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The chemical sector in Italy: Industrial structure and competitive advantage

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The importance of chemical employment over the total industrial employment in Italy declined sharply from 4.5% to 2.6% in the 1971-2009 period, and some studies concluded that the chemical industry in Italy has almost disappeared and that it has no future. This paper shows that the decline of the Italian chemical industry is mainly due to the disappearance of large companies operating in basic chemicals, while a new configuration is emerging for this industry based on SMEs having a good competitive advantage in the specialty chemicals. The competitive advantage of Italian firms is mainly due to niche specialisation, customized products, and flexible organisation.
The paper considers the chemical industry as an enabling factor to foster innovation in the other manufacturing sectors: thanks to chemistry, the Italian SMEs in textile, furniture, ceramics, and other fashion-related sectors (jewels, eyeglasses, shoes, etc.) are able to develop new products. Innovation policy should therefore consider the links within the filières and supply chains in order to support the diffusion of innovation throughout the whole industrial system.

Chemical Industry, Industrial Structure, SME

1. Introduction

The importance of chemical employment over the total industrial employment in Italy declined very sharply from 4.5% to 2.6% in the 1971-2009 period. Studies about the decline of the chemical large companies concluded that the chemical industry in Italy has almost disappeared and that it has no future (Gallino, 2003; Zamagni, 2006, 2010; Pizzorni, 2006).

This paper shows that the new configuration of the industry is based on SMEs having a good competitive advantage in the specialty chemicals. We think that the fall of the large companies that shaped the chemical industry in the 1970s and the 1980s is mainly due to the decline of large companies and basic chemicals, and it is not the effect of the decrease of the chemical industry as a whole.[1]

[1] In recent years the heated debate about this decline has continued in Italy, with negative expectations about the chemical industry, as in the following newspapers: “La chimica perde le ultime *griffe*”, Il Corriere della Sera, 17 September 2010; “La parabola Snia dal duce a Gnutti”, Il Sole 24 Ore, 18 April 2010; “Grande chimica italiana: storia di un declino”, La Repubblica, 14 June 2003; “Chimici: fuga verso la partita Iva”, Il Sole 24 Ore Nord-Est, 9 June 2010; “Chimica in erosione continua”, Il Sole 24 Ore Centro-Nord, 10 March 2010.

Our thesis is based on data about the long-term evolution of the chemical industry in Italy, whose structure has changed very deeply due to the emergence of SMEs and specialty chemicals.

It is worth underlining that the chemical industry plays a major role within the economic development of the Italian economy. This importance is not only due to the amount of production, employment and exports of the chemical industry, but also due to its relationships within the whole industrial system. Input-output tables and qualitative data about case-studies on innovative products confirm that specialty chemicals have strong links with the other manufacturing sectors (SusChem, 2005): thanks to chemistry, the Italian SMEs in textile, furniture, ceramics, and other fashion-related sectors (jewelry, eyeglasses, shoes, etc.) are able to develop new products.

This paper considers that chemistry is a key factor for fostering innovation of small and medium-sized enterprises (SMEs), of industrial districts, and of the "traditional" sectors of the so-called "Made in Italy" products. Moreover, we believe that the chemical industry can play a major role in supporting the recovery of the Italian economy after the 2008-2009 economic crisis, since the Italian industrial system has to increase the innovative content of its products (Pontarollo, 2009; Zanetti, 2010).

Because of this, a new innovation policy should consider the links within the filieres and supply chains in order to support the diffusion of innovation throughout the whole industrial system.

The remainder of the paper is organised as follows.

Section two deals with the evolution of the structure of the chemical industry, describing its main characteristics, the decline of large companies, the rise of SMEs, and the role of multinational enterprises in Italy.

The third section focuses on the competitive advantages of Italian firms, mainly based on niche specialisation, customised products, and flexible organisation.

Some concluding remarks summarize the main results of the paper.

2. Structure of the chemical industry in Italy

Industrial studies about the chemical industry in Italy are quite outdated, as they were published during the Eighties, when large chemical companies, such as Montedison, ANIC, SIR-Rumianca, Enimont, Snia, and Caffaro, played a major role within the sector (Guerci, 1978 e 1991; Bertini et al., 1987; Darida, 1986; Cazzola, 1984). Because of this, our paper tries to integrate an academic methodology, based on the Structure-Conduct-Performance approach and official statistical data (Istat, 2012), with a qualitative methodology based on case studies, interviews, and data collected by consulting companies and entrepreneurial associations (Deloitte, 2009, 2010; Federchimica, 2011, 2012; Cefic, 2010, 2011).

The structure of the chemical industry is described according to three main features: the heterogeneity of the sector, with a huge difference between basic chemicals[2] and specialty chemicals[3]; the long-term evolution of the statistical data,

[2] Basic chemicals include petrochemicals, derivatives, and basic inorganics.

[3] Specialty chemicals include auxiliaries for industry, paints, inks, crop protection, dyes and pigments, as well as consumer chemicals (soaps, detergents, perfumes, and cosmetics).

showing the decline of large companies and the growth of SMEs; the role of multinational enterprises (MNEs) in Italy.

2.1. The heterogeneity of the Italian chemical industry

Within the chemical industry there are very different sectors and industrial organisation studies have to take into consideration that the importance of technology, economies of scale, marketing investments, and exports is very different if we consider basic chemicals or specialty chemicals, with huge differences within the latter sub-sector, especially between industrial products and consumer ones.

This heterogeneity is crucial for the Italian chemical industry, as it has been affected by a deep evolution of industrial structure: statistical data show, over the last decades, a decline of large companies, a rise of SMEs, an increase in specialty chemicals, and a new internationalisation process, based on both foreign direct investments and exports.

The structure of the chemical industry is characterised by a relevant weight of specialty chemicals, which represent 63% of total employment, whereas basic chemicals account for only 37% (table 1). In contrast, at the EU level the weights are opposite, as basic chemicals account for 62% of total sales.

The evolution of the chemical industry in the last decades has increased the role of specialty chemicals, which represented only 57% of total employment in 2000.

The sub-sectors of specialty chemicals display a similar evolution within the 2000-2007 period: industrial components, paints, glues, and mainly soaps and cosmetics increased in importance within the Italian industry.

Table 1. Employment in the chemical industry by sectors (% composition)

	2000	2007
Organic chemicals and plastics	23.2	20.3
Inorganic chemicals	5.9	5
Technical gases	3.5	3.9
Pigments	2.1	2.3
Fibres	6.5	4
Fertilizers	1.7	2.3
Basic chemicals (sub-total)	42.9	37.8
Agrochemicals	1.8	1.8
Glues and paints	14.5	18.5
Other industrial components	22.3	19.1
Soaps and detergents	18.5	23.4
Specialty chemicals (sub-total)	57.1	62.8
Chemical industry (total)	100	100

Source: data processing of Ceris-Cnr on Federchimica, 2010

The heterogeneity of the chemical industry is a crucial feature that affects a wide range of aspects of the sector, such as:

- Economies of scale are very important in basic chemicals, as the business has an integrated production cycle, with a complex logistic infrastructure (comprising ports, railways, or pipelines) to supply raw materials. In contrast, the industrial plants in the specialty chemicals sector can

manage small production batches and production flexibility, which allow chemical SMEs to match the needs of industrial SMEs.

- Social governance has a different role in the different sectors. For example, the mass of industrial investments and the complexity of environment externalities within basic chemicals are so high that they create social problems in Italy (Maglia and Rapisarda Sassoon, 1999), mainly due to the strong opposition by local NIMBY groups, which fear environmental damages of the industrial activities; in contrast, specialty chemicals can develop and increase in terms of employment and production in Italy, as their level of scale is not so high and the importance of intangible assets (mainly innovation) is greater than that of large fixed investments.
- In some sectors, entry barriers are technological, since companies have a competitive advantage based on technological innovations, whereas in other sectors innovation is mainly linked to new organisation (and not to new technology). In some sectors entry barriers are at the commercial level, since it is important to exploit new market worldwide in order to increase the size of the SME's niche.
- The performance of the sectors within international trade is linked to the above characteristics, as basic chemicals are negatively affected by the decline of the Italian large companies, whereas specialty chemicals are positively affected by the competitive advantages of SMEs which is based on product customisation and production flexibility. The result is a negative trade balance of basic chemicals and a positive trade balance of some specialty chemicals, mainly in glues, chemicals for construction, paints, and chemicals for cosmetics (Federchimica, 2012).
- The dynamics of global demand affect the different sectors: within the basic chemicals the demand from industrialised countries is quite low, because of the economic crisis and the long-term evolution of the economic structure (where heavy industries are replaced by high-tech ones), whereas the demand from BRICs and other developing countries is very high and supports exports and FDI from the EU; within specialty chemicals the demand from post-industrialised countries is higher than the demand from BRICs, due to more advanced environmental regulations and energy saving policies.[4]
- Marketing has a higher importance in consumer chemicals relative to industrial chemicals. The best known sector where marketing matters is cosmetics, in which Italian SMEs are important sub-contractors of EU leaders: the performance of chemicals for cosmetics in terms of employment during the 2000-2007 period is impressive (table 1).
- The costs of production factors are different within the different sectors: energy represents a very high cost for basic chemicals, and a less important cost for some specialty chemicals; and other similar differences can be found in other production factors, such as labour cost, capital cost, cost of intellectual protection, etc.
- In some sectors, concentration indexes should be calculated at the niche level and not at the industry level, as niche specialisation is very important (Maglia, 2002). At the industry level there are many competitors and the concentration index is very low, while a high degree of concentration characterises the niche level. In this case, the company leader might be a SME, and it might have a relevant market share at the national or EU level.

2.2. The decline of large companies

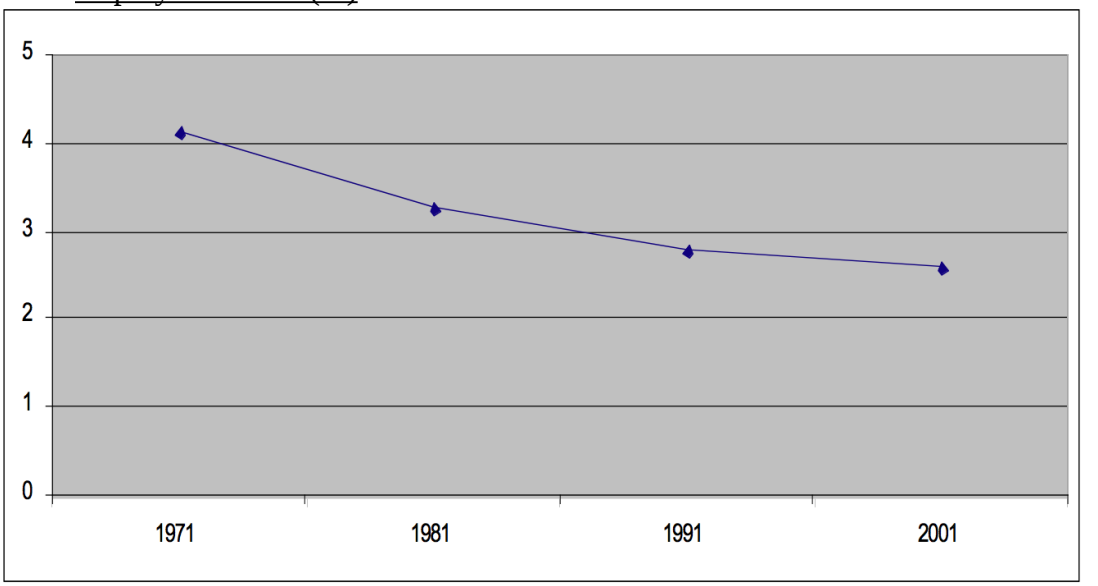
This paper argues that the fall of the large companies that shaped the chemical industry in the Seventies and the Eighties is mainly due to the decrease of basic chemicals in Italy, and it is not the effect of the decline of the chemical industry as a whole. The decline of basic chemicals is mainly due to the problems that such a complex sector faces in Italy, as basic chemicals heavily rely on imports and energy, and are strongly affected by environmental and infrastructure constraints.

If we consider the importance of chemical employment over total industrial employment in Italy, we find that in the 1971-2001 period the ratio sharply declined

[4] The last economic crisis slightly changed this scenario, but we think that it has a structural and solid foundation.

from 4.5% to 2.8%, and in the 2001-2009 period it decreased only slightly, from 2.8% to 2.6% (Figure 1).

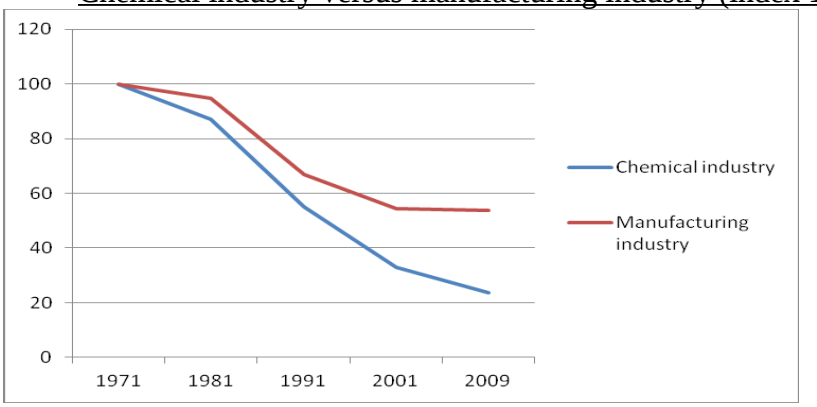
Figure 1. Chemical industry over manufacturing industry employment ratio (%)



Source: data processing of Ceris-Cnr on ISTAT

The sharp decline of the chemical industry in Italy derives mainly from the decline of large companies. Figure 2 shows that employment in large companies within the chemical industry declined more than that of the total manufacturing industry. This means that large companies reduced their importance more than the industrial average. Data show that large chemical companies represented 40% of total employment in 1971 and only 23% of total employment in 2009.

Figure 2. Employment in large companies (> 250 employees). Chemical industry versus manufacturing industry (index 1971=100)



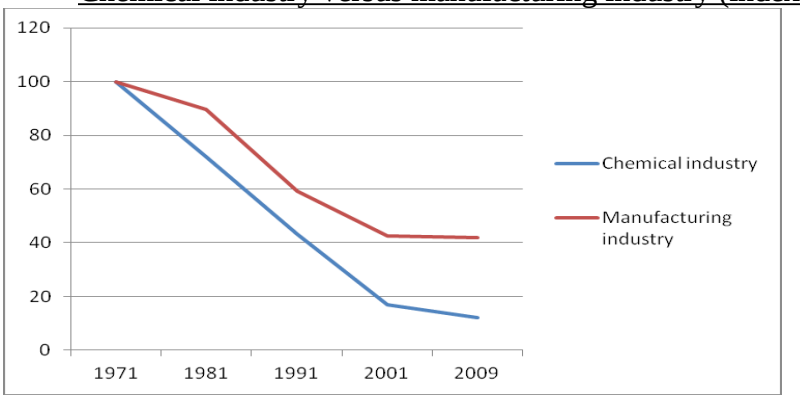
Source: data processing of Ceris-Cnr on ISTAT

The different evolution of large companies in the chemical industry and large companies in the manufacturing industry is more evident if we consider the biggest companies, i.e. those with more than one thousand employees (Figure 3).

In this case, the decline of large companies is even more noticeable than in the previous case: companies with more than one thousand employees reduced their

employment by almost 90% during the 1971-2009 period, whereas at the manufacturing level the reduction was only 58%.

Figure 3. Employment in very large companies (> 1000 employees). Chemical industry versus manufacturing industry (index 1971=100)



Source: data processing of Ceris-Cnr on ISTAT

The statistical data are the effect of the disappearance of the biggest chemical companies in Italy: Montedison, Enimont, Snia, and Caffaro either failed or considerably reduced their size. In the Eighties, the most important company was Enimont, a joint-venture between Eni and Montedison, which failed in 1991 and most of its assets were sold to other MNEs. The ISTAT survey on Italian firms states that this decline continued in the recent 2001-2009 period, when Caffaro reduced its workforce from 1,147 to 365 individuals and Montefibre from 1,441 to 336 workers. Enichem and Ausimont were downsized and restructured within the ENI Group; in 2001 they had 10,696 and 1,578 employees, respectively.

The decline of large companies was soon followed by the growth of SMEs (table 2). In the 1971-2009 period, SMEs have a positive dynamics. Within the industry, SMEs increased their importance from 29% of total employment (in 1971) to 64% (in 2009), whereas large companies declined from 71% to 37%.

Table 2. Employment in the chemical industry by firm size

Firm size	1971	1981	1991	2001	2009
1 – 9	9,742	13,367	11,466	11,446	9,631
10 – 49	21,849	29,658	26,255	26,970	26,905
50 – 249	38,473	45,163	37,006	40,183	37,592
> 250	175,403	152,829	96,303	57,764	41,205
Total	245,467	241,017	171,030	136,363	115,333

Source: data processing of Ceris-Cnr on ISTAT

The result is a new chemical industrial structure, characterised by SMEs with a new and strong competitive advantage, as well as a strong links between the chemical industry and its supply chain: the importance of the companies that supply the chemical industry with machineries, components, and services is considerable, and it is estimated as two employees in the supply chain for every employee in the chemical industry (Federchimica, 2010). The future trend of this relationship is positive, as the amount of services in the manufacturing industry, as well as in the chemical one, is expected to increase, mainly because of the outsourcing of services.

The evolution of the chemical industry during the 2001-2009 period confirms that there is a core of SMEs, strongly competitive at the EU level, which are able to shape a new scenario within the chemical industry as a whole. This core of SMEs compensates for the decline of the old large companies and can support the thesis that the chemical industry is not going to disappear in Italy but it has only changed its traditional characteristics, which were based on national champions and large companies.

This evolution is likely to continue in the future, with an increase in the quality instead of the quantity of the production located in Italy.[5]

2.3. The rise of SMEs

Statistical data show that SMEs represent 64% of total employment in the chemical industry, and this share is even higher (70%) if specialty chemicals are considered (Federchimica, 2009a). On the contrary, the importance of SMEs is lower (42%) at the EU level and particularly in Germany.[6]

Within SMEs there is a core group of firms that are strongly competitive and innovative. The 418 chemical firms listed in the Mediobanca survey about the best Italian SMEs were 9.3% of the total firms considered in the survey in 2007, whereas in 1998 there were only 268 firms (only 7.9% of the total). The increasing number of chemical SMEs within the whole Italian industry is a result of their competitive advantage, which determines good economic and employment performance.

SMEs are important not only due to their employment and production levels, but also due to their contribution to the trade balance, in terms of exports: Federchimica (2009) claims that companies with 20-250 employees accounted for 39% of total exports in 2007, with a considerable increase from the rate of 26% in 1999. The chemical sectors where the Italian trade balance is positive are the ones in which SMEs are dominant, such as glues, adhesives, paints, soaps, detergents, and cosmetics.

Table 3 shows the top-20 firms owned by Italian shareholders: their turnover is mostly lower than one billion euro (except in three cases) and they cannot be classified as large companies, when compared with their EU competitors. All together they account for € 11 billion of production in Italy, about one fourth of the total Italian industry, and they are the new leaders in the Italian scenario of the 2000s.

They mainly deal with specialty chemicals rather than basic chemicals, and industrial chemicals rather than consumer products: paints, glues, adhesives, chemicals for the building industry, chemicals for cosmetics, chemicals for the leather industry, chemicals for ceramics, and other chemicals for the so-called “Made-in-Italy” products.

Table 3. Top 20 Italian-owned companies in the chemical industry

[5] The statistical data about the industry should consider not only the number of firms and their employment, or the amount of production and value added, but also some dummy variables about the evolution of production quality, intangible assets, and non-price competitive factors.

[6] Germany is the leader of the EU chemical industry, and it has an industrial structure characterised by large companies, with high R&D investments (Arora and Gambardella, 1998; Cesaroni et al., 2004; ZEW, 2011).

Name of the company	Worldwide production 2010 (mln euro)	Italian production 2010 (mln euro)	Chemical sector
Polimeri Europa	6,138	4,821	Polymers
Mossi & Ghisolfi	1,970	383	PET for packaging
Mapei	1,832	744	Chemicals for construction
Radici	1,161	605	Polyamide and other fibers
Bracco	719	527	Chemicals for medical screens
P&R	692	487	Chemicals for pharmaceuticals
Polynt	614	483	Industrial components
COIM	550	327	Chemicals for industrial components
SOL	519	302	Technical gas
Colorobbia	470	211	Chemicals for ceramics
SIAD	452	265	Technical gas
Aquafil	432	249	Polyamide and other fibers
Sapio	431	414	Technical gas
Lamperti	368	253	Chemical components
Dobfar	315	271	Active pharmaceutical ingredients
Sipcam-Oxon	310	142	Agrochemicals
Intercos	267	134	Chemicals for cosmetics
Zobele	258	54	Home products
Sadepan	255	185	Resins and glues for the furniture sector
Desa	210	210	Detergents

Source: data processing of Ceris-Cnr on Federchimica, 2011

If we compare these companies with the German leader, BASF, the difference is impressive in terms of size: the average turnover is almost € 0.55 billion for Italian SMEs against € 50 billion for BASF. Despite this, Italian SMEs are able to face EU competition, even against major EU leaders, thanks to their specialisation in market niches.

SMEs can achieve EU leadership, despite their small size, because they focus on a very small market niche in which the big EU leaders operate with only one of their company's divisions or subsidiaries. Indeed, the comparison should be drawn not between the Italian SMEs and the big EU leaders, but between the Italian SMEs and one company's division or subsidiary. Of course, economies of scale matter at the group level, and this allows the EU leaders to attain relevant cost reductions for capital, technology, advertisement, and international investments. However, the Italian SMEs can compensate the missing economies of scale with advantages stemming from production flexibility and product customisation. Italian SMEs can better meet the clients' needs in terms of customised products, flexible orders, date

of delivery, and so on, because they are more flexible and quick in taking decisions than the big EU leaders.

We can summarize the competitive advantage of Italian chemical firms as follows:

- Production flexibility in terms of both the size of production batches and the production mix within each batch;
- Production customisation, in order to supply each client with a specific chemical product which best suits the client's needs. In this context, a major role is played by "business" proximity, rather than physical proximity, to the end user[7];
- Trade and production internationalisation, aimed at widening the size of the market niche at the world level;
- Control over the technological change of a specific niche,[8] which requires being at the forefront of technology, or at least monitoring its evolution in order to get the innovations developed elsewhere; R&D investment is generally limited to what concerns the applications belonging to the company's specific niche (Federchimica, 2006).

It is worth underlining that Italian chemical companies are "small" –in comparison to EU leaders– because of the typical Italian constraints related to family-run businesses. Nevertheless, their size is compatible with a leadership within a small niche market, where economies of scale are less important than non-price competitive factors, such as customised products and flexibility of production.

From this point of view, the chemical industry follows the typical Italian way of organising business, based on industrial districts, SMEs, low-tech innovation, flexible organisation, export propensity, and strong links between companies and their suppliers of machineries, plants, services, and components.

2.4. The role of foreign multinational companies

Foreign MNEs play a major role within the chemical industry, as they represent 36% of Italian production, 41% of exports, 37% of R&D investments, and 45% of fixed investments (table 4).

This major role of the foreign MNEs is a specific characteristic of the chemical industry, as the importance of MNEs in the whole Italian manufacturing industry is only about 10%.

Table 4. Importance of foreign MNEs localised in Italy

	% over Italian chemical industry
Number of firms	16
Production	36
Exports	41
R&D investments	37
Fixed investments	45
Employment	31

Source: data processing of Ceris-Cnr on Federchimica, 2010

Other statistics about MNEs in Italy confirm their importance: there are 213 MNEs in Italy having a total of 37,400 employees, with an average of

[7] Relationships between chemical SMEs and manufacturing SMEs are supported by their similar business attitude, which fosters informal agreements along the supply chain.

[8] As far as economic theory is concerned, control over the technology of a specific niche is justified by the theory of "localised technological change" (Antonelli, 2008).

176 employees per firm (table 5). The larger size of the MNEs in Italy in comparison to Italian-owned firms is the result of different organisation models, as mentioned above. For example, MNEs represent more than 50% of the total employment within the group of large companies (those having more than 250 employees).

Table 5. Comparison between MNEs in Italy and Italian-owned firms (2009)

	Number of firms	Employees	Average employment
MNEs localised in Italy	213	37,400	176
Italian-owned groups of firms	363	47,000	129
Italian-owned family business firms	1,845	34,700	19
Total of chemical industry	2,421	119,100	49

Source: data processing of Ceris-Cnr on Federchimica, 2010

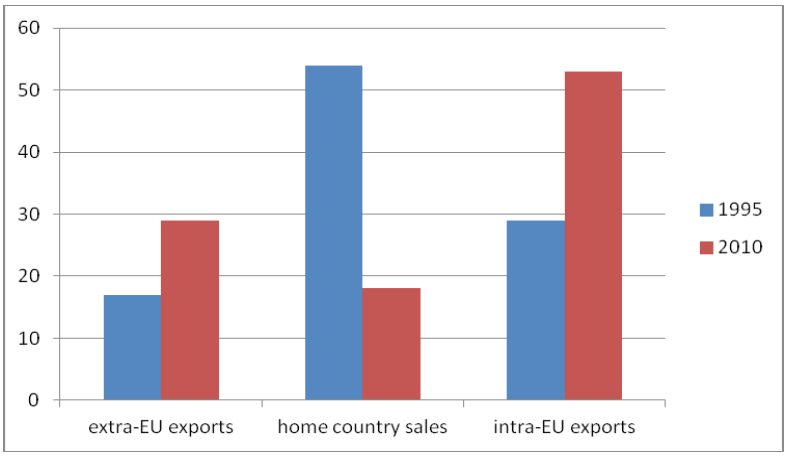
The attraction of Italy for MNEs is mostly due to internal demand, since Italy is still one of the most industrialised countries in Europe, and to the presence of good industrial factors at the company level, such as suppliers of machineries, qualified workforce, and subcontractors (Federchimica, 2009b). On the contrary, industrial factors at the country level are not equally attractive, as there is a long list of institutional constraints that reduce the flow of FDIs towards Italy.

The production of MNEs localised in Italy does not only focus on meeting internal demand, as 41% of chemical export comes from the Italian plants of MNEs. This means that Italy is a sort of “manufacturing platform” for exporting to other countries, with MNEs producing in Italy and exporting a portion of their production to other countries.

In general, this is a result of the new organisation that MNEs have within the EU market: thanks to the economic integration of the EU market, MNEs no longer need to overcome trade barriers within the EU countries[9] and they can specialise their plants according to both local regional economies and their production portfolio. Figure 4 shows the evolution over the 1995 to 2010 period, as home country sales declined from 54% of total sales to 18%, whereas intra-EU exports increased from 29% to 53%. The theories of Krugman (1991) about the geography of plant location can justify company behaviour in the chemical sector, as MNEs develop plants to produce one product for all the other EU countries, fostering intra-EU exports.

Figure 4. Sales structure of the EU chemical industry (% composition)

[9] As tariff and non-tariff trade barriers have been eliminated in the course of the economic integration (Vitali, 2001).



Source: data processing of Ceris-Cnr on Cefic, 2011

3. Determinants of the Italian competitive advantage

As mentioned above, the size of Italian companies is small relative to EU leaders; hence, they do not exploit economies of scale as their EU competitors do. Despite this, there is a core of SMEs that enjoy a strong competitive advantage based on non-price factors, deriving from their niche specialisation, international attitude, and incremental innovations.

3.1. Niche specialisation

Italian chemical SMEs follow a monopolistic competition strategy: they are specialised in a very small market, characterised by few competitors and high market shares at the worldwide level.

Table 3 shows the specialisation sectors of the top 20 Italian-owned firms. They are strongly specialised in specific sectors, and this shapes the characteristics of the Italian industrial structure, in which specialty chemicals are more important than basic chemicals.

For example:

- Mapei is specialised in adhesives and chemical products for the building industry, with a turnover of 1,7 billion euro, 6400 employees, and 59 plants located in 27 countries;
- COIM is specialised in chemical components for the coating industry: it produces industrial intermediates of polycondensation products (esters), polyaddition (polyurethanes) and several other specialty chemicals that meet the needs of coating producers; COIM has 700 employees worldwide and manufacturing plants located in six countries;
- Intercos is a leader in the creation, development, and production of make-up (lipsticks, powders, colored emulsions, and cosmetic pencils) for the cosmetic industry's major international players; Intercos has 1,600 employees, 9 production plants in five countries, and a turnover of about € 220 million;
- Zobele is specialised in chemical components for air fresheners, insecticides, repellents, detergents; Zobele has 5,000 employees, 8 manufacturing plants in seven countries, and a turnover of about € 260 million;
- SOL (2,100 employees and 518 million euro sales), Siad (458 million euro sales) and Sapio (431 million euro sales) are specialised in industrial, pure, and medicinal gases. Siad is integrated along the filière in the engineering of industrial plants for gases, too;
- Dobfar and P&R are specialised within the API (active pharmaceutical ingredient) sector; Dobfar has 1,300 employees in 12 plants, its turnover is about € 250 million, and it has a niche

specialisation in cephalosporin and penicillin, produced for the most important pharmaceutical leaders; the P&R group has 2,500 employees and a turnover of € 600 million.

3.2. The internationalisation process

Italian chemical firms have a strong propensity to operate at the international level and to face global competition. This propensity is due to the niche specialisation of SMEs, as they need to meet the whole niche demand wherever it is located in order to saturate production capacity and to increase cost efficiency. This internationalisation process is mainly based on exports from Italy, even if in recent years SMEs have created FDIs abroad to be closer to their foreign clients.

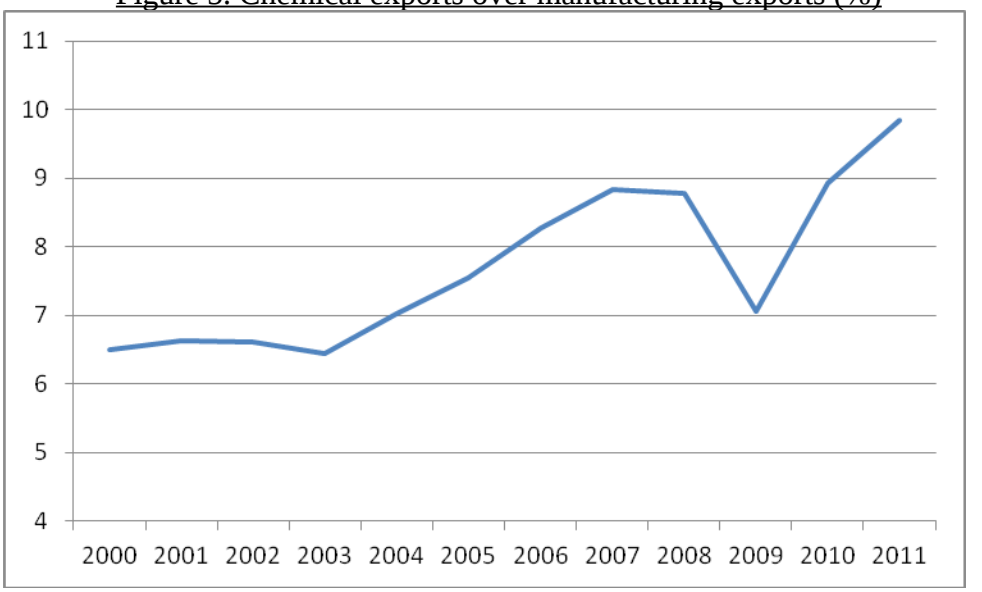
Some statistical data confirm the internationalisation of the Italian chemical industry: on average, the ratio of exports over production is about 40%, and the number of employees located abroad is 25% of the Italian employment (Federchimica, 2012).

3.2.1. Exports

In the 1990-2009 period the ratio of exports over production increased from 18% to 40%. In comparison with the manufacturing industry as a whole, the chemical sector represented 6.5% of total manufacturing exports in 2000 and 9.8% in 2011 (Figure 5).

It is worth underlining that exports grew considerably even after the 2008-2009 economic crisis. This means that chemical firms reacted more quickly than the other industrial sectors in meeting the demand coming from abroad. We have to consider that chemistry is a very cyclical industry, and at the beginning of the recovery from the economic crisis global demand is higher for industrial products, such as chemicals, than for consumer products.

Figure 5. Chemical exports over manufacturing exports (%)



Source: data processing of Ceris-Cnr on Istat

In addition, Italian firms act at the global level searching for the most dynamic demand, which in the last decade has usually come from the Asian markets. Table 6 shows that the Italian exports towards China increased by more than 240% in the

2000-2011 period, even if they represent a small portion of the total exports from Italy. This is the main strategy that SMEs will pursue in the future, to compensate for the low dynamics of the EU markets.

Table 6. Exports by markets (% composition)

	2000	2011
Germany	15	16
France	12	10
European Union (27)	62	62
Switzerland	3	2
North America	8	5
China	1	2
Asia (excl. China)	12	12
Russia	1	2
Africa	4	4
Other countries	10	11
Total	100	100

Source: data processing of Ceris-Cnr on Federchimica, 2010

3.2.2. Foreign direct investments

Italian chemical firms have made some FDIs abroad in order to manage their production opportunities at the global level.

Considering the chemical industry as a whole, there are 133 firms that are involved in FDIs abroad, which implies majority or minority shares in 358 foreign companies. Italian chemical companies employ about 24,000 workers in their plants located abroad, where they make € 8 billion sales (Mutinelli et al., 2010; Federchmica, 2011).

The most interesting characteristic of the chemical industry in this regard is not the total amount of FDIs or their intensity, as there are other Italian industries that are more internationalised, but the recent dynamics of the phenomenon. Table 7 shows how FDIs increased during the 2000-2009 period: the number of Italian firms investing abroad rose by 30%, from 102 to 133; the number of foreign firms controlled by Italian firms reached 358 from 217, with a 65% increase; the number of employees and the turnover of foreign firms controlled by Italian ones both rose to 23,700 employees and € 8.1 billion, respectively, in 2009.

Table 7. FDIs of the chemical industry abroad

	2000	2009	var.%
Number of Italian firms investing abroad	102	133	30.4
Number of foreign firms controlled by Italian firms	217	358	64.9
Number of employees in foreign firms controlled by Italian firms	19,905	23,700	19.0
Turnover of foreign firms controlled by Italian firms (million euro)	6,403	8,100	27.6

Source: data processing of Ceris-Cnr on Mutinelli et al., 2010

If we consider the geographical breakdown of the foreign firms controlled by Italian ones in terms of employees (table 8), we find that there is a high concentration in the OECD countries, even if the investments in Asia and Latin America are significant. The attention towards the BRICs appears to be the key factor for future FDIs abroad.

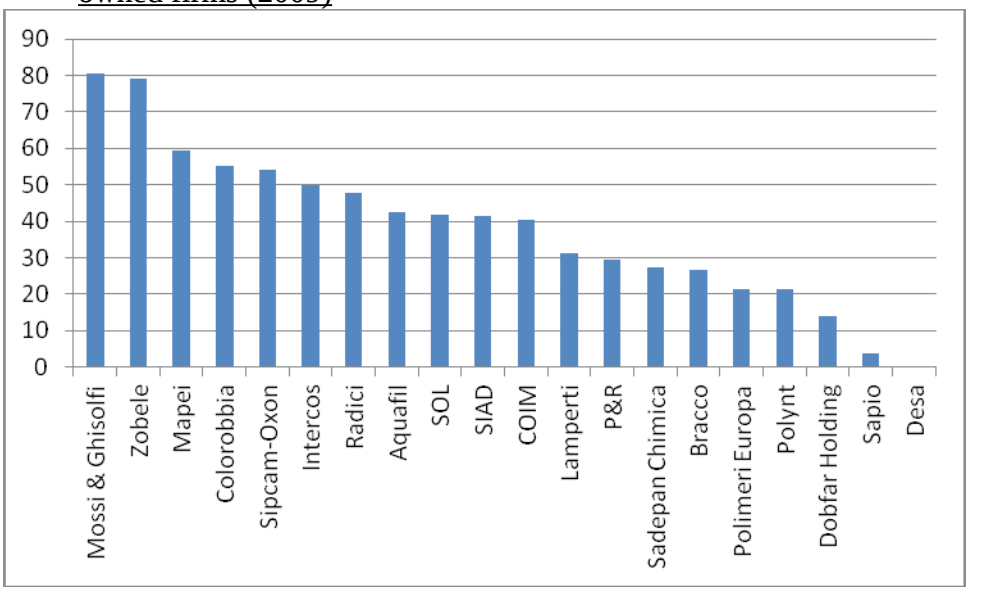
Table 8. Geographical breakdown of employment in foreign firms controlled by Italian firms (% composition)

	%
EU15	52.1
Eastern Europe	11.9
Other European countries	5.7
North America	8.2
Latin America	10.9
Middle East	2.6
Asia	6.2
Africa and Oceania	2.2
Total	100

Source: data processing of Ceris-Cnr on Federchimica, 2010

The main characteristic of the Italian companies involved in FDIs abroad is their size, as these internationalised firms are the biggest among the Italian ones. To confirm this, Figure 6 shows the intensity of foreign production of the top 20 Italian-owned firms. Some firms are very active internationally, as they make most of their production abroad: this ratio is 80% for Mossi & Ghisolfi, 74% for Zobele, 61% for Mapei, 55% for Colorobbia, and 54% for Sipcan-Oxon.

Figure 6. Foreign production over total production. Top-20 Italian owned firms (2009)



Source: data processing of Ceris-Cnr on Federchimica, 2010

3.3. Innovation

According to Federchimica (2012), within the chemical industry there are 4,000 employees in the R&D function, representing 3.3% of total employment. In addition, we have to consider that the chemical industry has filed 21% of total manufacturing patents.

These data put the chemical industry at the top of the high-tech sectors in Italy, but also quite far from the data of its EU competitors (Eurostat, 2008; ZEW, 2011).

Italian chemical firms often create innovation without large investments in R&D,[10] as they make incremental innovation or they adapt innovations made abroad. This model is applied to process innovation as well as to product innovation.

Process innovation is based on the strong relationships between chemical firms and their suppliers of machineries, plants and components: within these links there is a strong technology transfer, as machinery producers can supply the chemical firms with customised plants, perfectly adapted to their specific needs in terms of size of batches, flexibility of the cycle, quality of production, and so on.

As far as product innovation is concerned, it is mainly made by SMEs thanks to the product customisation strategy: when SMEs have to meet the specific needs of a client, they develop a “new product” by adapting an old one to the client’s needs. It is a sort of continuous evolution of the product portfolio, even if the investment is considered as R&D expenditure.

We think that the main contribution of the chemical industry to the innovation of the Italian industrial system is related to the pervasiveness of chemical products, which are used in the other industrial sectors in order to create new products or new processes (SusChem, 2005).

4. Some concluding remarks

Our paper has highlighted some important characteristics of the chemical industry in Italy.

First, the statistical evidence shows that the chemical sector has changed its shape, through a sort of metamorphosis, in which large companies have abandoned the Italian panorama, leaving room for the growth of the chemical SMEs. At the same time, basic chemicals have given way to the development of specialty chemicals, in which SMEs follow the strategy of niche specialisation.

Second, SMEs are the new players within the Italian industry, as they have achieved a competitive advantage based on non-price factors, such as production flexibility and customised products.

In addition, SMEs are extremely internationalised, as they have made a large amount of FDIs abroad, entering new markets such as the BRICs and retaining a high level of export/production ratio.

Third, the chemical industry is important for the economic development of the Italian economy not only because of its amount of production, employment and exports, but also due to its relationships with the other industrial sectors.

[10] Chemical firms invest in R&D more than the other Italian manufacturing firms (Federchimica, 2012), but less than the EU chemical ones (ZEW, 2011; Eurostat, 2008).

The chemical industry is an enabling factor for innovation in the whole industrial system in Italy: innovation in chemicals are used in textile, furniture, ceramics, and other fashion-related sectors (jewelry, eyeglasses, shoes, etc.) to develop new products and new processes.

In addition, chemicals are important for innovations related to environmental protection, as they can strongly contribute to energy efficiency in the construction industry (Arora and Gambardella, 2010). Federchimica estimates that, for one ton of CO_2 generated by the chemical industry within its production steps, 2.6 tons of CO_2 are saved by the other Italian industrial sectors, thanks to the new chemical products that are "environmentally friendly" (Squinzi, 2010).

These results give us the opportunity to define an industrial policy for the Italian manufacturing system, as the role of enabling factor played by the chemical industry could be taken into consideration in the policy for technology transfer and innovation by promoting R&D agreements along the supply chain. Subsidised R&D joint-ventures could create stronger relationships among producers of machinery/industrial components, chemical firms, and SMEs that use the chemicals for new products and processes. This R&D policy fosters the technological transfer along the supply chain, emphasizing the positive externalities created by the chemical industry within the innovation process of the Italian manufacturing system as a whole, even regarding environmental protection (CNEL, 2004; European Commission, 2009).

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