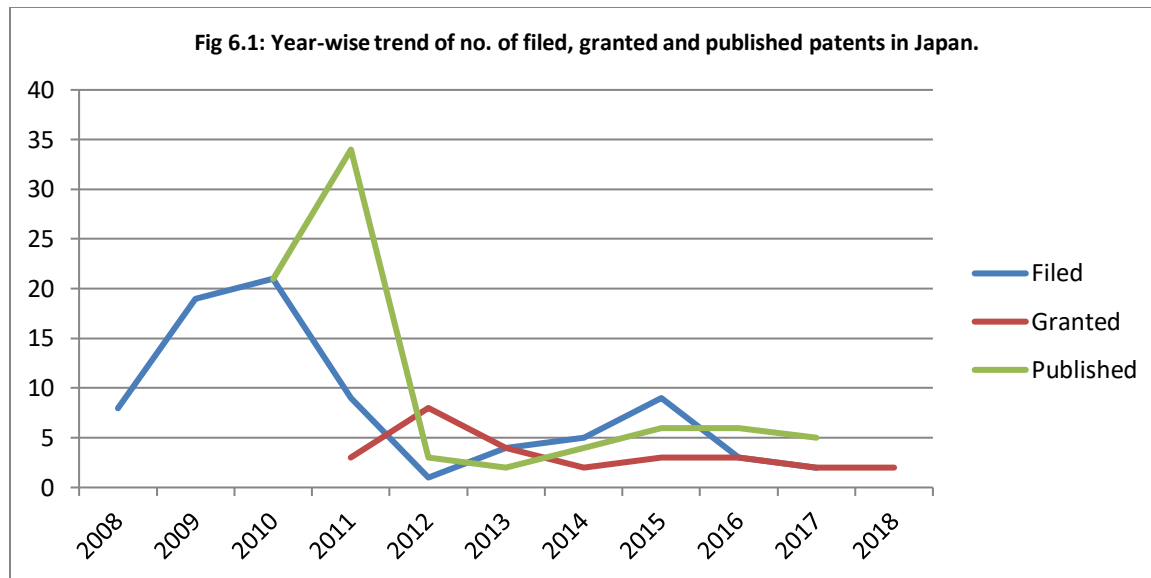


Fig 5.2 hints at an exponential rise in patents with commercial value 2013 onwards. With the exception of the period 2012-2013 where the numbers of non-commercialized patents seem to be more than the frequency of commercialized patents, commercialized patents seem to be more in numbers than non-commercialized patents. The commercialized patents have seen a slump in 2013-2014 margin before sky-rocketing in 2014.

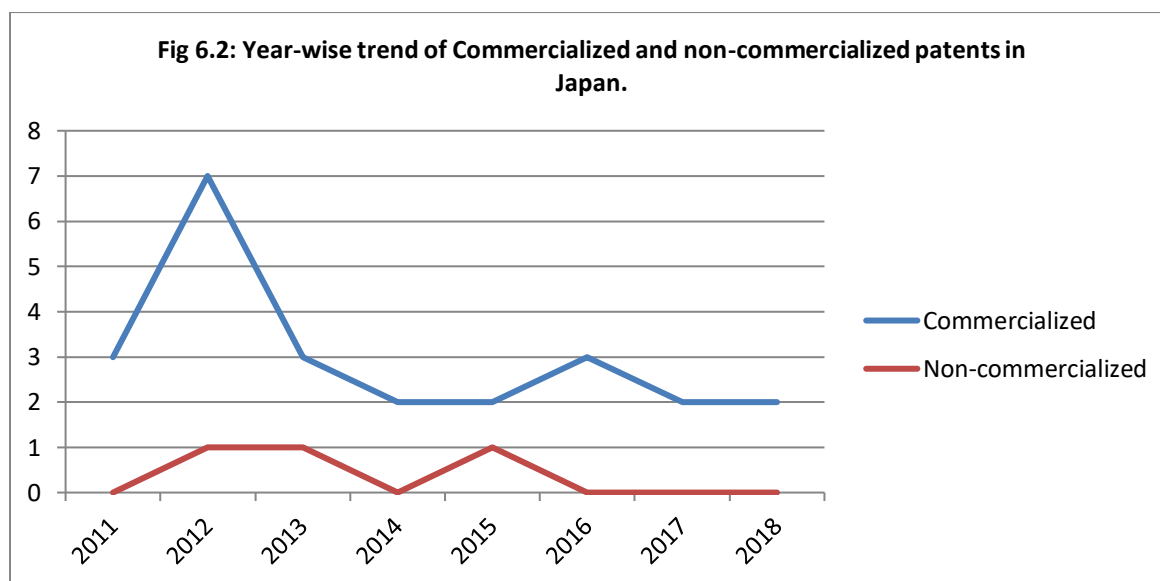


Much like in the previous cases the companies dominate throughout with the exception of the years 2004, 2006, 2012 and 2015 where individuals seem to outperform the Companies. Research organizations seem to be struggling. There seems to be a sharp increase in the number of company patents in 2016.

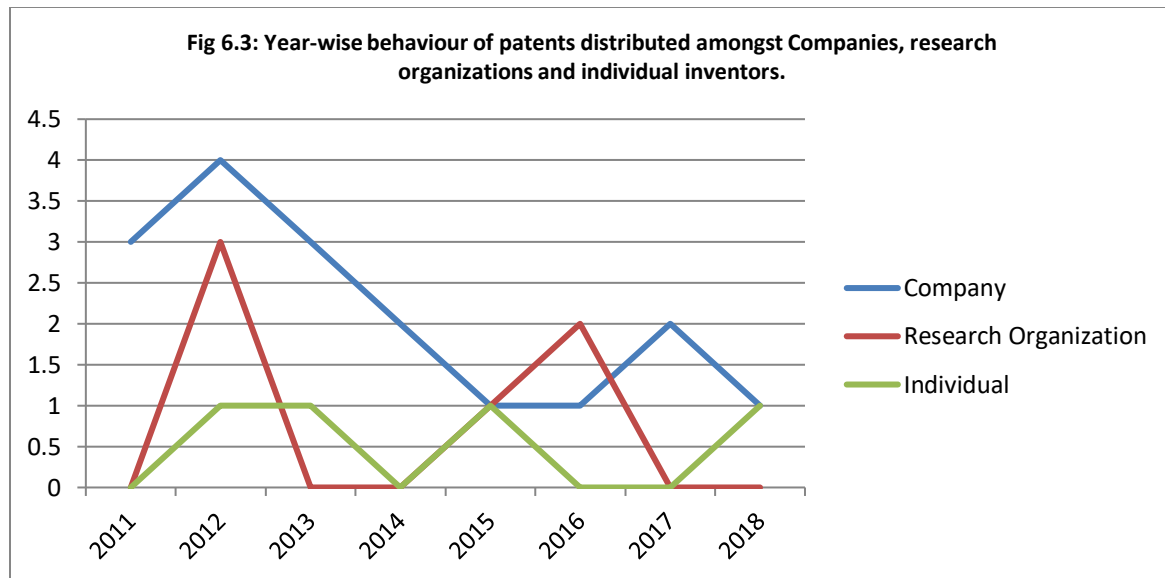
(3). Japan:



The frequency of filed patents increased to maximum in 2010 and then it exhibits a decreasing trend thereafter. The published patents line shows a maximum at 2011 and then follows a trend similar to the filed patents. The granted patents reach maximum in 2012 and then slacks of.

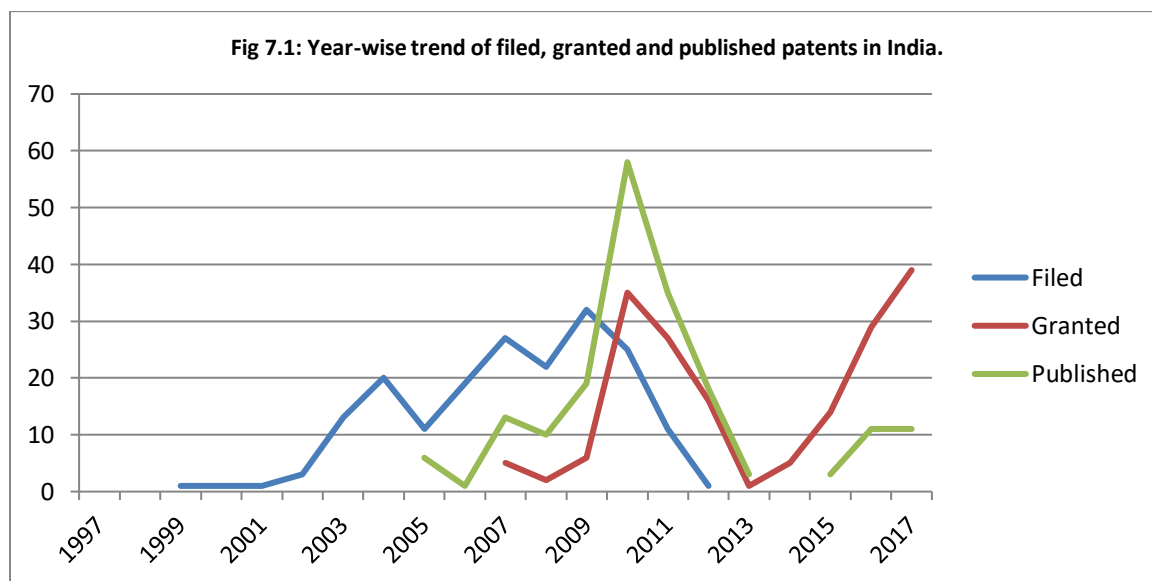


From figure 6.2 it is evident, much like the rest of the cases, most of the patents are of high commercial value. However the frequency of commercial patents over the years seems to be decreasing. Due to the lack of large number of data points it is difficult to say anything about the non-commercialized data.



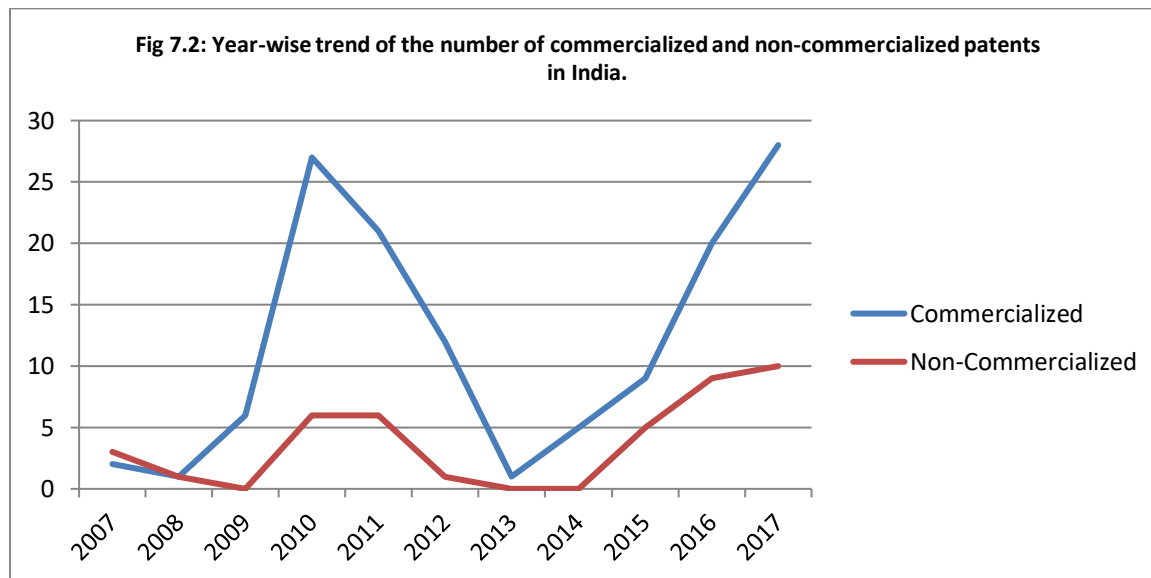
Once again, we can see that the private companies again dominate the patent frequencies.

(7). India:

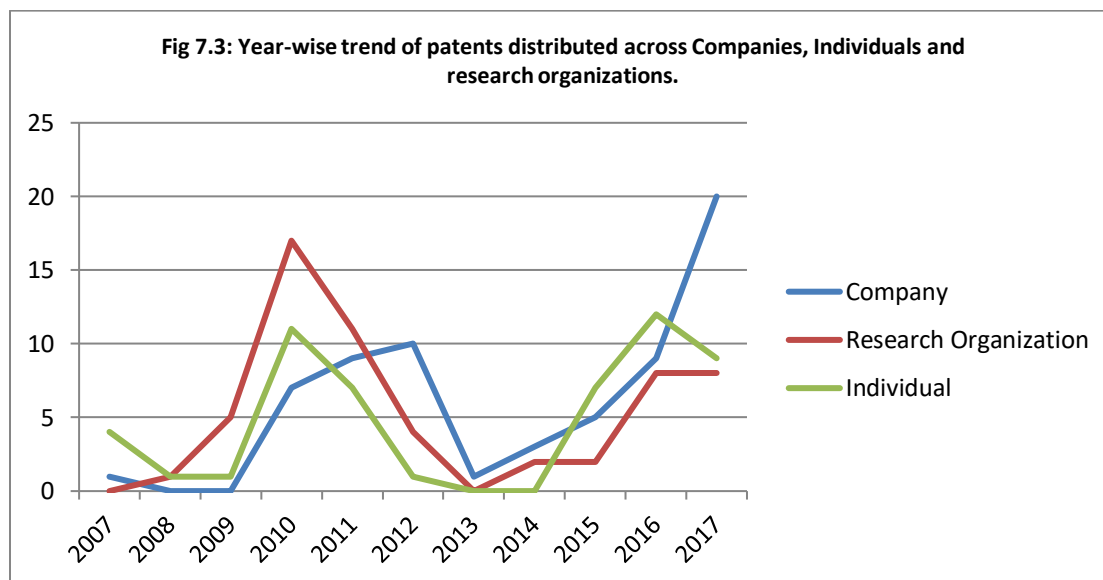


From figure 7.1 we observe that the number of filed patents was lowest in 1999. From there on it increased in frequency displaying a positive cyclic trend attaining maximum value in 2009. Thereafter,

the filed patents decrease in frequency attaining another minimum in 2013. The published patents attained a high value in 2011 after which it slumped. The frequency of granted patents increases from 2008 onwards attaining a peak in 2010 and then a bottom in 2013. It finally shows a rise attaining an all time high in 2017

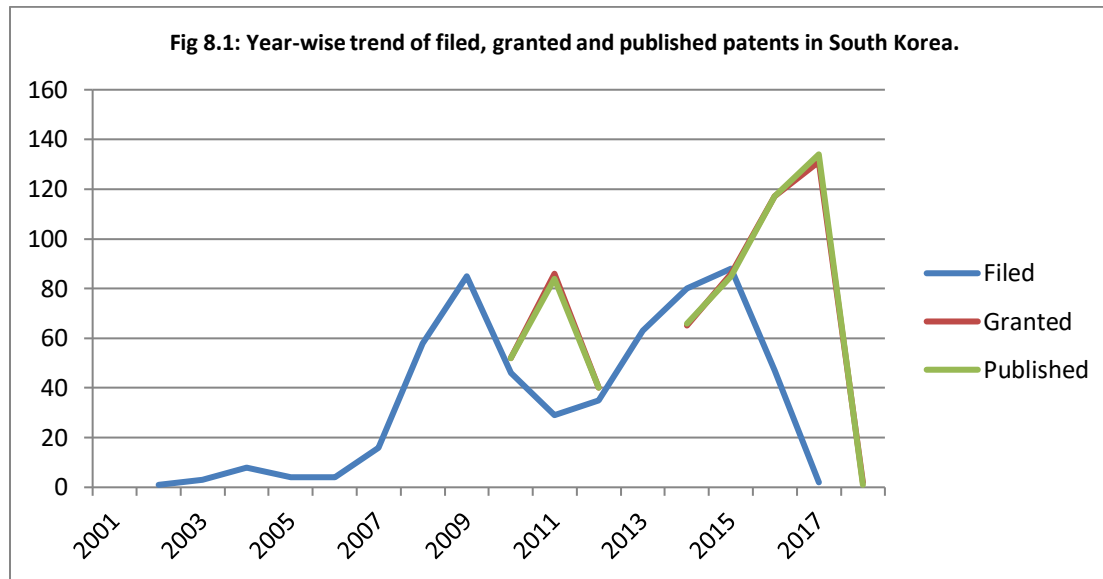


From figure 7.2 we observe that the Indian patents have been of highest commercial value in 2010. Thereafter, we see a fall in the number of commercialized patents attaining an all time low in 2013. However the number seems to be improving gradually getting better achieving an all time high in 2017.

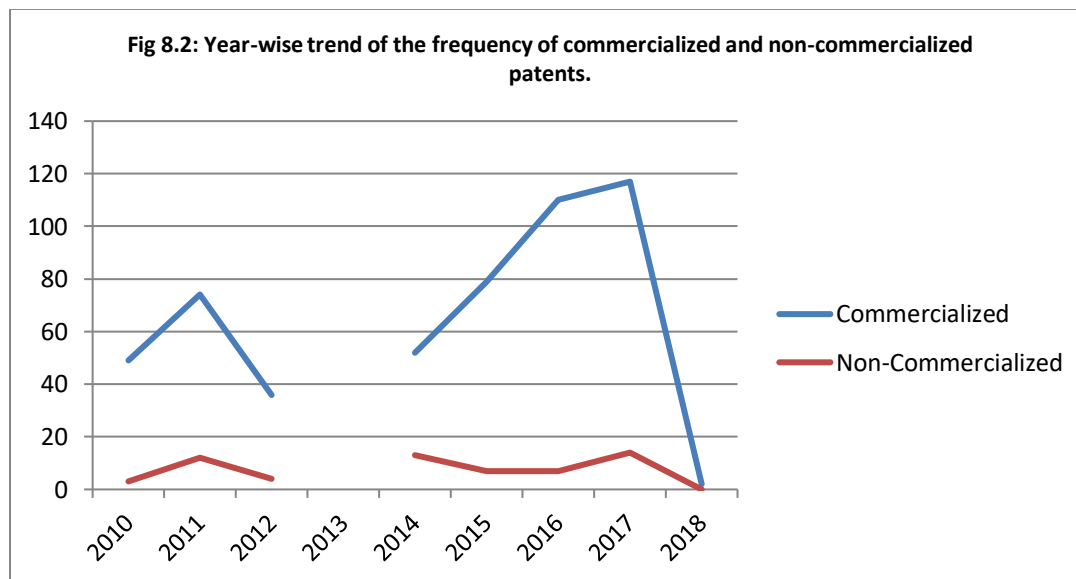


From figure 7.3 we observe that the research organizations used to dominate the innovation field of herbal patents contributing the highest in 2010. Thereafter, Companies seemed to catch up. They seem to dominate the herbal patents innovation field after 2012 with the exception of a small time period of 2015-2016 when the individuals seem to be leading the innovation.

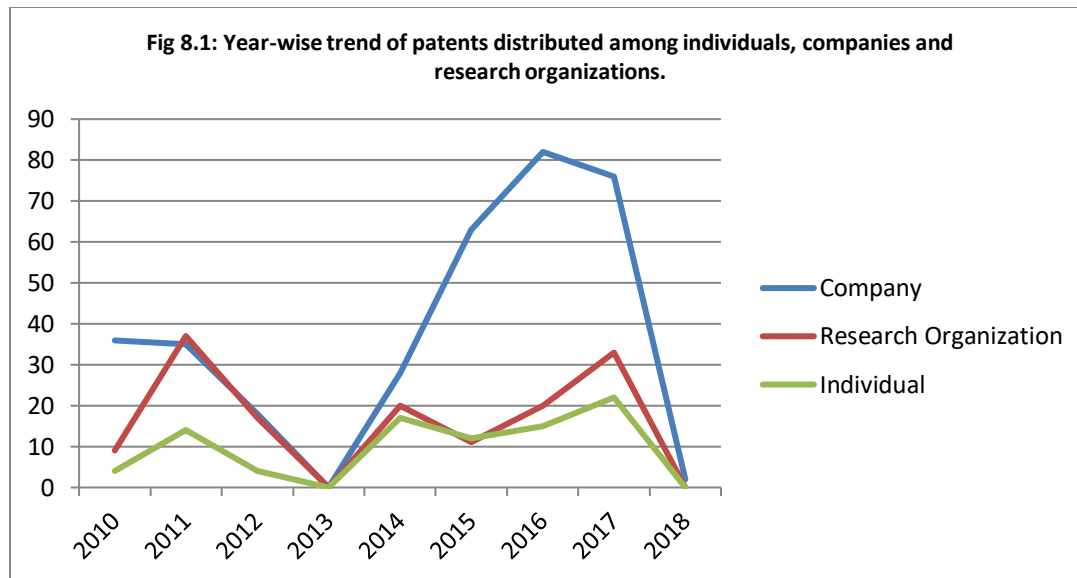
(8). South Korea:



From figure 8.1 we observed that the number of filed patents have been increasing since 2001 and reaches a high in 2016. Unfortunately, not much data is available. As a result of which not much can be drawn from this.



From figure 8.2 we observe that most of the patents throughout the years have been of high commercial value. The highest number of commercialized patents can be observed in 2018.



Clearly the Private companies have been dominating over individuals and research organizations. The companies have the highest output in 2016.