Red Internacional de Investigadores en Competitividad
Memoria del VIII Congreso
ISBN 978-607-96203-0-3

RED INTERNACIONAL DE INVESTIGADORES EN COMPETITIVIDAD

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Innovation in European Chemical Industry: A Focus on Large Chemical Companies

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ABSTRACT

The European chemical industry supplies to virtually all sectors of the economy and accounts for 17.8 % of the total chemical sales in the world. This paper gives an overview of the European chemical industries and focusses on the top fifteen chemical companies of this region. It gives an idea about the current problems this industry is facing in Europe and shows how the region and the top companies are investing in R&D to bring innovation to overcome the current challenges. The study shows that the R&D spending in absolute term has remained similar over the years and it is still globally the largest investor for the R&D activities. BASF has been making the largest R&D spending followed by Bayer and Syngenta while the R&D intensity is highest for Syngenta and Bayer. BASF and Bayer top the list in patent application and number of granted patent.

Keywords: Innovation, Competitiveness, Technology, Patenting, Chemical Industry.

RESUMEN

La industria química europea suministra prácticamente a todos los sectores de la economía y representa el 17,8% de las ventas totales de productos químicos en el mundo. Este artículo ofrece una visión general de dicha industria y se centra en las 15 primeras empresas químicas de esta región. Da una idea de los problemas actuales que enfrenta en Europa, después de la crisis económica y muestra cómo las empresas están invirtiendo en I+D para que la innovación los ayude a superar los desafíos actuales. Se muestra que el gasto en I+D en términos absolutos se mantuvo similar a lo largo de los años y sigue siendo el mayor inversor a nivel mundial para estas actividades. En inversiones en I+D, BASF es el mayor seguida por Bayer y Syngenta, mientras que la intensidad de la I+D es mayor para Syngenta y Bayer. BASF y Bayer son líderes en el número de patentes concedidas.

Palabras clave: Innovación, Competitividad, Tecnología, Patentes, Industria Química.

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INTRODUCTION

According to Arora et al. (1998), the chemical industry is one of the largest and most R&D-intensive manufacturing sectors in all advanced economies, and its innovative patterns and productivity growth process can have profound impacts on economic growth as a whole. In the recent study by Tullo (2013), out of the 50 top global chemical companies, 19 are headquartered in Europe (Table 1). They consist of 14, 5 % of Global chemical sell. The objective of this paper is to give an overview of the European chemical industry and the problems currently faced by it. According to the industry Guru, more innovation and research are key to securing the future of the European chemical Industry. The paper also talks about the research and development investment of European chemical industry in general and also the top fifteen European chemical companies in particular. We also analyse the patent landscape of these fifteen large companies to understand the reach activities and the innovation trend of them.

EUROPEAN CHEMICAL INDUSTRY: AN OVERVIEW

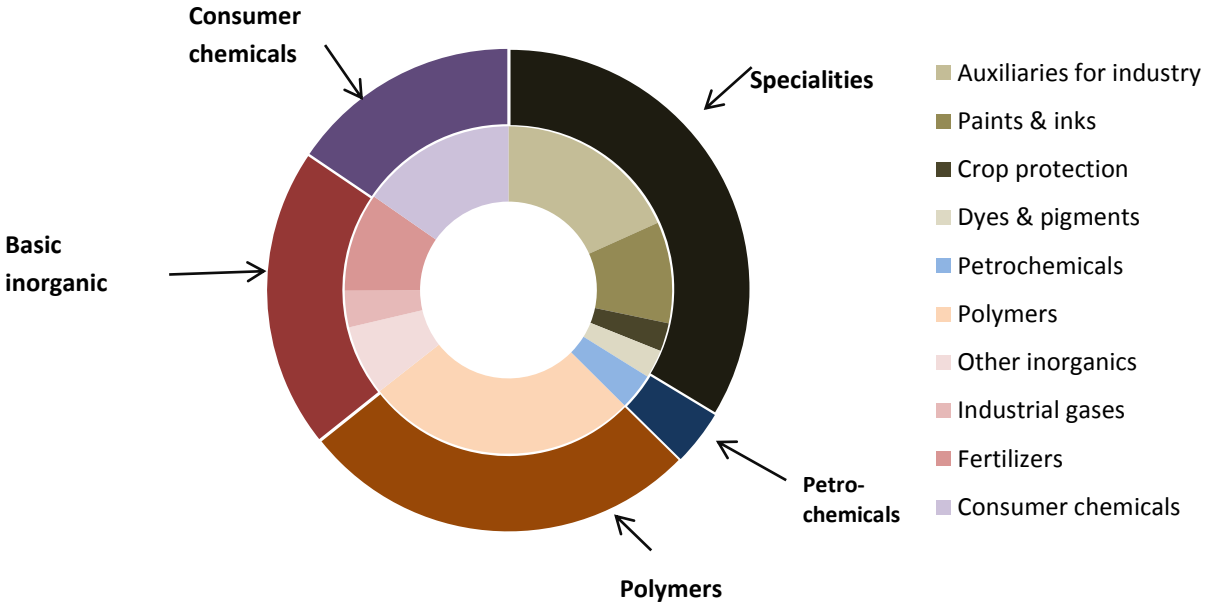
The chemicals industry is present everywhere in our daily lives. Modern society and its life style are unthinkable without its products. The European chemicals industry is key for economic development and wealth, providing modern products and materials and enabling technical solutions in virtually all sectors of the economy. More than any other manufacturing sector, this industry provides the technical basis for other economic activities, both in traditional sectors such as agriculture, construction, textiles, clothing and footwear, and in technologically advanced industries ranging from automobiles, modern healthcare to electronics and oil and gas.

The European chemical industry is a world-leading, robust sector, in terms of productivity and employment. But it is also the root of all other industries. Innovation in the chemicals sector not only provides Europe with raw materials for consumer products, health products, information technology industries and contributes to global food supply. It also leads to the development of advanced materials (such as hybrid and lightweight materials for automotive and aerospace, materials for tissue engineering, insulating and self-cleaning coatings for energy-efficient buildings and energy recovery and storage for e.g. electric mobility), and advanced process technologies that enable more flexible production with more efficient use of energy, feedstock and water. Furthermore, it contributes to improving recyclability and increases the use of renewable feedstock; visionary projects such artificial photosynthesis hold ambitious promises that would revolutionize our economy.

The European chemical industry supplies virtually all sectors of the economy and accounts for 17.8 % of the total chemical sales in the world (Cefic, 2014). The European chemical industry is based on the following four categories of products: Basic chemicals, Specialty chemicals,

Petrochemicals, Polymers, Pharmaceuticals, Consumer chemicals. The industry has an extremely broad range of customers. Only 30 % of the combined output of the chemicals and pharmaceuticals industries is sold to private households and other end users.

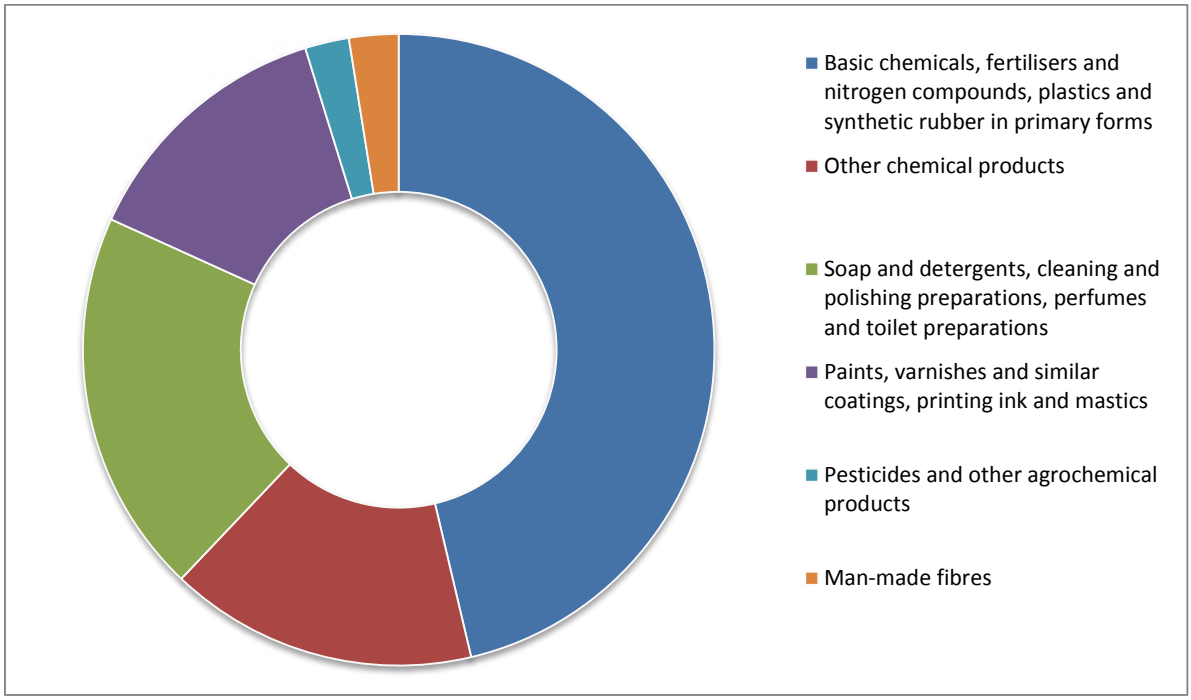
Figure 1: The product mix of European chemical Industry



Data Source: Cefic, 2014, Graph: Author

With a workforce of 1.2 million and sales of €642 billion, it is one of the biggest industrial sectors and an important source of direct and indirect employment in many regions of the European Union (Cefic, 2013). The chart below shows the distribution of the direct work force based on the product mix. It is seen that bulk of the work force is employed in producing the basic chemicals and its related products.

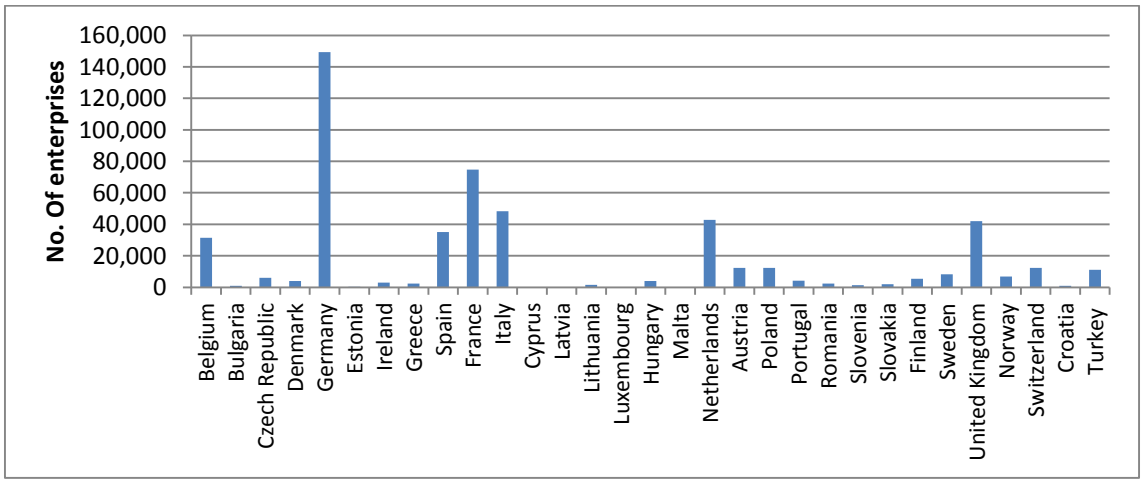
Figure 2: Percentage of employees in each sector of European chemical industry



Data Source: EUROSTAT, 2013; Graph: Author

The bulk of European chemical companies are located in seven EU countries: Germany, France, Italy, UK, Netherlands, Spain and Belgium. Among them, Germany is the leader with more than 140000 enterprises followed by France and Italy.

Figure 3: The number of chemical companies in various EU countries.

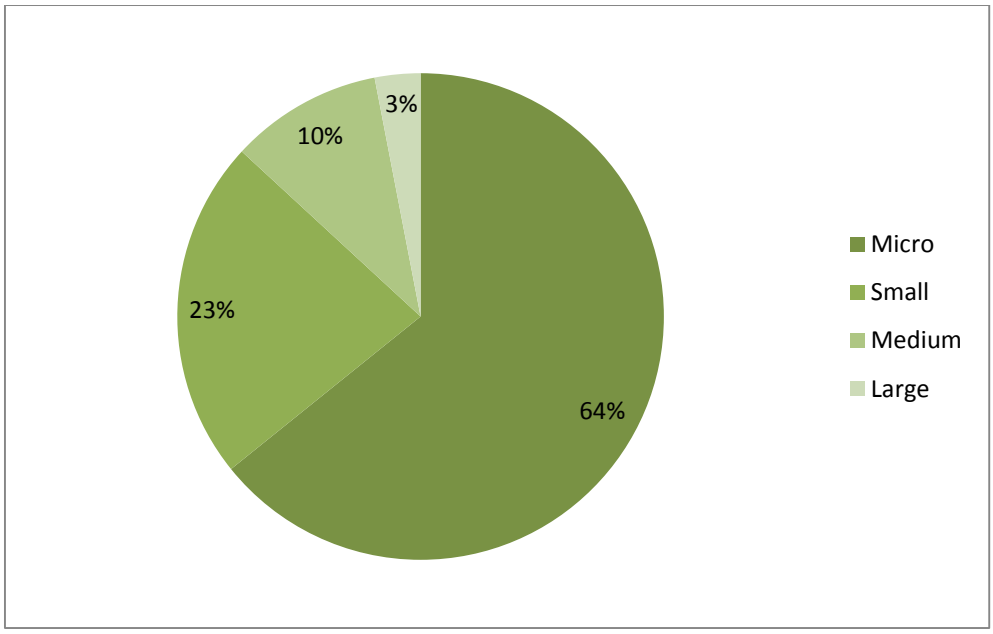


Data Source: EUROSTAT, 2013; Graph: Author

In the EU, there are around 29,000 semi-medium, medium and large chemical companies which employ a total staff of about 1.2 million. This is equivalent to 4% of the manufacturing industry's overall workforce. Employment in the industry has decreased by 2% annually over

the past ten years. 4 % of all chemical companies have more than 250 employees and these are responsible for 72 % of all sales and 65% of total employment (EUROSTAT, 2013). They make a major contribution to the transfer of innovation generated upstream in the chemicals value chain to downstream manufacturing industry. As producers of basic and specialties, large chemical companies are often supplier to SMEs and also source for innovation.

Figure 4: The percentage of companies of various sizes in Europe.

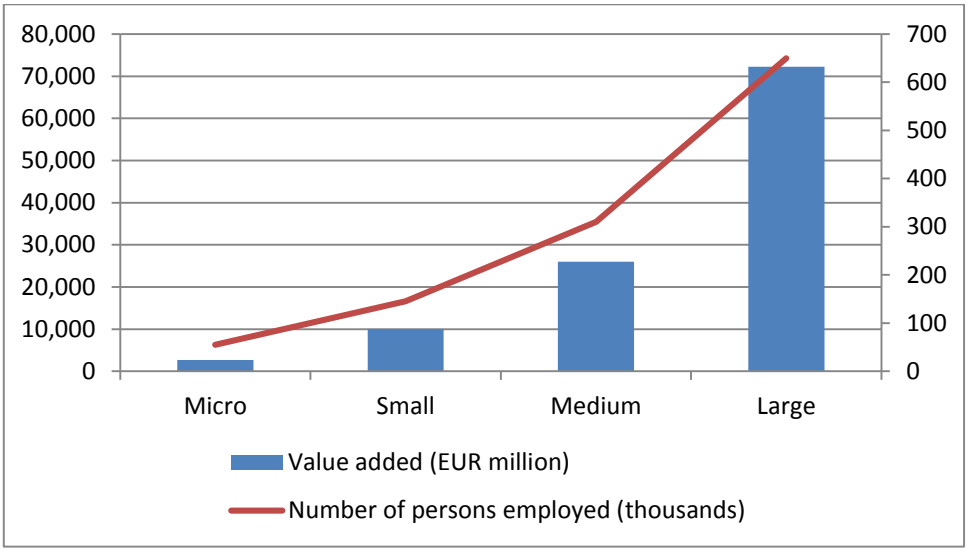


Data Source: EUROSTAT, 2013; Graph: Author

Even though the large chemical companies makes up only 3 % of total chemical companies, there contribution is significant as they are the largest supplier of product and also the biggest employer. The grouping of the enterprise is based on the following criteria:

- small enterprises: with 10-49 persons employed;
- medium-sized enterprises: with 50-249 persons employed;
- large enterprises: with 250 or more persons employed.

Figure 5: The value addition of different sizes of EU companies and the number of persons employed in each size.



Data Source: EUROSTAT, 2013; Graph: Author

Since large companies of Europe contributes significantly on value creation and also the largest employer, understanding of their innovation trend is very important. Table I shows the list of the top 19 chemical companies headquartered in Europe. The paper will focus on the R&D investment and patent landscape analysis of these 19 companies.

Table I: The top 19 chemical companies of Europe.

	Companies	**Headquater**			**Companies**	**Headquater**
1	BASF	Germany		11	Yara	Norway
2	Shell	Netherlands		12	DSM	Netherlands
3	LyondellBasell	Netherlands		13	Lanxess	Germany
4	Bayer	Germany		14	Syngenta	Switzerland
5	Ineos Group	Switzerland		15	Borealis	Austria
6	AkzoNobel	Netherlands		16	Arkema	France
7	Air Liquide	France		17	Eni	Italy
8	Evonik	Germany		18	Styrolution	Germany
9	Solvay	Belgium		19	Total	France
10	Linde	Germany				

Data Source: Tullo, 2013; Table: Author

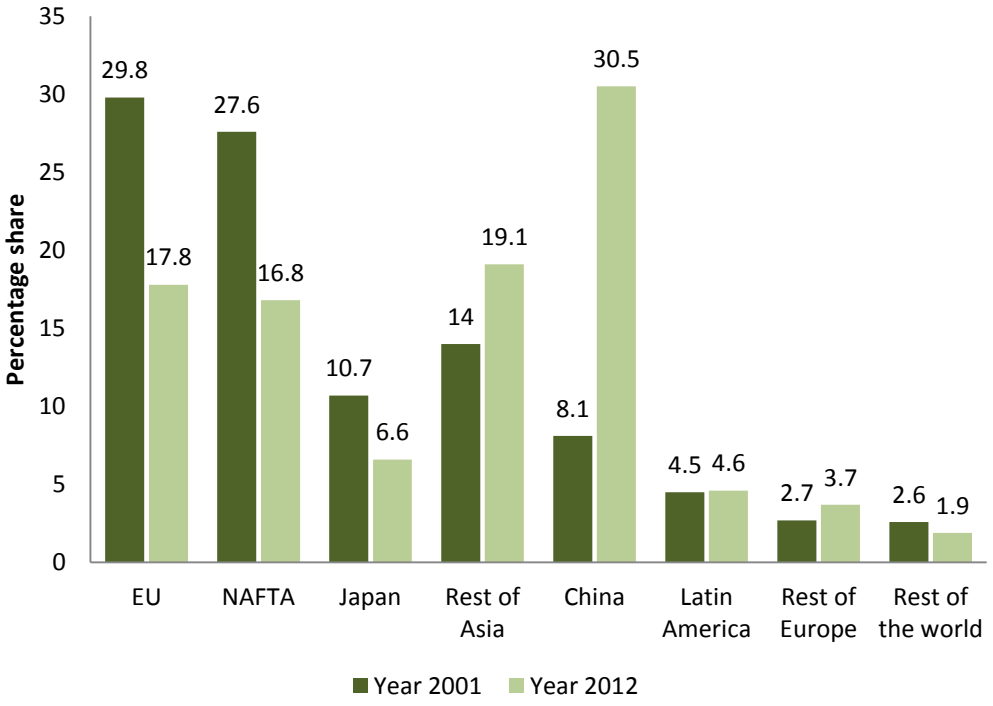
It is the time for the big European players to prepare to defend their home markets, develop growth platforms based on innovation and better value capture and build the skill and scale required to compete. The key to survival for European chemical companies is based on innovation at three different levels-moving from bulk chemical production to the specialty end of the value chain, leveraging their traditional advantage in technology and establishing closer customer and competitor relationships through joint development agreements, acquisitions, value add services and other strategies initiatives (Schulz et al., 2012).

So, in perspective of the current scenario of the chemical industry in Europe, the study is even more relevant. The project studies the innovation that this industry has seen in the recent past. There is also intent to understand the trend and source of such innovation also to determine the determinants of such innovation in fifteen large chemical companies.

PROBLEM OF THE EUROPEAN CHEMICAL INDUSTRY

Over the years, the European chemical industry has shown considerable resilience, strength and adaptability. In 2007, 12 of the 30 leading chemical companies in the world were headquartered in Europe, representing 10 percent of world chemical sales while in 2012, 11 of the 30 top global chemical companies were from Europe (Cefic, 2013). Like virtually every other industry worldwide, the European chemical industry has felt an enormous impact from the recent global recession. At its lowest point in March 2009, the industry saw a monthly year-on-year decline of 13.2 percent, a figure that if annualized would represent an output decline of approximately EUR56 billion (Cefic, 2013). In Europe, the chemical industry saw massive reductions in demand for plastics, paint and man-made fibers, especially in key markets such as automotive and construction. This fall in demand led to a severe destocking by many companies, with some companies (particularly in the base chemicals, polymers and specialty chemicals sectors) watching their own output decline by 30 to 60 percent. Tight credit continues to hold back recovery. Many large companies are finding major credit lines both difficult and expensive to obtain. The European chemicals industry is currently facing unprecedented challenges arising from the need to address: Strong competition from emerging countries, notably in Asia, the Middle East and Russia. The European chemical industry share of world chemical sales declined from 29,8 % in 2001 to 17,8 % in 2012 which translates in 34 % decline over a period of 10 years (figure 6).

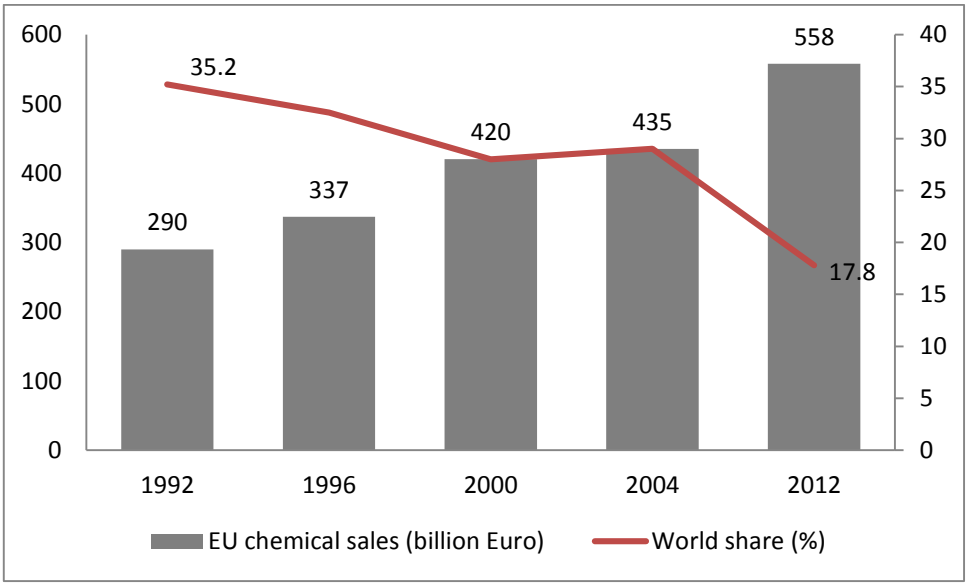
Figure 6: Contribution of each region to global chemical sell for the year 2001 and 2012.



Source: Cefic, 2014

The graph below shows even though EU chemicals sales have increased over time, they have lost in world market share depicting that the other geographies has increased at a much faster rate.

Figure 7: EU chemical sales over times and declining trend of percentage of total world shares.



Data Source: Cefic, 2014

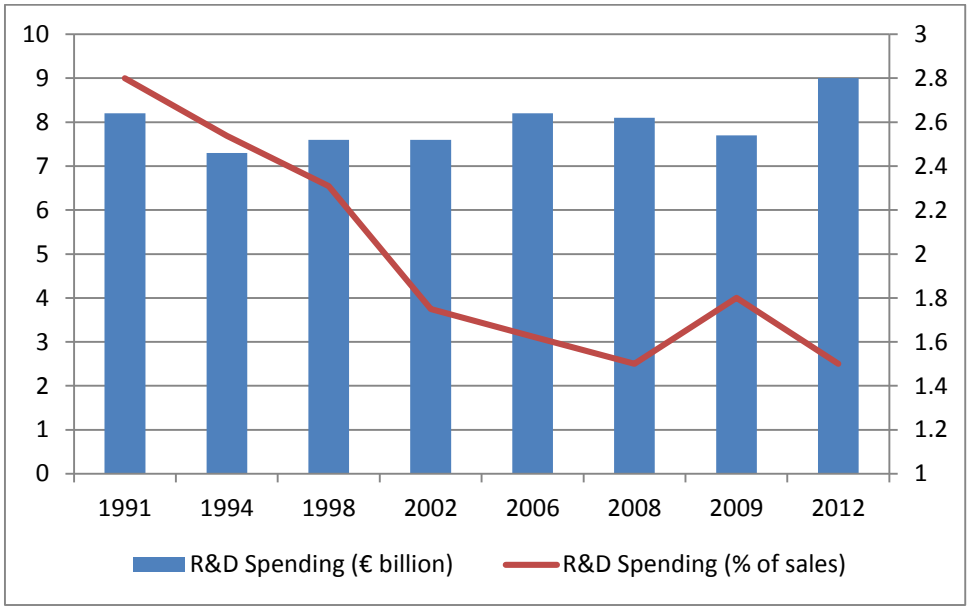
R&D INVESTMENT

European leadership in science, research and technology is the pillar to becoming a key player in the field of innovation. While innovation is more than research and development, the link between research in chemistry (and related sciences) and innovation is particularly strong in the chemicals industry. Overall, it is necessary to increase the quantity of research. Excellence in science and research must get more opportunities to unfold its inherent impact on open innovation along technology driven paths. In general, companies are urged to review their R&D plans and to extend corporate research programmes to medium and long term objectives. Furthermore, product innovation, competitiveness, sustainability and resource efficiency provide important opportunities for differentiation and, potentially, growth. Innovation will have high positive impacts in economic terms such as improving the performance and competitiveness of existing industries, the development of new industries and solutions as in products and services; in social terms, such as keeping and creating new high value-added jobs and leading to healthier and more comfortable lives; and in environmental terms such as reducing the pressure on our resources by increased efficiency through optimised production processes and products.

The European chemical industry is therefore uniquely placed to grow in the internal market as well as develop a global competitive advantage in development-driven and breakthrough.

Many of the challenges faced by the chemicals industry affect economic activity and society as a whole and concern manufacturing industry across the board. Innovation is indispensable to overcome these challenges, avail of related opportunities and ensure the industry's further success. The chemicals industry has a key role through its enabling function for the entire economy. It shapes economic activities in other sectors. It is an irreplaceable provider of innovation to 'downstream' industries and an essential component of value chains that end with the great majority of consumer products. This means that the industry will always have a strategic, economic and social importance. Europe must retain a strong base in this sector, not only because of its economic weight, but also because of its ability to continually generate innovation critical to meeting the major challenges of modern societies. In European Union, R&D spending in terms of absolute value has remained almost constant while R&D spending as a percentage of sales has steadily declined as shown in the figure 8.

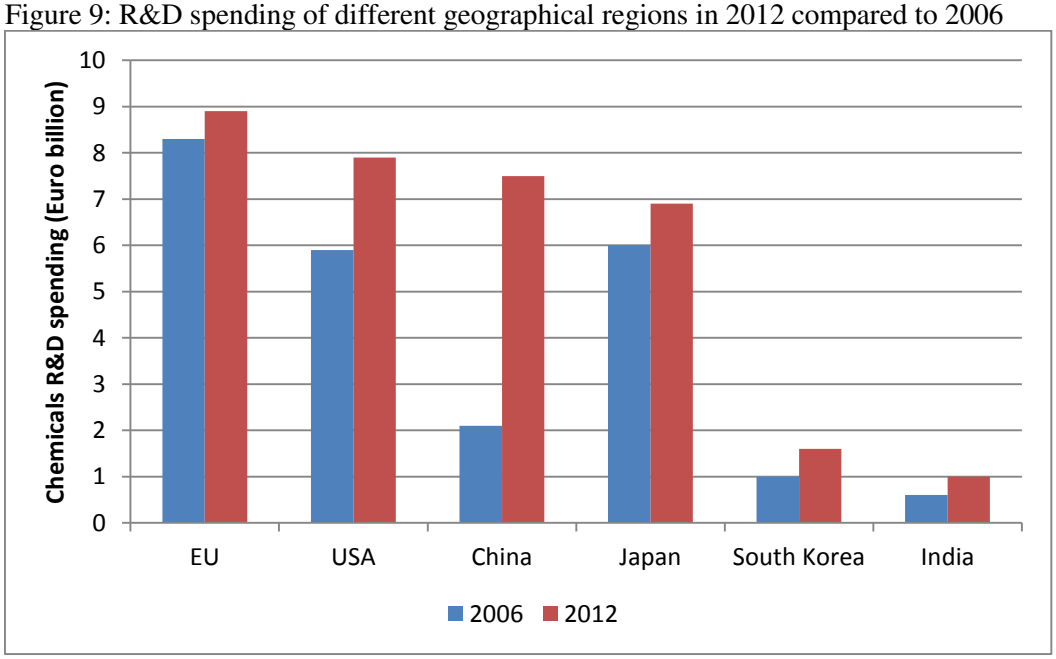
Figure 8: R&D spending and R&D spending as a percentage of total sales.



Data Source: Cefic 2014, Graph: Author

Even though the R&D spending in absolute term has remained almost the same over the years, it is way ahead compared to other geographical region. In case of china there has been three folds increase of R&D investment in 2012 compared to that of 2006. For other regions, the R&D spending has slightly increased.

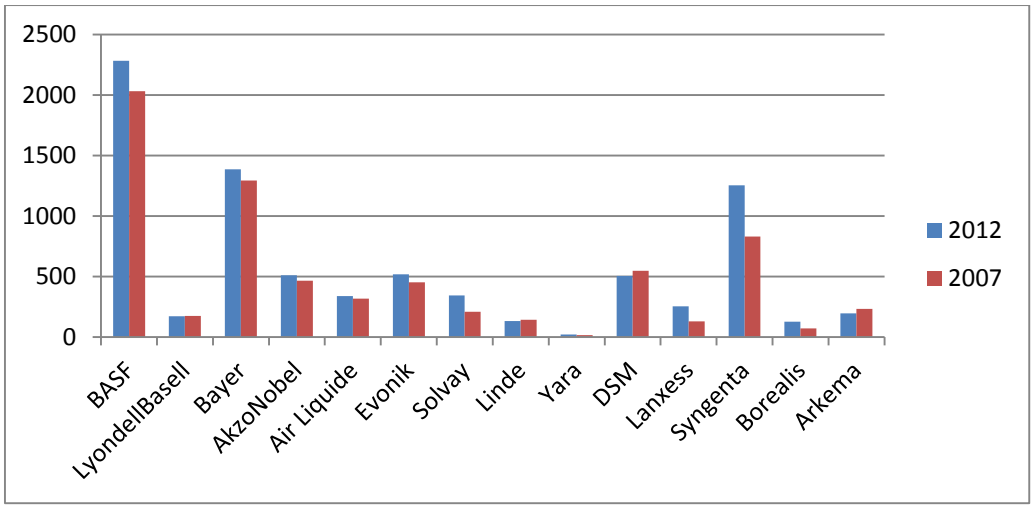
Figure 9: R&D spending of different geographical regions in 2012 compared to 2006



Data Source: Cefic,2014

It will be interesting to understand the large European chemical companies´ strategy in terms of R&D investment. It is seen BASF as the leader followed by Bayer. The Other top investors in R&D are Syngenta, Evonik, DSM and Akzo Nobel.

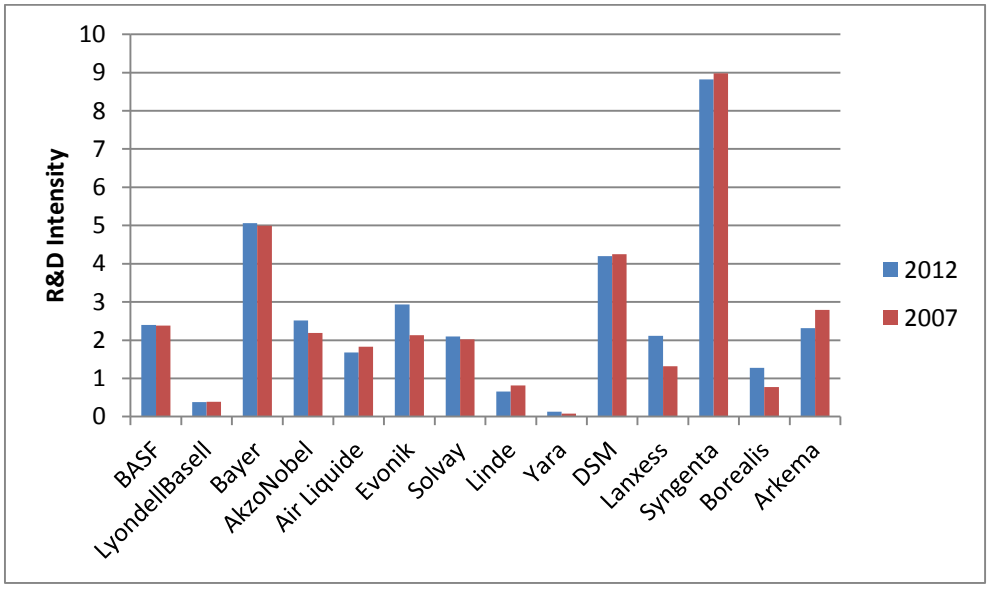
Figure 10: Investment in R&D for the top European chemical companies.



Data Source: Davis, 2013; Author´s analysis

R&D intensity is the ratio of the R&D investment to total sales and expressed as percentage. It is another measure of efficiency of R&D activities. Syngenta has the highest R&D intensity followed by Bayer and DSM.

Figure 11: R&D intensity of top chemical companies of Europe



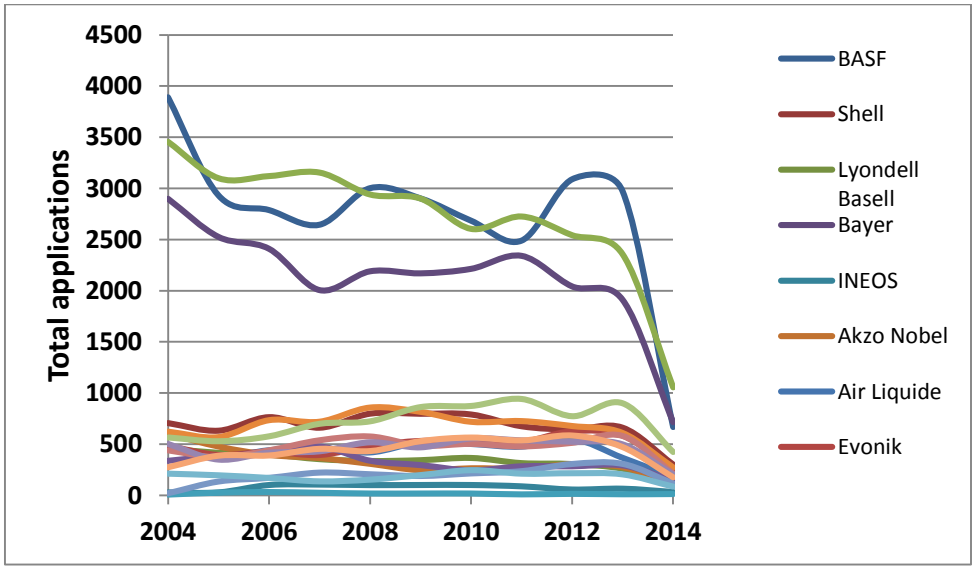
Data Source: Davis 2013, Author´s analysis

PATENTING OF THE TOP EUROPEAN COMPANIES

Patents are undoubtedly one of the instruments that firms use to capture rents from innovation. An application for a patent has to meet certain requirements: the invention must be novel, involve a (non-obvious) inventive step and be capable of industrial application. A patent is valid in a given country for a limited period (generally 20 years). Among the few available indicators of technology output, patent-based indicators are probably the most frequently used.

The most commonly used indicators are counts of patent family that share a number of common elements. The paper focuses the study of patent landscape of the top chemical companies in Europe. In the list of top nineteen chemical companies, three oil companies were included. For the sake of not mixing up the patent from chemical industry with patents from other application, these three companies are ignored in this study. The graph 12 shows the patent applications made by these companies over last ten years in all the prominent patent authorities all over the world. In order to avoid counting more than once of the same type of patent applied in two different countries, patent families were counted instead of actual patent number. A patent family is a set of patents taken in various countries to protect a single invention (when a first application in a country – the priority – is then extended to other offices). In other words, a patent family is the same invention disclosed by a common inventor(s) and patented in more than one country. It is seen that BASF, Bayer and Lyondell Basel are the top applicants. All other companies were predominately lower number of application, while Solvay showed an upward trend. So it can be stated that these three companies are forefront of reach and development.

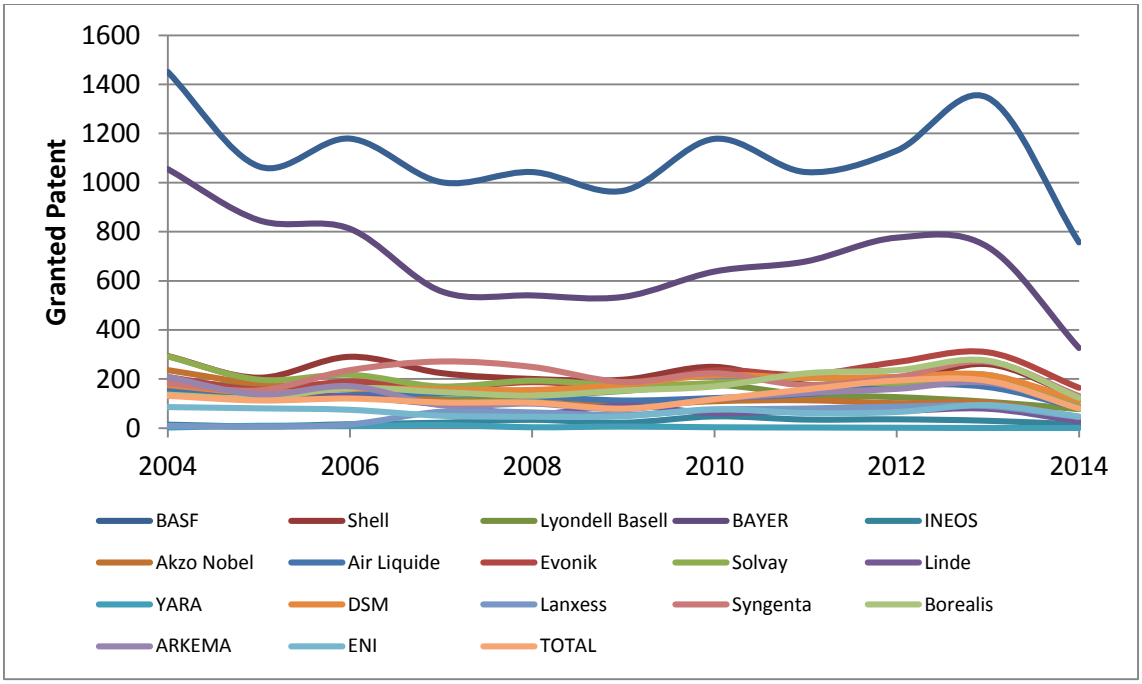
Figure 12: Global patent application and patent related document publication.



Data Source: Thomson Innovation, 2014; Author´s analysis

The graph below shows the number of granted patent families for the top fifteen chemical companies of Europe. The granted patents were searched from the database of the most important patent authorities: US, European, Australian, Canadian, German, Chinese, Indian, Japanese, Korean, Singaporean and Vietnamese. Based on the granted patents, the companies can be divided as highly patenting companies, médium patenting companies and low patenting companies. It is seen that BASF has highest number of granted patent followed by Bayer. It is also seen for both of them, there has been fall of number of granted from the year 2004 until 2009. Then they seem to have recovered. For the year 2014, we have considered data until mid of the year. Many of the companies fall in the range of 150 to 250 granted patent which we can consider as médium innovative companies. In this study we also found a few of the companies whose focus on patent has been, thus have very few patent granted.

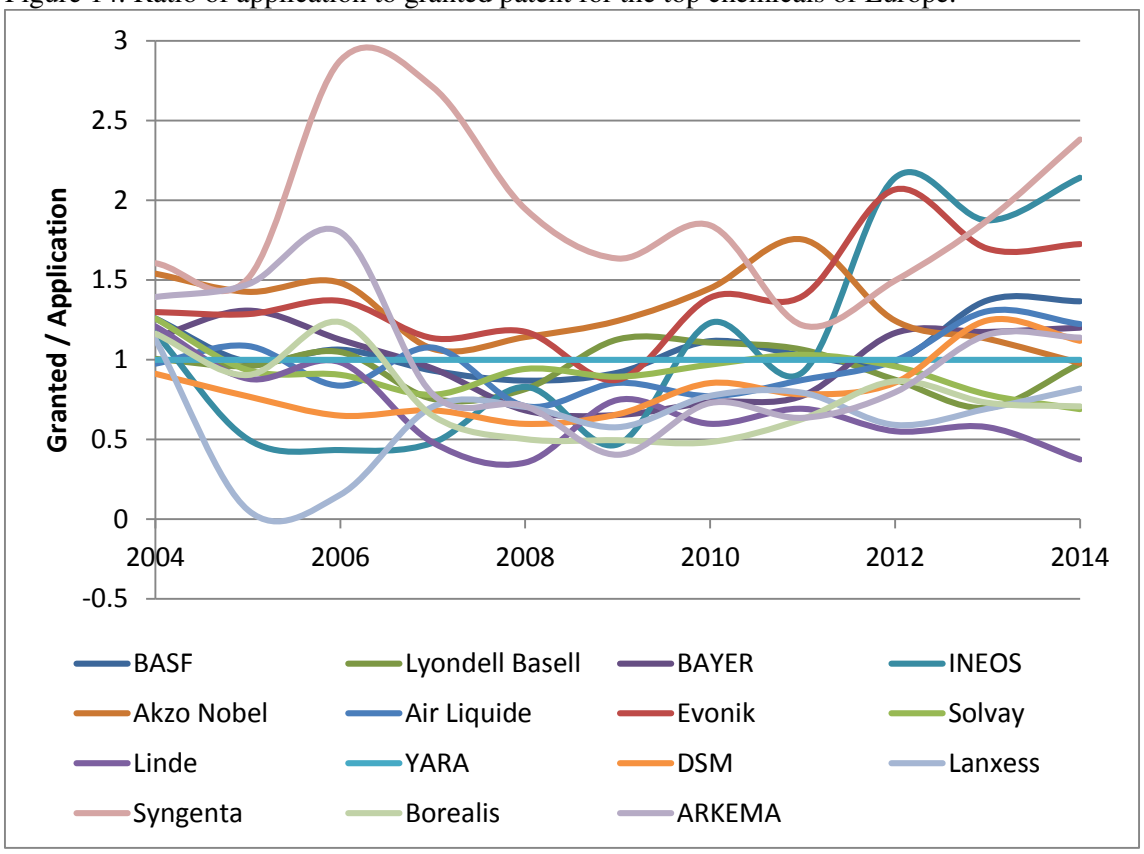
Figure 13: Granted patent of the top chemical companies at the important patent offices



Data Source: Thomson Innovation, 2014; Author´s analysis

It is generally believed that the higher quantity of research of a company can result in larger number of patent applications, while the quality of research is judged by the number of granted patents. The graph 14 below shows the ratio of granted patent to patent applied for a particular year. It can be seen that in most cases the ratio is between 0.5 and 1.5 which suggest high quality of their patent application which in turn represent high quality of research. It is seen in many cases that the ratio is above one. This is due the fact that a patent applied can take few years before it is granted. So many cases the number of granted is higher than number of applied for a particular year.

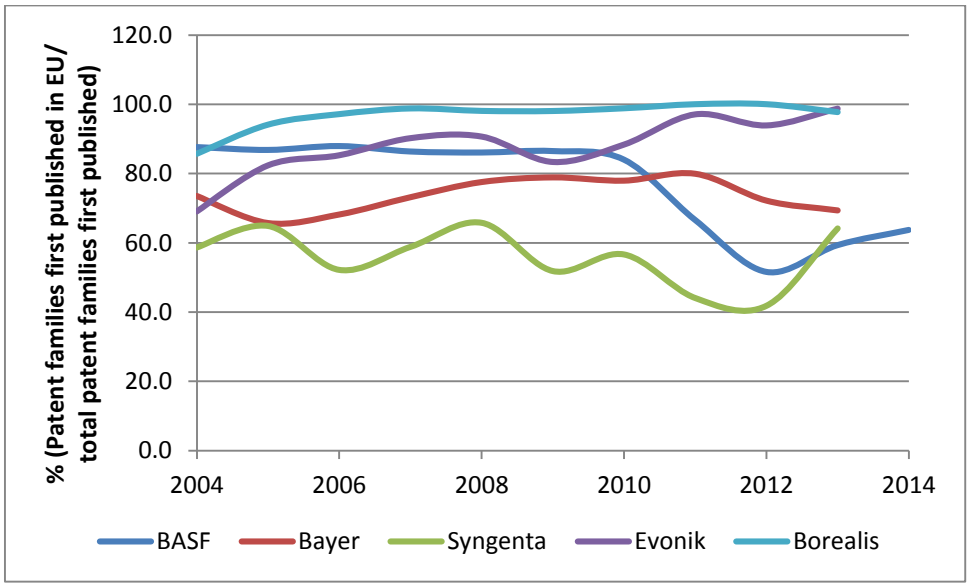
Figure 14: Ratio of application to granted patent for the top chemicals of Europe.



Data Source: Thomson Innovation 2014, Authors´ analysis

The graph 15 shows the percentage of the patents of a particular family that were first applied in EU compared to total global application of the first patent of that family for the companies having highest granted patents. It is seen in most cases, 50 % of the first patent is applied in EU which can be due to the fact that the research is coming out of the laboratories in EU or the companies see higher urge to protect their technology in the EU market. It also interesting to see that in case of BASF, there is a steady fall of the EU share of the total first patent, which can be due to the effect of growth of the emerging economies.

Figure 15: Percentage of patent first published in EU compared to total patent published first time.



Data Source: Thomson Innovation, 2014; Authors´ analysis.

CONCLUSION

The European chemical Industry supplies raw material virtually to almost all industry and concentrated mainly in seven EU countries of Germany, France, UK, Netherlands, Spain and Belgium. Even though there are huge amount of micro and small chemical enterprise in Europe, large enterprises are the biggest value creator and also the largest employer. The chemical industry in Europe has felt an enormous impact from the recent global recession and it global share of the chemical market has fallen to 17.8 % in 2012 from 29,8 % in 2001. The R&D spending in absolute term has remained similar over the years and it is globally the largest investor for the R&D activities. Out of the 50 top global chemical companies, 19 are headquartered in Europe which provides 14,5 % of Global chemical sell. In terms of R&D Investment, BASF has been making the largest investment followed by Bayer and Syngenta while the R&D intensity is highest for Syngenta and Bayer. BASF and Bayer are the leader in patent application and number of granted patent. Most of the large European company makes their first patent application in Europe compared to other Geographical location.

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