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OVERVIEW OF THE AGRICULTURAL INPUTS SECTOR IN THE EU

STUDY

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AGRICULTURE AND RURAL DEVELOPMENT

OVERVIEW OF THE AGRICULTURAL INPUTS SECTOR IN THE EU

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Abstract

This study analyzes the seed, feed, energy, fertilizer, and plant protection agents farm input sectors from two perspectives: the demand side and the supply side. Average input shares in the EU-27 for seeds and fertilizers declined while they increased for feeds. Market concentration is the largest in the plant protection agents sector followed by the energy sector, and lowest in the feed sector.

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LIST OF ABBREVIATIONS

AES	Average Enterprise Size
CR	Concentration Ratio
DKK	Danish Krone
EP	European Parliament
ESA	European Seed Association
EU	The European Union
EU-27	European Union (27 Member States)
FADN	Farm Accounting Data Network
FAO	Food and Agriculture Organization of the United Nations
FEFAC	European Feed Manufacturers' Federation
HHI	Herfindahl-Hirschman Index
IFA	International Fertilizer Association
K	Kalium
MS	Member State
Mt	Megaton
N	Nitrogen in the fertilizer part
N	Number of observations in the econometric analysis
N/A	Not Applicable
P	Phosphorus
PANE	Pesticide Action Network Europe
PEMS	Post Enlargement Member States

PPA	Plant protection agents
SPM	Seed and planting material
UAA	Utilized Agricultural Area
USD	US Dollar

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EXECUTIVE SUMMARY

Background

The development of input markets has always been an important issue for the agricultural sector and its stakeholders. Price and quality developments in the input markets affect the comparative advantage of agricultural production among regions and types of production; these developments also affect the income of farm households and can have implications beyond the farm level. Concerns regarding the concentration in input markets have been expressed by different stakeholder groups, including farmer unions, advocacy groups, and policy makers.[1] The concerns arise especially with respect to market power of input suppliers as this can result in higher input costs and a distribution of rents different from what a competitive market would produce.

Aim

This study analyzes the seed, feed, energy, fertilizer, and plant protection agents farm input sectors from two perspectives: the demand side and the supply side.

The study focuses on the following five main aspects of each input sector:

- Farm-level demand and usage among EU Member States;
- European farmers' cost structure;
- Market structure;
- Market concentration;
- Important mergers and acquisitions.

For the demand side, we use country- and NUTS2-level data from the Farm Accountancy Data Network (FADN). Due to a change in the methodology of the data collection, the FADN database contains two overlapping periods. In the period of 1989–2009, the average data for represented farms were calculated using a farm typology based on Standard Gross Margins (SGM).[2] The period 2004–2012 contains average data for represented farms calculated using a farm typology based on Standard Output (SO).[3] The time-series for Member States start in the year when a Member State entered the EU.

For the supply side, first insights in whether or not market power has increased over time can be gained by investigating the development of market concentration. If the largest companies operating in an industry can be identified, one can obtain concentration ratios (CRs), defined

[1] For instance, in the European Parliament's resolution of 19 January 2012 on the farm input supply chain: structure and implications (2011/2114(INI)), a major concern was highlighted with respect to the concentration in the agricultural input markets.

[2] The standard gross margin is a measure of the production or the business size of an agricultural holding. It is based on the separate activities or 'enterprises' of a farm and their relative contribution to overall revenue.

[3] The standard output (SO) of an agricultural product (crop or livestock), is the average monetary value of the agricultural output at farm-gate price, in euro per hectare or per head of livestock. There is a regional SO coefficient for each product, as an average value over a reference period (5 years, except for the SO 2004 coefficient calculated using the average of 3 years). The sum of all the SO per hectare of crop and per head of livestock in a farm is a measure of its overall economic size, expressed in euro.

as $CR_N = \sum_{i=1}^{N} S_i$, where N represents the number of companies with N highest market shares in the industry and S represents a company's share. The concentration ratios for the Top 3, 5, and 10 companies, where possible, have been calculated. If the shares of the largest companies increase, market concentration increases as well.

However, concentration ratios ignore differences in market shares among companies; therefore, we calculated the Herfindahl-Hirschman Index (HHI) for the different input sectors as well.[4]

Main Findings

The share of seeds in total farm cost ranges between 2% and 15% among EU Member States and shows a declining trend over time. The EU commercial seed market is less concentrated than the world seed market. The HHI of 673 for the EU seed market in 2014 is low. Substantial differences in concentration can be observed by seed markets. The sugar beet seed market shows the largest concentration with an HHI of 2444. Mergers and acquisitions in the world and the EU seed market since 2010 are characterized more by investments in technology rather than acquisition of seed companies. Acquisition of seed companies by the World Top 10 seed companies over the past five years concentrated on Latin America.

The EU-28 produces roughly 16% of global compound feed production. Compound feed is mainly produced and consumed in the same country. The eight biggest EU compound feed producers are Germany, France, Spain, the UK, Italy, The Netherlands, Poland, and Belgium. The turnover of the EU feed companies increased by 50% over the last eight years, whereas the number of companies decreased in most countries by more than 15%. The five largest feed producers in Europe have an average market share of 53%. Some market concentration can be found on a country-level, for example, the share of the countries' five largest producers are: 38 % in Germany, 44% in the UK, 53% in Poland, 63% in Belgium, and 69% in The Netherlands. None of the merger decisions of the European Commission showed a concern about competition in the feed sector due to the large number of important, internationally active competitors present in the market.

The agricultural sector of the EU-27 has become more energy-intensive. Farmers in 23 out of 27 Member States spent more than 50% of their energy costs on motor fuel and lubricants. Energy companies in the EU market are often vertically integrated and operating on several energy markets (e.g., natural gas and electricity; crude oil and natural gas). The concentration in the energy sector gradually increases. Crude oil sector is the most concentrated, followed by natural gas, and electricity sectors. Low crude oil prices may result in more frequent mergers and acquisitions in the energy sector in the future.

Consumption of inorganic fertilizers has been declining in the EU-27; the decline in consumption of N-based products is less marked than for K and P. Differences in relative usage of the three types of fertilizers (N, K, and P) can be found across geographic areas, with Mediterranean areas showing less consumption of N-based products and higher consumption

[4] Suppose, the five largest companies in an industry collectively take up 50 percent of the market share. Consider two possible distributions of the market shares (in percent): 10, 10, 10, 10, 10 and 30, 10, 5, 3, 2. Clearly, the market is more concentrated in the second case, but the concentration ratio for the five largest companies does not reflect that.

of P-based products than other countries. The share of fertilizers costs over total specific cost has followed a positive but declining trend over time. Among the EU-15, the share of soil improvers increased in the previous decades to decline in the recent years; among post enlargement Member States (PEMS), one can observe a growing and increasing cost share of fertilizers. The total value of sales of fertilizers' company operating in EU Member States has increased in the period 2003–2012, recovering from the sharp decline marking the years of the economic recession. The number of enterprises producing fertilizers and soil improvers has increased in the period 2003-2012. Germany, France, Poland, the United Kingdom, and The Netherlands are the countries with the largest values of fertilizer sold, accounting for more than 50% of the total fertilizer turnover in the EU-27. The European fertilizer industry appears only moderately concentrated with an estimated range of the CR5 spanning from 22.23% to 29.48%, and simulated HHIs that vary between 205 and 302. Firms in the European fertilizer industry appear actively engaged in operations of mergers and acquisition.

Consumption of plant protection agents in Europe increased in value until 2008, to show a decline for the following years. Quantity consumed has overall declined, suggesting an increase in unitary value of these products. Herbicides are the plant protection agents consumed in largest amounts, especially in northern Member States. Fungicides are the second most consumed. Mediterranean countries show the largest consumption share of insecticides and the lowest share of herbicides over the total plant protection agents consumed. The incidence of plant protection agents' costs over total farming cost in the EU-15 has declined over the last two decades, while there is an uptrend for PEMS. The total value of sales of plant protection agents' companies operating in EU Member States has seen a slight decline in the period 2003-2009, followed by a marked increase in the following years. The number of enterprises producing plant protection agents has maintained relatively steady, varying between 630 and 655 in the period 2003–2012. Germany, France, the UK, Italy and Spain are the countries where the highest values of plant protection agents turnover is realized, concentrating more than 80% of total sales. The European plant protection agents industry appears concentrated, with an estimated range of the CR5 spanning between 79% and 83%, and calculated HHI values varying between 1556 and 1717. The number of patents in the plant protection agents industry in Europe has declined considerably in the last decades. Investments cost for R&D and product development for companies operating in the EU crop protection agents industry are large and can play a role of sunk costs acting as barriers to entry and fostering further consolidation.

Table 1 shows the average time coefficients of the input cost shares trend analysis by input in the period 2004–2012. A positive coefficient implies a percentage cost share increase and a negative a percentage cost share decrease. The share of energy costs increases faster for the EU-15 farmers (0.346 percentage points per year) than for their PEMS counterparts (0.197 percentage points per year). On average, for the EU-27 the share of seed costs decreased the largest over the period 2004–2012 with 0.08 percentage points per year.

Table 1: Average time coefficients of the input costs shares among EU farmers for the period 2004–2012

Input Sector	EU-27	EU-15	PEMS
Seeds	-0.080	-0.164	-0.030
Feed	0.257	0.000	0.000
Energy	0.000	0.346	0.197
Fertilizers	-0.025	-0.097	0.000
Plant protection agents	0.000	0.000	0.000

Source: Authors, based on FADN data.
The values in the table mean that, for example, the share of energy cost in the total farm cost in the EU-15 increased annually on average by 0.346 percentage points in the period 2004–2012.

Table 2 shows the concentration among the suppliers of farm inputs. The feed, fertilizer, and seed sectors indicate a level of concentration that is not of concern. The results for the seed sector differ substantially by crop. Nevertheless, considering the competition among crops, market power is highly limited and overall the EU seed market is less concentrated than the word seed market (CR5 of 54%). This looks different for the plant protection agents sector. The concentration in this sector is moderately high but has not yet reached a level of high concentration yet is larger in the EU markets than world markets (CR5 of 69.5%). The market concentration in the energy market is also higher than in the seed, feed, and fertilizer markets, but less than in the plant protection agents sector.

Table 2: Concentration of agricultural input sectors in the EU

Input Sector	CR3	CR5	HHI
Seeds (2014 by value)	35	49	673
Feed (2013 by volume)	11	16	130
Energy (2014 by value)			
- Electricity	44	64	1008
- Natural Gas	46	64	1137
- Oil	56	72	1351
Fertilizer (2012 by value)	21	29	286
Plant protection agents (2010 by value)	61	81	1566

Source: Authors.

1. INTRODUCTION

The development of input markets has always been an important issue for the agricultural sector and its stakeholders. Price and quality developments in the input markets affect the comparative advantage of agricultural production among regions and types of production; these developments also affect the income of farm households and can have implications beyond the farm level. Concerns regarding the concentration in input markets have been expressed by different stakeholder groups, including farmer unions, advocacy groups, and policy makers. The concerns arise especially with respect to market power of input suppliers as this can result in higher input costs and a distribution of rents different from what a competitive market would produce. The worries related to the concentration in the agricultural input markets were also highlighted, for example, in the European Parliament's resolution of 19 January 2012 on the farm input supply chain: structure and implications (2011/2114(INI)).

A number of indicators are available to describe the market concentration of sectors and sub-sectors. Although economic theory predicts that an increase in market concentration should lead to higher industry margins, this does not necessarily imply additional market power and higher prices. An increase in market concentration may also result in lower input prices through efficiency, perhaps, achieved via mergers and acquisitions. Increases in input prices might also be driven by an increase in demand. Intensification in agricultural production triggered by a global decrease in supply, as observed in 2008 and 2009, increases the demand for variable inputs and may result in a price increase if the input supply is not perfectly elastic. Separating the effect of concentration on market power and efficiency is not an easy task (e.g., Azzam, 1997; Lopez, Azzam, and Liron Espana, 2002). The difficulty is the separation of pricing power and other forces on input prices; forces that include changes in the demand for inputs as well as changes in policies. Tighter regulation, which may, for example, be in place to protect consumers from ingesting potentially harmful compounds in their food, may result in higher entry barriers and increase entry costs, reducing the number of products available by banning specific products or compound; this could increase market concentration and push prices up. Trade policies can also increase market concentration via tariffs and subsidies. Furthermore, the protection of property rights via patents and trademark can both limit market access, but also provide economic incentives for market entry.

In this study, the input sectors for
1) Seeds and planting material (SPM).
2) Feed.
3) Energy.
4) Fertilizer; and
5) Plant protection agents (PPA) have been investigated.

These variable inputs markets are of most interest as changes in concentration have been reported for these markets (ETC 2011). In the seed and planting stocks market concerns about the market power of large seed companies such as Limagrain, Monsanto, or Syngenta have been raised. Feed inputs comprise the largest share of inputs in agricultural production and the largest increase in prices in recent years. Energy prices are of special interest as the energy market has witnessed mergers and acquisitions and the dependence on a few countries such as Russia are of concern. Similarly, mergers and acquisitions happened in the PPA and fertilizer market. Other input markets are either highly

competitive (e.g., maintenance of materials and buildings or services) as they are not only specific to agriculture or have only a small share on input costs, such as veterinary expenses. Overall, the five input markets considered cover about 70% of the agricultural input market, excluding labor.

Each chapter of this study analyzes concentration in a given input sector from two perspectives: the demand side and the supply side.

Material and Methods

Demand Side

For the demand side, we use country- and NUTS2-level data from the Farm Accountancy Data Network (FADN). Due to a change in the methodology of the data collection, the FADN database contains two overlapping periods. In the period 1989–2009, the average data for represented farms were calculated using a farm typology based on Standard Gross Margins (SGM) (see footnote 2 for definition). The period 2004–2012 contains average data for represented farms calculated using a farm typology based on Standard Output (SO) (see footnote 3 for definition). The time-series for Member States start in the year when a Member State entered the EU.

In order to carry out our demand side calculations later in the study, we must compute the total cost for a represented farm. To do this, we observe that the item Total specific costs (Se281) in the FADN database includes Forestry specific costs (Se331), which we exclude as the focus of our study is on the agricultural sector. On the other hand, the Total specific costs item does not include Energy costs (Se345), which, therefore, has to be added. As a result, the total farm costs used in this study based on FADN are calculated as follows

$$\text{Total cost} = \text{Total specific costs} - \text{Forestry specific costs} + \text{Energy costs}.$$

The FADN database contains, among other data, input costs for representative farms in EU Member States. To be able to make some conclusions for the EU as a whole, one would have to aggregate these data in some way or another. Clearly, aggregating by summing over individual Member States does not make sense, because of substantial differences between them. Another option would be to take an average of the representative Member States' values, which by themselves are averages. By doing so, we would possibly lose a lot of information. Therefore, we decided to take an alternative route. For every input, we calculate its share in the total farm costs in each Member State and then use regression analysis to see what the overall trend is on the EU-27 (EU-15 or PEMS) level.

In this study, we also investigate the development of an input cost share in total farm costs over time. In general, this trajectory does not need to be linear. We therefore estimate a more general non-linear (quadratic) trend where the rate of change of the cost can vary over time

$$\frac{\text{input cost}_i}{\text{total cost}} = \alpha_0 + \alpha_1 t + \alpha_2 t^2 + \alpha_3 D2004 + \sum_{j=1}^{26} \gamma_j D_j + \varepsilon,$$

where α_0, α_1, α_2, and α_3 denote the regression coefficients of our primary interest to be estimated. The variable t denotes time, which we normalize to zero for the beginning of each

period (i.e., 1989 = 0, and 2004 = 0, respectively). The dummy variable[5] D2004 equals 1 for observations starting in 2004 and 0 otherwise. In addition, our model has 26 Member State-specific dummies (D=1 for a given Member State and 0 otherwise) with Luxembourg as the reference.[6] Using this notation, the parameter α_0 can then be interpreted, for example, as an estimate of the energy share for Luxembourg in 1989 (2004). Finally, ε denotes an error term (representing the difference between the observed and predicted values of a variable) that is assumed to have zero mean and constant variance.

It should be noted that the model estimated at the NUTS2-level has the same structure as in the previous equation but with a corresponding number of NUTS2 regions in place of countries (keeping Luxembourg as a reference region as it is both an EU Member State as well as a single NUTS2 region). The regression model simplifies in some cases, for example, when we estimate time trends for the old Member States. We estimate the regression model using ordinary least squares with the heteroscedasticity-consistent[7] standard errors procedure in econometric software Stata 13.

As the FADN data do not allow simple aggregations, linear trends in expenditures for farm inputs have been calculated at Member State level and are reported in Table 1.1. The table illustrates that for almost all inputs and in almost all EU Member States expenditures by the average farm increased. The data also reveal that there are substantial differences between Member States. These differences are not necessarily caused by the specificity of the input market or market power of the input industry, but to a large extent can be explained by structural differences in the farm sector. For example, the Dutch average farm is much larger than the average farm in Poland.

To avoid problems caused by the structural differences in the farm sector for investigating potential problems caused by concentration in the input supply sector, we have analyzed changes in the expenditure shares. An increase in the share of expenditures combined with a high concentration on the input supply side would be an indicator that the high concentration did indeed result in market power. The regression model above does not only allow us to determine if the cost share increases or decreases, but also if the rate at which the share changes is accelerating or slowing down. To do this, one just needs to use the estimated time coefficients from the regression model to calculate the rate of change of a cost share at some point in time and then repeat the calculations for various years to see whether the rate of change is accelerating or decelerating. Mathematically, one needs to calculate the value of the following expression

$$\text{change in an input cost per year} = \sim_1 + 2\sim_2 t \ .$$

Supply Side

First insights in whether or not potential market power exists and may have increased over time can be gained by investigating the development of market concentration on the input supply side. If the largest companies operating in an industry can be identified, one can obtain

[5] In econometrics, particularly in regression analysis, a dummy variable is one that takes the value 0 or 1 to indicate the absence or presence of some categorical effect that may be expected to shift the outcome.

[6] We also estimate a parameter γ for each of the 26 Member States but do not report them in this study.

[7] In statistics, a collection of random variables is heteroscedastic if there are sub-populations that have different variance from others.

concentration ratios, defined as $CR_N = \sum_{i=1}^{N} S_i$, where N represents the number of companies with N highest market shares in the industry. If the shares, S, of the largest companies increase, market concentration increases as well.

Table 1.1: Average annual change in farm expenditures (euros/year) for selected farm inputs by EU Member States in the period 2004–2012

	SPM	FEED	ENERGY	FERTILIZERS	PPA
Austria	50	411	196	99	53
Belgium	459	3989	963	490	289
Denmark	648	6676	1190	778	387
Finland	141	433	1154	348	37
France	272	1232	491	731	261
Germany	450	2645	959	983	405
Greece	20	129	120	49	20
Ireland	22	560	277	303	42
Italy	27	-175	232	122	66
Luxembourg	255	2156	820	618	195
Netherlands	1760	6673	2479	472	412
Portugal	18	244	97	49	42
Spain	62	415	193	136	73
Sweden	411	844	996	591	210
United Kingdom	149	2516	866	1113	294
Bulgaria	179	265	509	515	253
Cyprus	49	348	329	69	39
Czech Republic	423	216	2311	1415	929
Estonia	94	814	991	893	244
Hungary	166	633	302	309	104
Latvia	50	74	384	477	168
Lithuania	77	319	381	471	170
Malta	89	236	122	-10	6
Poland	47	203	159	147	46
Romania	28	-181	1	66	32
Slovakia	416	917	2671	2342	825
Slovenia	37	51	179	99	42

Source: Authors, based on FADN data.
The values in the table mean that, for example, in The Netherlands, the farm seed (SPM) costs increased on average by 1760 euros a year in the period 2004-2012.

Concentration ratios ignore differences in market shares among companies; therefore, we calculated the Herfindahl-Hirschman Index (HHI) for the different input sectors as well. The HHI has become an indicator used by regulators to assess market concentration. The HHI is calculated by summing the squared market shares of all (I) firms in an industry, $HHI = \sum_{i=1}^{I} S_i^2$. As such, the index can range from 0 to 1, moving from a large number of very small firms to

a single monopolistic producer. Increases in the HHI generally indicate a decrease in competition and an increase in market power, whereas decreases indicate the opposite. Alternatively, if whole percentages are used—as in this study—the index ranges from 0 to 10 000 “points.” For example, an index of 0.25 is the same as 2 500 points. In the EU, a post-merger HHI between 1000 and 2000 points in combination with a change of less than 250 points or a post-merger HHI of more than 2000 points with a change of less than 150 points are not considered to raise competition concerns (European Commission 2004). Similarly, in the United States a HHI below 2 500 is considered not to represent high concentration, while a post-merger change in the HHI by more than 200 points as an indication of potential market power in highly concentrated markets (US Department of Justice 2010).

In many cases the HHI of a sector can not exactly be calculated as either the total number of firms or the market share of all firms is not known. This does not pose a serious problem as long as for the leading companies market shares are available. As done in this study and several other studies, the firm-specific HHI values are calculated and added. The remaining market share is divided by the lowest market share of the company among the top companies and multiplied by the HHI of that company. This assumes, that the remaining market share is evenly distributed among a minimum number of firms and maximizes the HHI for remaining market share and is thus a worst case scenario for the sector.

2. SEEDS AND PLANTING MATERIAL

KEY FINDINGS

- Expenditure shares for seeds show a declining trend.
- The share of seeds on total farm cost ranges between 2% and 15% among EU Member States.
- The EU commercial seed market is less concentrated than the world seed market.
- The HHI of 673 for the EU seed market in 2014 is relatively low.
- Substantial differences in concentration can be observed by seed markets
- The sugar beet seed market shows the largest concentration with an HHI of 2444.
- Mergers and acquisitions in the world and EU seed market since 2010 are characterized more by investments in technology rather than acquisition of seed companies.
- Acquisition of seed companies by the World Top 10 seed companies over the past five years concentrated on Latin America.

2.1. Overview

The EU seed market is a key part of the global seed market. In 2012, the value of the EU seed market reached €7 billion, representing 20% of the global market. In an expanding world seed market, the EU market grew by 45% between 2005 and 2012 (the global market rose by 76% in the meantime) (European Parliament 2013). The EU seed market can be considered de facto globalized, consisting of smaller segments delimited by either EU Member States or crop species (Mammana 2014). France is by far the biggest European player (nearly one third); Germany, Italy, Spain, and The Netherlands combined cover most of the remaining market share.

2.2. Demand and Usage

In this report, we only consider purchased seeds and seedlings. The FADN database does not contain detailed data on the demand and usage of different types of seeds; all seed costs are under the heading “seeds and seedlings.” There are approximately 47.5 million hectares of cereal crops in the EU. The most important cereals are wheat (24 million hectares), barley (12 million hectares, of which 7.1 million is spring barley), and triticale and oats (combined cover approximately 2.6 million hectares). The most important pulse crops are peas (660,000 hectares), beans (335,000 hectares), and sweet lupines (50,000 hectares). Grasses used for fodder purposes (pastures and meadows), leisure (lawns, sport fields, and golf courses), and landscaping represent the largest crop in the EU. It covers approximately 57 million hectares of permanent grasslands and meadows of a total of 173 million hectares of Utilized Agricultural Area (UAA), which represents 33%.

Around 15 million hectares of maize are grown in the EU-28, of which 60% (9.4 million ha) is harvested as grain and the rest (5.9 million ha) as silage. Sweet corn covers 70,000 hectares. Maize seed is produced on approximately 180,000 hectares.

The most important oil crops are rapeseed, with an area of 6.8 million hectares, and sunflower, with 4.3 million hectares. The most important fiber crops grown in the EU are cotton (225,000 hectares), flax (75,000 hectares), and hemp (20,000 hectares).

The EU produces potatoes on approximately 1.7 million hectares. Seed potatoes are produced on approximately 180,000 hectares. There are more than 2,600 potato varieties listed in the European Common Catalogue. Of the global potato breeding companies 95% are located in the EU. The main markets are table potatoes, French fries, crisps, and starch. In the past decades, however, several smaller markets were established, for example, for salads, fast food, or organic potatoes.

The EU is the world's leading producer (50%) of sugar beet. Annually, the EU produces nearly 20 million metric tons of white sugar from around 2 million hectares. Sugar beet seed is produced on approximately 9,000 hectares, mostly in France and Italy.

Vegetables are produced on more than 400,000 hectares in the EU. The EU imports approximately 12.5 million metric tons of fresh fruit and vegetables worth €11 billion. At the same time, the EU exports 5 million metric tons of vegetables worth €4 billion.

2.3. The Importance of Seeds for European Farmers' Cost Structure

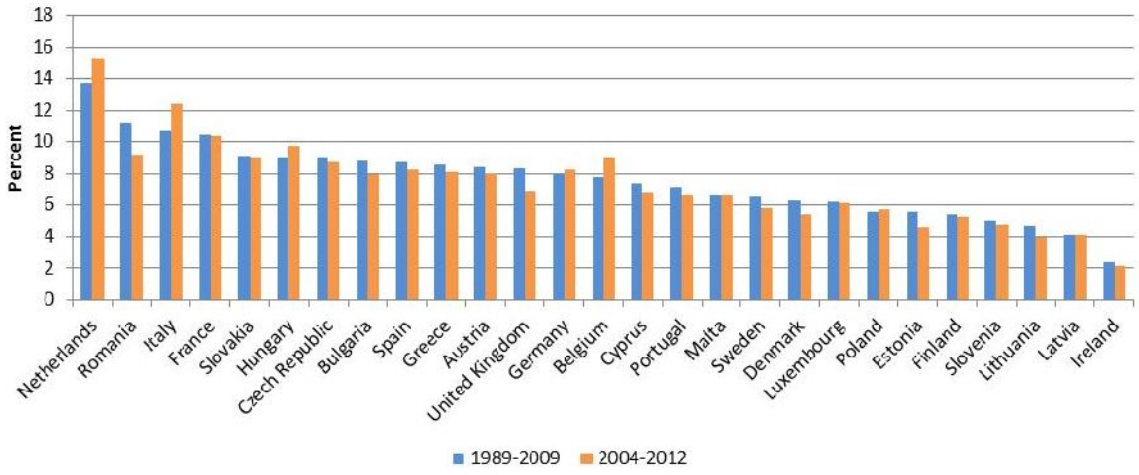
Figure 2.1 shows the average percentage of seed in total farm costs. The Netherlands shows the highest average share of seed costs in total cost in both periods, 1989–2009 and 2004–2012; with cost increasing by 12% in the latter period. On the other hand, Ireland exhibits the lowest seed cost share.

For the rest of Member States, the share of seed costs was quite smooth over time, around 8% on average in both periods. However, countries like Romania, the United Kingdom, and Estonia show a decrease of about 18% (15% for Lithuania) between the first and second period whereas Belgium, Italy, and The Netherlands show an increase of 12% to 16%.

Table 2.1 reports the results for the fixed effects regression models[8] with a quadratic time trend for seed cost shares in both periods. The first panel of the table presents results for all Member States. A dummy (D2004) is included in order to take into account the effects of the post-2004 EU enlargements. This variable is used only for the period 1989–2009 to control for the higher variation in the seed shares due to the new Member States entering. The second panel presents results for the old Member States (EU-15). The third panel presents results for the new Member States entering in or after 2004 (PEMS). It should be noted that the reference country (NUTS2 region) in the third panel is Cyprus, as the observations for Luxembourg were, by definition, not available.

[8] The fixed-effect model assumes there exist time independent effects for each entity that are possibly correlated with the explanatory variables.

Figure 2.1: Share of seed in total farm cost (average for 1989–2009 and 2004–2012)



Source: Authors, based on FADN data.

For the period 1989–2009, the estimated trend coefficients for the EU-27 and the EU-15 samples are statistically significant at the 1% level at both country- and NUTS2-level. The EU-15 panel does not show statistical significance.

The patterns show an increase in the cost share of seed from the beginning of the 1990s. The coefficient associated with the dummy variable for the years following the enlargement is not significant. For the EU-15 a similar pattern is observed with increasing shares as shown from the trends. The coefficients are statistically significant and positive, indicating an increase in the shares of costs for seed.

The fourth and fifth columns report similar patterns for the 2004–2012 period. The trend is negative and statistically significant at both country- and NUTS2-level for the EU-27, EU-15, and PEMS. For the new entering countries, statistical significance is found in the trends. The patterns show a decrease in the cost shares of seed in the period 2004–2012 when considered both at country- and NUTS2-level for all Member States, confirming what emerged also in Figure 2.1. The decrease in costs is particularly evident for the Member States entering after 2004.

Table 2.1: Trend analysis regression results for seeds

		1989–2009				2004–2012			
		Country-level		NUTS2-level		Country-level		NUTS2-level	
EU-27	Constant	5.096	***	4.953	***	6.599	***	6.810	***
		(1.199)		(0.204)		(0.307)		(0.320)	
	Time	0.223	***	0.229	***	-0.192	***	-0.263	***
		(0.036)		(0.033)		(0.068)		(0.073)	
	$Time^2$	-0.008	***	-0.007	***	0.014	*	0.017	***
		(0.002)		(0.002)		(0.008)		(0.009)	
	D2004	0.106		-0.196					
		(0.249)		(0.196)					
	R^2	0.883		0.812		0.942		0.880	
	N	363		4111		237		2169	
EU-15	Constant	5.183	***	4.956		6.674	***	6.827	***
		(0.199)		(0.205)		(0.333)		(0.339)	
	Time	0.186	***	0.233	***	-0.164	**	-0.221	***
		(0.036)		(0.032)		(0.084)		(0.087)	
	$Time^2$	-0.006	***	-0.008	***	0.006		0.009	
		(0.002)		(0.001)		(0.010)		(0.010)	
	R^2	0.882		0.810		0.962		0.883	
	N	297		3829		135		1726	
PEMS	Constant	1.985		-0.952		7.060	***	7.284	***
		(11.666)		(9.351)		(0.364)		(0.373)	
	Time	0.883		1.131		-0.214	**	-0.388	***
		(1.339)		(1.082)		(0.105)		(0.089)	
	$Time^2$	-0.032		-0.037		0.023	*	0.044	***
		(0.038)		(0.031)		(0.013)		(0.011)	
	R^2	0.900		0.864		0.886		0.815	
	N	66		282		102		443	

Source: Authors' calculations.
Note: Dependent variable: percentage share of seed costs in total farm costs. Standard errors in parentheses.
***, **, and * represent 1, 5, and 10% statistical significance, respectively. The change in the seed cost share per year can be computed as the coefficient on Time + 2* the coefficient on $Time^2$ * year. For example, for the EU-15 in the year 2000 (i.e., t=11) a change in the seed cost share per year is estimated to be 0.186 + 2* (-0.006)*11 = 0.054%.

2.4. Supply

The market for commercial seeds has been assessed with approximately $45 billion for the year 2012 by the International Seed Federation. The distribution by region is Asia and Oceania with about 33%, Northern America with about 32%, Europe with about 24%, including the European Union with about 20%, Latin America with about 9%, and Africa with about 3%.

2.5. Market Structure: Number of Establishments and Size

The European seed market is very diverse. For the year 2010, 6,974 seed companies have been reported. The largest number of companies have been reported for Poland and Romania with around 2,000 each, Hungary around 800, the United Kingdom around 800; between 120 and 350 companies for France, Italy, Germany, The Netherlands, and Slovakia, and fewer than 60 in the other Member States. The sector is expected to employ about 50,000 people (EP 2013). Detailed data about the number of companies and employment are difficult to obtain. They are not provided for the sector by Eurostat. The European Seed Associations and the national seed associations report numbers but not annually.

The size of the European seed market grew by about 3.79% in terms of value between 2010 and 2014, which is rather small (see Table 2.3). The most important markets for commercial seeds in value terms are cereals and pulses (39%), maize (26%), seed potatoes (14%), vegetables (11%), oil and fiber crops (4%), sugar beet (3%), and grasses (3%) (EP 2013).

2.6. Market Concentration

Concentration in the seed market represents a worldwide concern. The report by Mammana (2014) indicates that the market concentration is increasing. As highlighted elsewhere in this document, the major players in some of the agricultural input markets have a market presence in more industries. Some of the leading seed companies are also present in the plant protection agents market (e.g., Bayer, DOW, Dupont, Monsanto).

According to a report published by the European Parliament (EP 2013), the Top 10 seed companies had a share of about 62% of the global market in 2012. According to our calculations, we find a slightly larger market share of 68% for 2012 (Table 2.2). Of the companies listed in Table 2.2, most are global players that also operate in the European market. Their market share has increased substantially between 2010 and 2012 from about 51% to 68%, but slightly decreased to 66% in 2014.

Table 2.2: World Top 10 seed companies by net sales (million euros)

Company	2010	%	2011	%	2012	%	2013	%	2014	%
Monsanto	5975	18.5	6419	20.2	7919	24.0	8096	23.0	8420	23.7
DuPont/Pioneer Hi-Breed	4204	13.0	4543	14.3	5914	18.0	6435	18.3	5989	16.8
Syngenta	2202	6.8	2382	7.5	2619	7.9	2509	7.1	2474	7.0
Group Limagrain/Vilomorin	974	3.0	1109	3.5	1256	3.8	1392	4.0	1419	4.0
DOW	442	1.4	804	2.5	1084	3.2	1285	3.7	1257	3.5
KWS	754	2.3	855	2.7	986	3.0	1147	3.3	1178	3.3
Land O'Lakes/Winfield	848	2.6	811	2.6	1034	3.1	1007	2.9	1041	2.9
Bayer Crop Science	687	2.1	820	2.5	897	2.7	921	2.6	978	2.8
DLF Trifolium	255	0.8	274	0.9	292	0.9	330	0.9	427	1.2
Sakata	291	0.9	319	1.0	341	1.0	296	0.8	301	0.8
Top 10 seed market	16632	51.4	18337	57.7	22343	67.7	23419	66.5	23483	66.0
Total world seed market	32342		31790		33014		35235		35570	
CR3	38		42		50		48		47	
CR5	44		48		57		55		54	
CR10	51		58		68		66		66	
Remaining net sales other companies	15710		13453		10670		11816		12087	
Minimum number other companies[1]	127		116		37		40		40	
Average net sales of minimum number other companies	124		116		292		296		301	
HHI	604		724		1041		997		979	

Source: Authors' calculations based on company reports. For details see the notes in Appendix 1.
Note: [1]Calculated by dividing the remaining net sales by the Top 10 companies by the lowest net sales.

The calculation of the HHI at world market level poses some problems as the detailed distribution of the remaining 49% to 34% net sales among the remaining seed companies not listed under the Top 10 is difficult to assess. Instead, HHIs for a highly concentrated remaining seed market have been calculated. For the year 2010, we divided the value of 15,710 by 255 (net sales of DLF in 2010) and rounded it, resulting in a minimum number of other seed companies of 127 with an average amount of net sales of €124 million. This provides an HHI of 604. The overall results show HHIs for the years 2010 to 2014 between 604 and 1041. We conclude that the world seed market based on this result is not highly concentrated.

The situation might be different for the EU. Table 2.3 lists the net sales of the world Top 10 seed companies in the EU. The Top 8 companies are also the Top 8 companies in the EU.

Sakata has net sales in the EU between €38 to €48 million for the period 2010–2014. There are other EU seed companies that are not among the World Top 10 but belong to the Top 10 in the EU. These include RAGT and Euralis, both international seed companies with headquarters in France and reported turnovers within the seed business of more than €200 million.

Table 2.3: Net sales of the world Top 10 seed companies in Europe (million euros)

Company	2010	%	2011	%	2012	%	2013	%	2014	%
DuPont/Pioneer Hi-Breed	968	13.4	1181	15.0	1419	16.5	1514	16.1	1467	14.3
Monsanto	719	10.0	823	10.4	1006	11.7	1112	11.8	1164	11.3
Syngenta	822	11.4	795	10.1	891	10.3	965	10.2	999	9.7
Group Limagrain/ Vilmorin	543	7.5	619	7.9	689	8.0	698	7.4	752	7.3
KWS	480	6.7	554	7.0	619	7.2	657	7.0	673	6.5
Bayer Crop Science	351	4.9	375	4.8	428	5.0	428	4.5	460	4.5
DOW	152	2.1	279	3.5	366	4.3	411	4.4	428	4.2
DLF Trifolium	186	2.6	200	2.5	213	2.5	268	2.8	279	2.7
Sakata (not among the Top 10 in Europe)	35	0.5	38	0.5	41	0.5	41	0.4	48	0.5
Land O'Lakes/Winfield	N/A		N/A		N/A		N/A		N/A	
Total European seed market	7217		7885		8616		9414		1028	
Total EU seed market	6974		6968		7106		7127		7238	
CR3 European seed market	35		35		38		38		35	
CR5 European seed market	49		50		54		53		49	
CR9 European seed market	59		62		66		65		61	
Remaining net sales other companies	2961		3020		2943		3320		4017	
Minimum number other	19		15		14		12		14	
Average net sales of minimum number other	282		200		213		268		279	
HHI European market	705		685		764		755		673	

Source: Authors' calculations based on company reports. See for details the notes in the Appendix 1. Note: [1] Calculated by dividing the remaining net sales by the Top 10 companies by the lowest net sales of the Top 8 company. N/A – information not available.

Proceeding as with the calculation of the HHI for the world market, HHIs for the European seed market range between 673 and 764 for 2010 to 2014. In comparison with the world market, the European seed market is much less concentrated, while the calculations for the European seed market are upward biased as the net sales reports of the Top 9 companies in many cases not only cover the European market but also Near East and Africa (see Appendix 1 for details). An explanation for this difference is that the world seed market is dominated by US companies with a strong presence in non-EU seed markets.

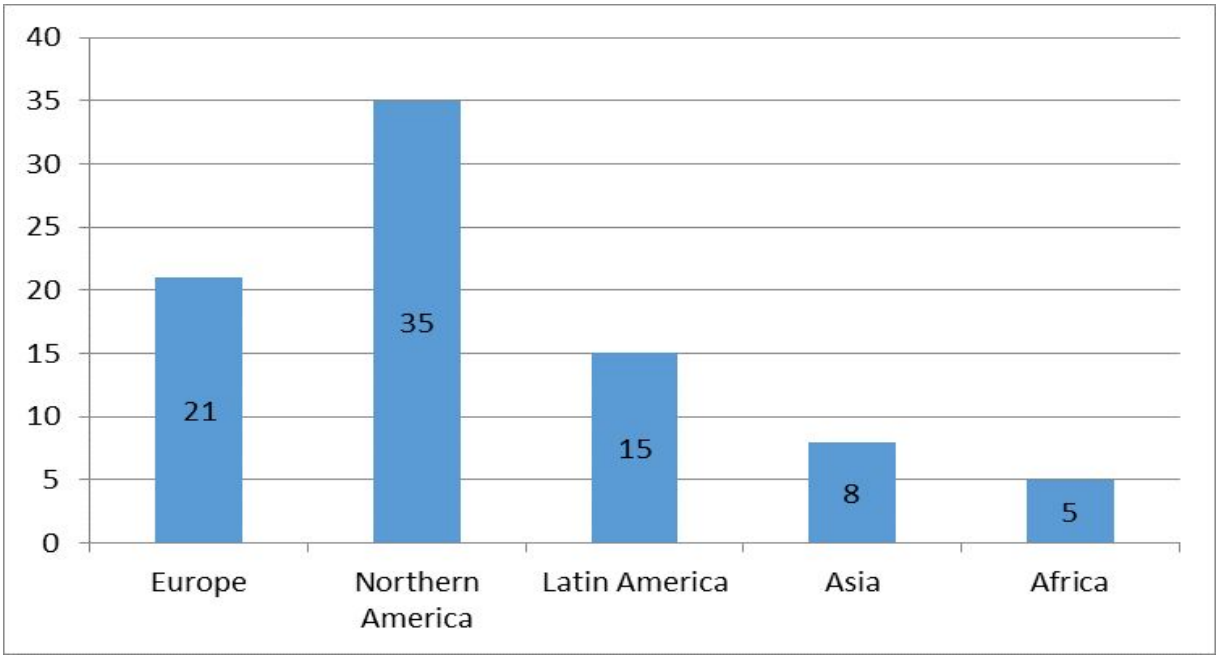
While the numbers reported in Table 2.3 apply to the total seed market, concentration by crop differs. The seed market for sugar beets shows the largest concentration with KWS having a market share of about 39% and the sector CR3 is 79% (HHI=2444). This is followed by the market for maize seeds, where Dupont/Pioneer Hi-breeds has a market share of 22% and the

market CR3 is 56% (HHI=1425). Also in the vegetable market a high concentration in the market for tomato seeds has been mentioned, where Monsanto has a share on registered seed varieties of 20% and CR3 of seed varieties is 37% (HHI= 783). The HHI for the sugar beet and the maize sector may raise concerns, but competition is not only within the specific crop/vegetable sector but also among different crops and vegetables as crop and vegetable producers have the possibility to switch between different crops and vegetables, albeit this is somewhat reduced by the investment specificity in sugar beet and vegetable production.

2.7. Mergers and Acquisitions

The seed market was characterized by a number of mergers and acquisitions in the 1990s and early 2000s (Howard 2013; Schenkelaars 2011). Since 2010, mergers, acquisitions, and joint ventures somewhat cooled down. Figure 2.2 shows the mergers and acquisitions since 2010 of the World Top 10 seed companies according to their company reports (details in Appendix 1). This may not include all the company activities as most companies only report major ones. The main activities took place in Northern America (34), followed by Europe (21), Latin America (15), Asia (8), and Africa (5). Despite those activities, they had no major implications for the concentration of the seed market, which can be explained on the one hand by the small size of the seed companies acquired and on the other hand by investments in technology rather than seed production. One of the noteworthy activities is the takeover of Danisco, Denmark, a biotechnology and food company by DuPont for $6,300 million; The Climate Corporation, the Unites States, a weather data analysis company for $917 million by Monsanto; Devgen, Belgium, a biotechnology company focusing on rice by Syngenta for $522 million and of AgrQuest, the Unites States, a global supplier of biological pest management solutions based on natural microorganisms by BayerCropScience for $375 million.

Figure 2.2: Number of mergers, acquisitions, and joint ventures of the World Top 10 seed companies in the period 2010–2014



Source: Authors, based on company reports.

The recently announced intention by Monsanto to acquire Syngenta would change the concentration in the EU and world seed markets. Looking at the market shares for the year 2014, the market share of the merged companies would increase to 22% in the EU and to 30.7% at World Market level. The HHI would increase for the EU for 2014 by more than 200 points from 673 to 892 and at world market level by more than 300 points from 979 to 1308.

According to the EU competition policy this would not raise a concern within the EU yet. This is not that surprising as the benefits of the acquisition of Syngenta by Monsanto are mainly seen by Monsanto in the combination of the seed technology with the pest control technologies owned by Syngenta. While the concentration in EU markets might not be of immediate concern, for other markets such as the US market the picture might look different. At world market level the EU conditions for raising concerns, an HHI of more than 1000 point post-merger and a change of more than 200 points, are met.

Table 2.4: Simulated changes in the HHI for the EU-27 PPM market due to a merger by Monsanto and Syngenta

	2010	2011	2012	2013	2014
HHI_{max}	705	685	764	755	673
HHI_{max} (postmerger)	932	895	1005	998	893
Difference	227	210	241	242	220

Source: Authors' calculations based on company reports.

3. FEED

KEY FINDINGS

- The EU-28 produces roughly 16% of global compound feed production.
- Compound feed is mainly produced and consumed in the same country.
- The eight biggest EU compound feed producers: Germany, France, Spain, the UK, Italy, The Netherlands, Poland, and Belgium.
- The turnover of the EU feed companies increased by 50% over the last eight years, whereas the number of companies decreased in most countries by more than 15%.
- The five largest feed producers in Europe are ForFarmers B.V., Nutreco, DLG Group, De Heus, and Agrifirm Feed, with an average of market share of 53%.
- Some market concentration can only be found on a country-level, for example, the share of the countries' five largest producers are: 38 % in Germany, 44% the UK, 53% in Poland, 63% in Belgium, and 69 % in The Netherlands.
- None of the merger decisions of the European Commission showed a concern about competition due to the large number of important, internationally active competitors present in the market.

3.1. Overview

Animal feeds play a leading role in the global food industry. Feed is the largest and most important component to ensure safe, abundant, and affordable animal proteins. According to the definition of the European Commission (2008), feeding stuffs are divided into purchased and produced and used on the farm. For the purpose of this study, we only analyze the purchased feeds.

The purchased feeds include mineral licks, milk products (bought or returned to the farm), products for the preservation and storage of feeding stuffs, as well as the expenditure on agistment, on the use of common pasture and grazing land not included in the UAA and on renting forage land not included in the UAA. Purchased litter and straw are also included. Feeds purchased for grazing stock are subdivided into concentrated feeds and coarse fodder. The heading "Concentrated feeding stuffs" includes in particular oilcakes, compound feeds, cereals, dried grass, dried sugar beet pulp, fish meal, milk and dairy products, minerals, and products for the preservation and storage of such feeding stuffs.

We consider the following breakdown of animal feeds in this study: concentrated feeding stuffs for grazing stock (equines, cattle, sheep, goats); coarse fodder for grazing stock; and purchased feeding stuffs for pigs, poultry, and other small animals.

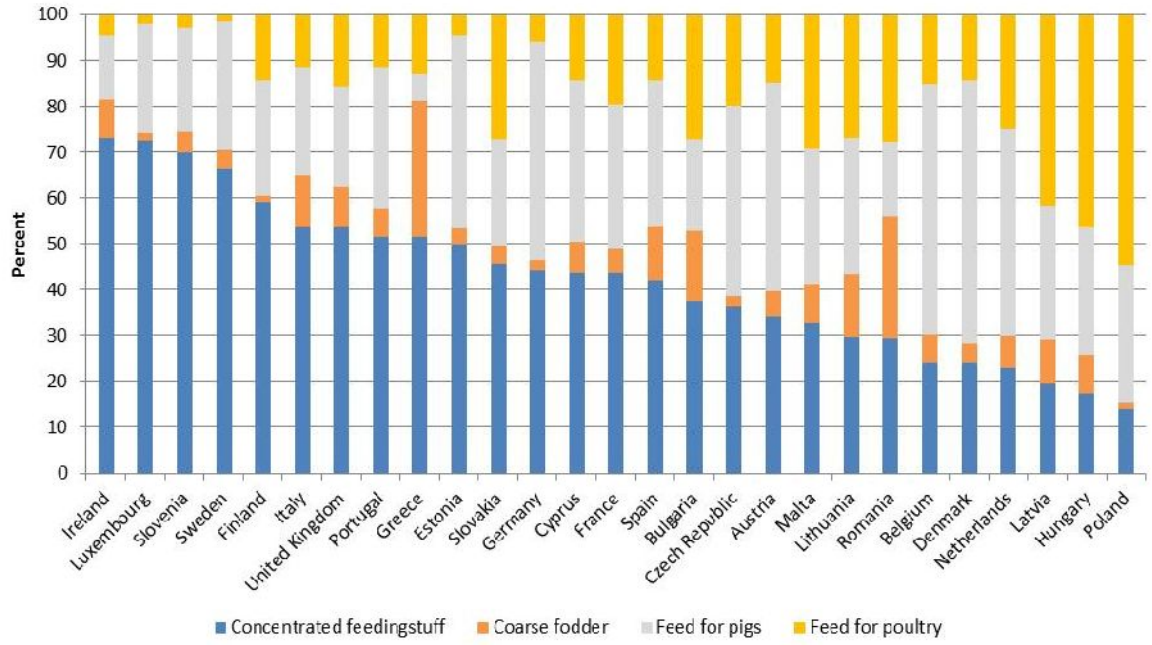
3.2. Demand and Usage

Figure 3.1 and Figure 3.2 show the breakdown of the total value of purchased animal feed use into concentrated feeding stuffs for grazing stock, coarse fodder for grazing stock, feeding stuffs for pigs, and feeding stuffs for poultry for individual Member States. Data are obtained

from FADN database. The series of data represent two overlapping periods, 1989–2009 and 2004–2012.

For the period 1989–2009, concentrated feeding stuff represents 40–50% of the cost for feed for most of the EU Member States, with farms in Ireland, Luxembourg, Slovenia, and Sweden spending more than or close to 70% of their total animal feed on concentrates. On the other hand, farms in Belgium, Denmark, and The Netherlands spend less than 30% on them (Latvia, Hungary, and Poland less than 20%). The last three countries show considerable spending on feed for poultry compared to the other countries. Only farmers in Greece and Romania spend a big part of their feed cost on coarse fodder, whereas farmers in other countries do not seem to demand this category of feed.

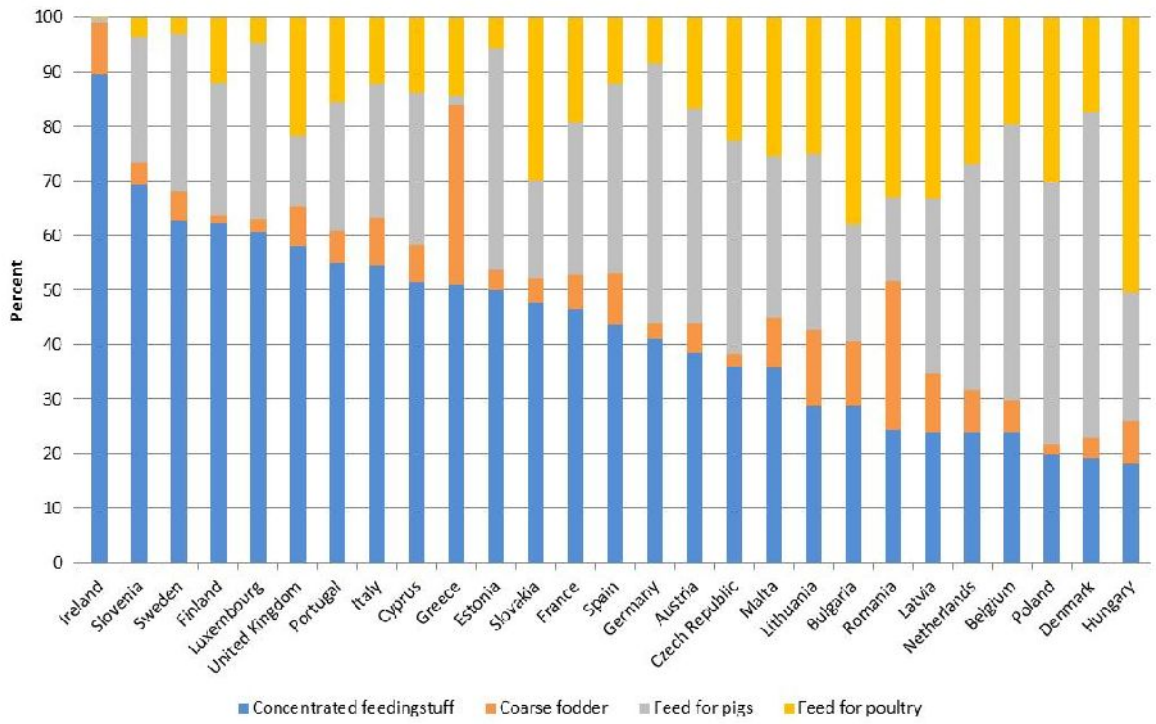
Figure 3.1: Composition of the feed cost in the period 1989–2009



Source: Authors, based on FADN data.

The composition of the feed cost is generally similar in the period 2004–2012 (Figure 3.2). Farmers in Ireland, in particular, increased the demand for concentrated feeding stuff at the expense of other feed categories. Hungary shows increased consumption of feed for poultry (more than 50% of the feed cost, which is the highest share of all Member States in 2004–2012).

Figure 3.2: Composition of the total feed cost in the period 2004–2012



Source: Authors, based on FADN data.

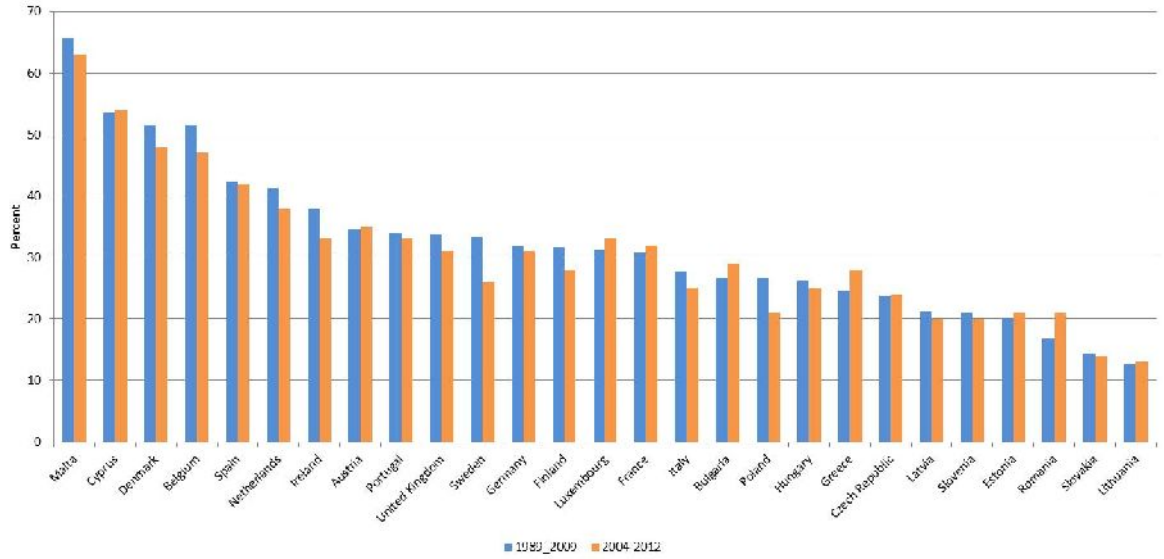
3.3. The Importance of Feed for European Farmers' Cost Structure

Figure 3.3 reports an average percentage share of feed costs in total farm costs. Farmers in Malta appear to spend most on feed, whereas their Lithuanian counterparts spend least.

For several countries, especially in Eastern Europe (e.g., Bulgaria, Greece, the Czech Republic, Estonia, and Romania), the share of feed costs appears to increase over time. Romania shows an increase of 4, Greece 3, and Bulgaria 2 percentage points. Of EU-15 Member States, only Luxembourg and France show a similar increase of 2, and 1 percentage points, respectively. On the other hand, the feed cost share decreased in Poland, Sweden, Ireland, and Italy.

The results of the fixed effects regression models with a quadratic time trend for feed cost shares are reported in Table 3.1. The structure of the table is identical to Table 2.1 of Section 2. For the period 1989–2009, the estimated trend coefficients for the EU-27 states sample appear statistically significant at the 1% level only at NUTS2-level. The patterns show an annual decline in the cost share of feed from the beginning of the 1990s. The coefficient associated with the indicator for the years following the enlargement is not significant. The EU-15 Member States show a similar pattern with declining shares as shown from the trends. The coefficients are statistically significant and negative, indicating a decline in the shares of costs for feed.

Figure 3.3: Share of feed in total farm cost (average for 1989–2009 and 2004–2012)



Source: Authors, based on FADN data.

The fourth and fifth columns of Table 3.1 report similar patterns for the 2004–2012 period. The trend is negative and statistically significant at both country- and NUTS2-level for the EU-27 and the EU-15. No statistical significance is found in the trends for the Member States of post-2004 enlargements.

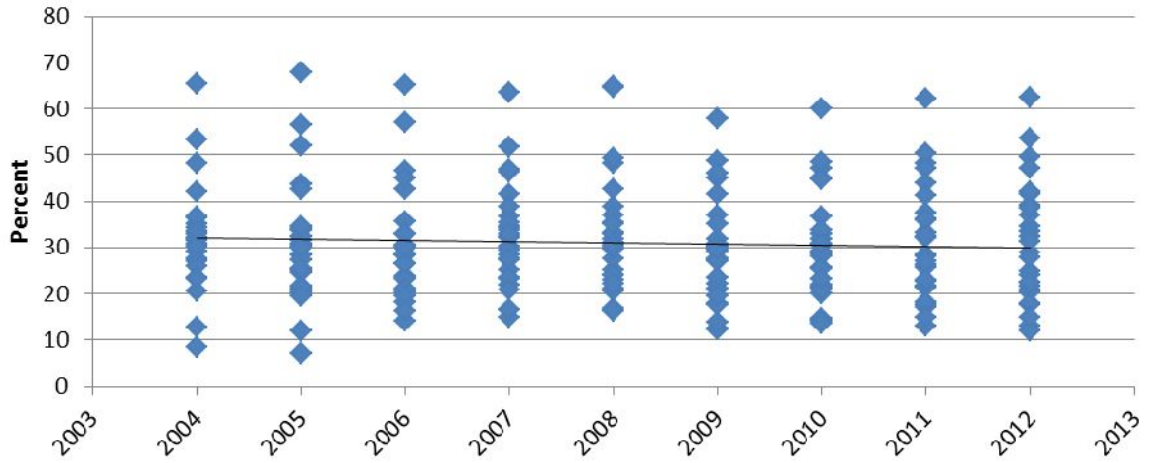
Table 3.1: Trend analysis regression results for feeds

		1989–2009				2004–2012			
		Country-level		NUTS2-level		Country-level		NUTS2-level	
EU-27	Constant	33.941	***	33.299	***	33.890	***	33.036	***
		(0.896)		(0.827)		(2.173)		(1.997)	
	Time	-0.187		-0.262	***	-0.550	*	-0.342	***
		(0.124)		(0.075)		(0.317)		(0.159)	
	$Time^2$	-0.006		0.005		0.042		0.043	***
		(0.007)		(0.004)		(0.037)		(0.019)	
	D2004	0.029		-0.659					
		(0.797)		(0.422)					
	R^2	0.927		0.8588		0.9362		0.906	
	N	363		4111		237		2169	
EU-15	Constant	34.044	***	33.330	***	33.607	***	33.020	***
		(0.893)		(0.838)		(2.063)		(1.956)	
	Time	-0.228	**	-0.256	***	-0.778	***	-0.484	***
		(0.118)		(0.071)		(0.335)		(0.178)	
	$Time^2$	-0.004		0.003		0.095	***	0.069	***
		(0.005)		(0.003)		(0.042)		(0.021)	
	R^2	0.881		0.856		0.859		0.910	
	N	297		3829		135		1726	
PEMS	Constant	57.715		118.961	***	55.595	***	54.426	***
		(54.137)		(36.987)		(1.703)		(1.672)	
	Time	0.191		-6.679		-0.317		0.115	
		(6.069)		(4.168)		(0.600)		(0.348)	
	$Time^2$	-0.024		0.167		-0.020		-0.045	
		(0.169)		(0.117)		(0.065)		(0.039)	
	R^2	0.970		0.887		0.957		0.850	
	N	66		282		102		443	

Source: Authors' calculations.
Note: Dependent variable: percentage share of feed costs in total farm costs. Standard errors in parentheses.
***, **, and * represent 1, 5, and 10% statistical significance, respectively. The change in the feed cost share per year can be computed as the coefficient on Time + 2* the coefficient on $Time^2$ * year. For example, for the EU-15 in the year 2000 (i.e., t=11) a change in the feed cost share per year is estimated to be -0.228 + 2* (-0.004)*11 = -0.316%.

The trend in the share of feed costs at country level for 1989–2009 is negative, but as emerged in discussing the results of the estimates in Table 3.1, it is not significant. Figure 3.4 reports then only the trends for the shares of feed cost for all Member States against time in the period 2004–2012. Here, the time trend is slightly decreasing and the variation in feed shares is minimal across years. These two figures only depict the situation at the EU-27 level and do not reflect what happens at Member State (or NUTS2) level.

Figure 3.4: Share of feed in total farm cost for EU-27 in the period 2004–2012



Source: Authors, based on FADN data.

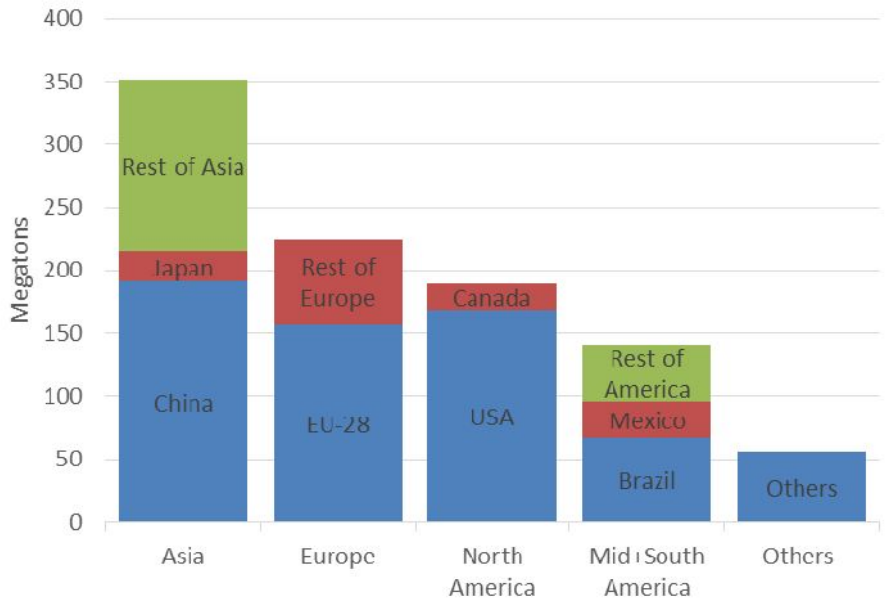
3.4. Supply

According to the European Feed Manufacturers' Federation (FEFAC), European livestock farms and potentially other processing firms consumed a total of 477 million metric tons of livestock feedstuffs in the year 2013. The total amount is a composition of roughage [233 megatons (Mt)[9]], farm grown cereals (51 Mt), and supplementing feed materials and compound feed. Since farmers mainly grow and use roughages and cereals themselves, our study will focus on the analysis of market concentration of compound feed supply. The reason for this is that (unlike highly competitive farmers) capital-intensive firms produce the compound feed. Compound feed is a mixture of various raw materials (e.g., soya and other grains) and Premix. Premix is a blend of feed additive, like fiber, vitamins and minerals and comprises 1-5% of the total compound feed volume (Rabobank International 2015).

Figure 3.5 shows that of the globally produced 962 Mt, Asian countries (mainly China) produce more than one third. The EU-28 countries and the United States together produce another one third. The remaining third is produced in the Rest of Europe, Canada, Brazil, Mexico, the rest of America and other countries.

[9] One megaton is equivalent to million metric tons.

Figure 3.5: Global compound feed production in 2013 (total 962 Mt)



Source: Data from Rabobank International (2015) based on Alltech Global Feed Survey.

Industrial compound feed (154 Mt in 2013) constitutes about 30% of the total livestock feedstuffs consumption in Europe (ForFarmers 2012) and about 80% of all purchased feeding stuffs (FEFAC 2013). Table 3.2 shows the production volume per animal category of the eight major EU Member States that produced more than 5 Mt in the year 2013 and the total production in the EU-27, sorted by the total production volume per country. These eight major Member States constitute about 80% of the total EU-27 compound feed market. The EU Member States have different animal category focuses. Four of the countries in the table have their major production in pig feed: Germany, Spain, The Netherlands, and Belgium. The remaining four produce most of their total compound feed for poultry: France, United Kingdom, Italy, and Poland. Overall, poultry compound feed constitutes about one third, followed by pig feed, with a similar but somewhat lower share. Cattle is the third most important compound feed with 28%. The Other category includes milk replaces, dry pet food, and other livestock animals. Processors sometimes specialize in producing feed for some of the animal categories. This report does not distinguish in market concentration by category but rather by country.

Table 3.2: Production volume of industrial compound feed production of EU-27 with more than 5 Mt in 2013

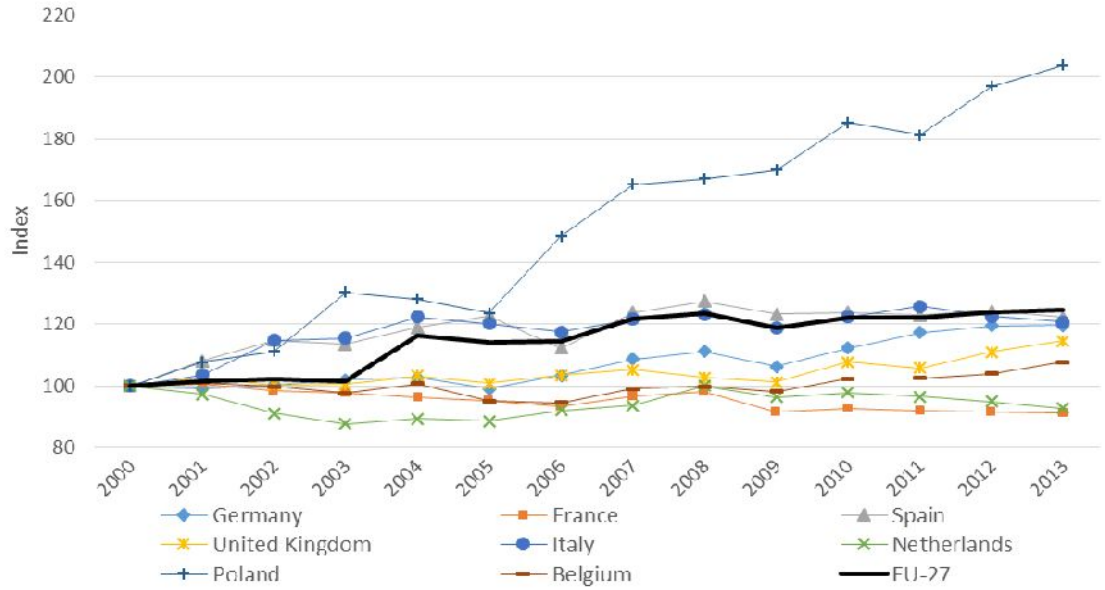
	Cattle	Pigs	Poultry	Other	Total	%EU-27
Germany	6.91	9.6	6.09	0.88	23.48	15
France	5.38	5.32	8.63	1.81	21.14	14
Spain	6.7	8.9	4.4	0.91	20.91	13
The UK	5.57	1.86	6.55	1.65	15.63	10
Italy	3.35	3.3	5.79	1.64	14.08	9
The Netherlands	3.69	5.05	3.75	1.09	13.58	9
Poland	1.04	1.8	5.49	0.38	8.7	6
Belgium	1.39	3.72	1.46	0.22	6.78	4
EU-27	42.44	49.43	51.95	11.21	155.03	100

Source: FEFAC (2015).

Figure 3.6 shows a production index of industrial compound feed for all countries of Table 3.2 with 2000 as a base year. The total production of all EU Member States steadily increased over time from 124 Mt in 2000 to estimated 155 Mt in 2013. As the figure shows, Poland is the country with the strongest increase in production, more than doubling the volume within the last 13 years. All other countries are rather steady. Only in two countries, France and The Netherlands, did the production decrease so that France was succeeded as the year 2000 Top producer by Germany.

Akin to the increase in volume in most major compound feed producing Member States, the turnover also increased over the last eight years by 50% on average (compare this to the right part of Table 3.3). Turnover increased even in those countries in which the total volume decreased. Contrary to the increase in turnover the number of enterprises decreased. The decrease is about 15% for the EU-27 and even stronger for the eight major producing EU Member States besides France and Spain.

Figure 3.6: Production volume index of industrial compound feed production of EU-27 Member States with more than 5 Mt (2000, base year)



Source: FEFAC (2015).

Table 3.3: Number of enterprises and turnover for Member States with more than 5 Mt of feed production

	Number of enterprises			Turnover (million euros)		
	2004	2012	Difference (%)	2004	2012	Difference (%)
Germany	396	313	-21	4500	7200	60
France	330	292	-12	6400	8400	31
Spain	922	859	-7	5183	6700	29
United Kingdom	460	340	-26	2714	3840	41
Italy	700	510	-27	5100	7700	50
The Netherlands	136	100	-26	3400	5000	47
Poland	136	105	-23	1226	3400	177
Belgium	77	74	-4	1780	2900	63
EU-27	4489	3812	-15	36679	54950	50

Source: Data from FEFAC (2013) and Eurostat (2015) with NACE code C1091: Manufacture of prepared feeds for farm animals (European Commission, 2010).

The increase in turnover and decrease in the number of enterprises indicates a structural change in the feed production sector towards a market with fewer firms with higher market share. However, the number of feed processors is still relatively large with most processors in Spain.

3.5. Market Structure: Number of Establishments and Size

3.5.1. Major EU compound feed manufacturers

For a better understanding of how the feed processor market is structured, the question is what share the countries' largest processors have relative to the total country production. Table 3.4 shows the 24 largest European compound feed manufacturers that produce more than 1 Mt. The Top 5 producers produced approximately 17% of EU's 155 Mt in 2013.

Table 3.4: Largest European compound feed producers in 2013

	Company	Production (megatons)	Country
1	ForFarmers B.V.	6.40	The Netherlands
2	Nutreco (mainly premix)	6.30	The Netherlands
3	DLG Group	4.50	Denmark
4	De Heus	4.20	The Netherlands
5	Agrifirm Feed	4.10	The Netherlands
6	Glon Sanders	4.00	France
7	Agravis Raiffeisen	3.30	Germany
8	Veronesi	3.10	Italy
9	InVivo NSA	3.00	France
10	AB Agri	2.50	United Kingdom
11	DTC Deutsche T C	2.30	Germany
12	Triskalia	2.00	France
13	Terrena	1.90	France
14	Aveve Group	1.60	Belgium
15	Cooperl Arc Atlantique	1.54	France
16	Vall Companys Grupo	1.51	Spain
17	Amadori	1.50	Italy
18	Bröring Unternehmensgruppe	1.30	Germany
19	Latmännen Lantbruk	1.20	Sweden
20	MEGA Tirernährung	1.20	Germany
21	Nutréa Nutrition Animale (NNA)	1.02	France
Total feed production in the EU		155.03	
Feed production by other companies		96.56	
Remaining companies evenly distributed		95	
CR3		11.09	
CR5		16.45	
CR10		26.70	
HHI		130.36	

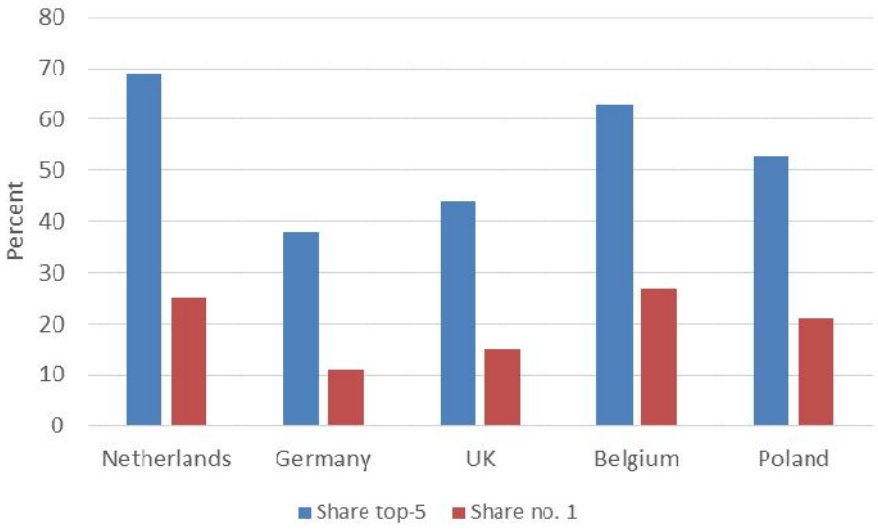
Source: Feed International (2014).

In terms of feed volume, the share of the 3, 5 and 10 largest EU firms is 11.09, 16.45, and 26.70 percent, respectively, of the total feed in the EU. These values are very low compared to all other all other sectors analyzed in this report. The numbers indicate that the feed market is unconcentrated on an EU level. The HHI of 130.36 further suggests that it is unlikely to change with further mergers of some of the above firms even if the number of firms further decreases and their market share increases.

3.5.2. Market share overview and market concentration measure

One of the reasons for the low EU level concentration is that, as mentioned above, feed is mainly consumed in the country or region where it is produced. Figure 3.7 shows the market share of the five largest producers and of the single largest producer in the selected EU Member States.

Figure 3.7: Market share (%) in relevant EU Member States of the five largest and the single largest producers



Source: Data from Rabobank International (2015).

The evaluation of the data has shown that the compound feed market has many competitive firms. Since much of the market is operated regionally, market shares and market concentration can be assessed by country for some indication. As a very rough measure of market concentration, the HHI per country is used.[10] Since we have only values available of the countries' largest few firms, we compute a conservative measure, HHI_{max} (see Appendix 2 for the detailed computation description). This measure computes the maximum potential market concentration, if only the market shares of the Top producers are given and the market shares of the remaining firms are unknown.

Since companies in The Netherlands are of major concern regarding market concentration, the HHI_{max} is computed using the maximum market shares stated by the European Commission (2012) for Dutch companies and market share estimates using the production volume of the

[10] Note that the HHI for the EU is very low and hence suggests the compound feed market to be unconcentrated.

relevant firms. The HHI_{max} for The Netherlands is 1600. This value exceeds the minimum threshold for "moderate concentration" by 100 points (US Department of Justice 2010). However, the HHI threshold on an EU basis is very low, indicating that the major European feed processors are unconcentrated. Additionally, it should be emphasized again, that the HHI_{max} is very conservative. For all remaining countries, the HHI_{max} on a per-country basis is below the 1500 threshold, which would even for a non-conservative HHI indicate an "unconcentrated index." Appendix 2 describes the major EU compound feed manufacturers by Member State.

4. ENERGY

KEY FINDINGS

- The agricultural sector of the EU-27 has become more energy-intensive.
- Farmers in 23 out of 27 Member States spent more than 50% of their energy costs on motor fuel and lubricants.
- Energy companies in the EU market are often vertically integrated and operating on several energy markets (e.g., natural gas and electricity; crude oil and natural gas)
- The concentration in the energy sector gradually increases.
- Crude oil sector is the most concentrated, followed by natural gas, and electricity sectors.
- Low crude oil prices may result in more frequent mergers and acquisitions in the energy sector in the future.

4.1. Overview

Energy is an indispensable factor of the EU agricultural production. The cost of direct energy use represented more than a tenth (12.2%) of all intermediate inputs costs of the EU-28 agricultural sector in 2012 (Eurostat 2014a). This excludes the energy contained, for instance, in inorganic fertilizers. The importance of energy inputs varies, however, by the farm type (e.g., crop production versus dairy) and by cultivated crops (e.g., wheat, versus sugar beet).

According to 2012 Eurostat data, energy consumed in the EU-28 agricultural sector represented 2.2% of the total energy consumption of the European Union (Eurostat, 2014b). The share of energy used in agriculture in the final energy consumption is highest in the Netherlands (6.5%), Poland (5.8%), and Denmark (5.4%). Although total energy consumption in the EU-28 increased between 1990 and 2012 by 2.2%, energy consumption in agriculture decreased by 24.6%; such a sharp decrease was primarily due to the collapse of agricultural production in East European countries following the transition to market economies.

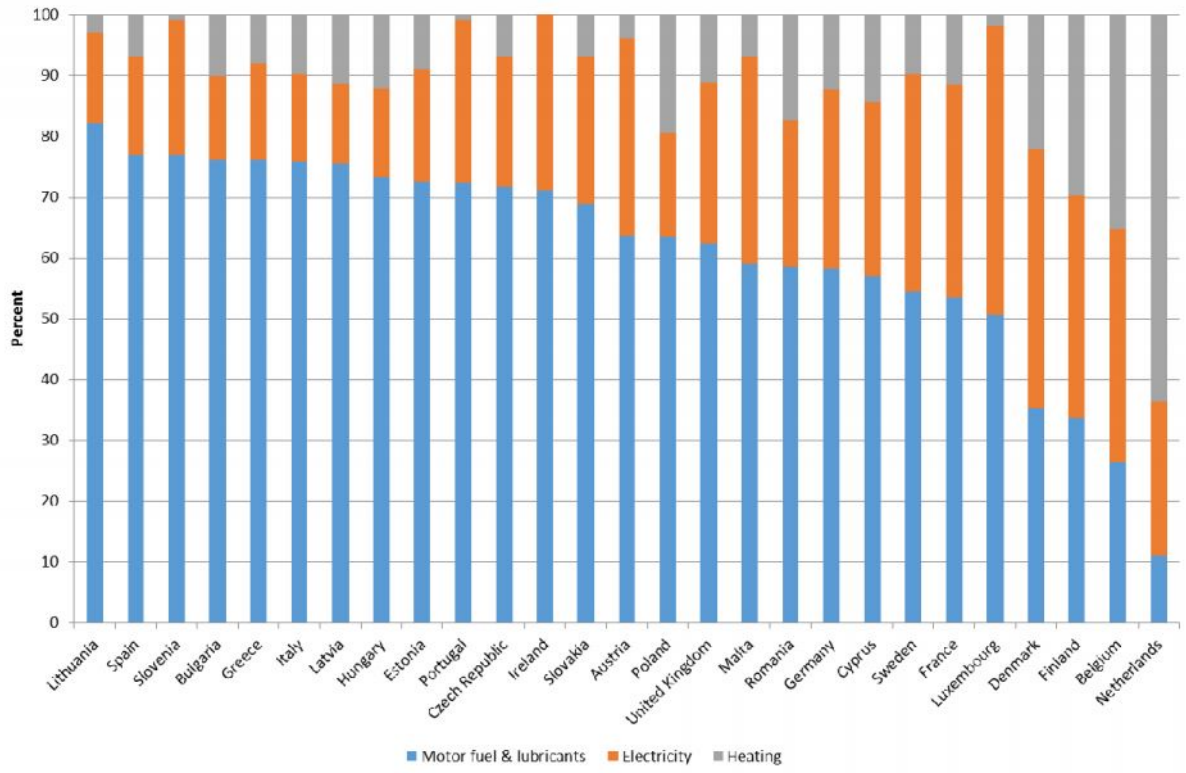
The Eurostat data show that oil is the dominant fuel type in most countries, representing 53% of total energy consumption in the EU-27 agriculture in 2010 (Eurostat 2014c). The exceptions are the Netherlands where natural gas is mostly used; Sweden with the dominant use of renewables; and the United Kingdom with a substantial use of electricity. The main fuel types used by agriculture in the EU-15 are oil (54%), electricity (20%), and natural gas (17%). On the other hand, Central and East European countries use mostly oil (52%), solid fuels (22%), and renewables (10%).

In this section, we consider only costs related to primary energy used in the agricultural sector; that is, we do not consider energy carriers such as fertilizers or feed—these inputs are investigated elsewhere in this study. The Farm Accountancy Data Network (FADN) database we use breaks down the energy cost into three components: motor fuels and lubricants, electricity, and heating.

4.2. Demand and Usage

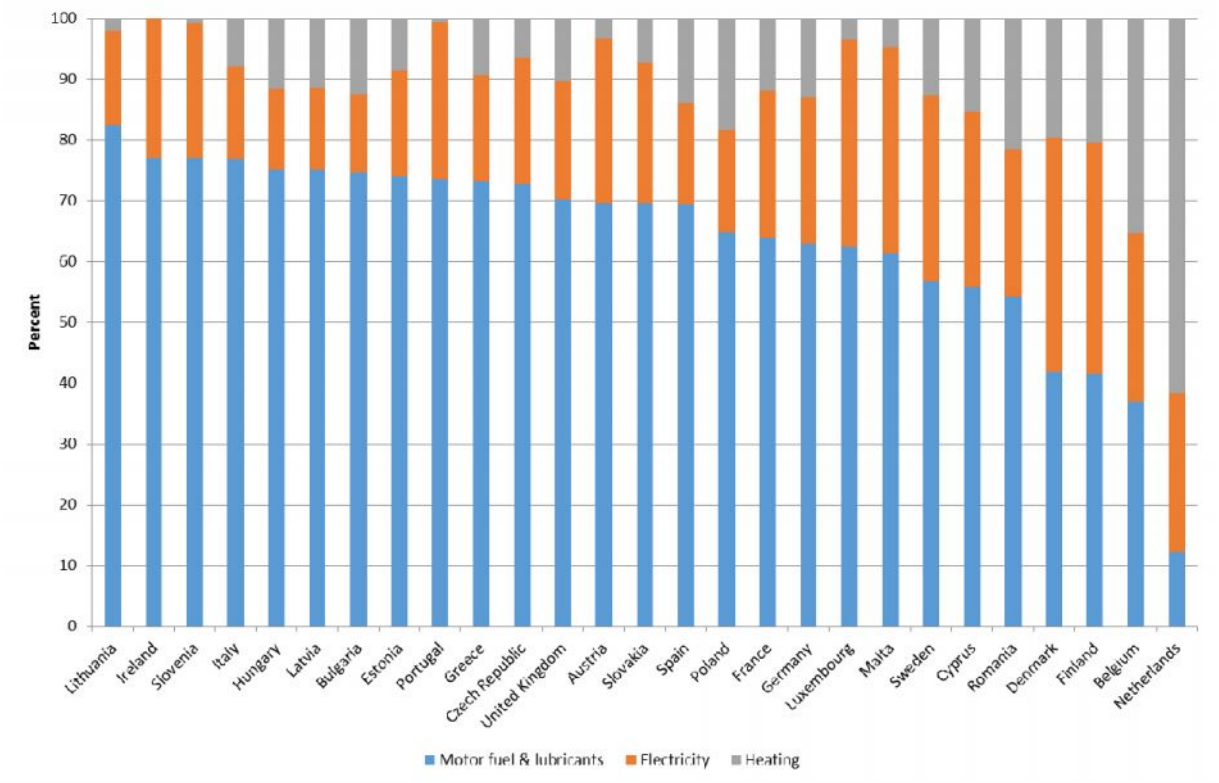
Figure 4.1 presents the relative decomposition of farmers' energy expenditures for the period 1989–2009 and Figure 4.2 does the same for the period 2004–2012. We order the Member States by the share of fuel and lubricants. A common observation for both time periods is that farmers in 23 out of 27 Member States spent more than 50% of their energy costs on motor fuel and lubricants; in the remaining countries—Denmark, Finland, Belgium, and The Netherlands—electricity and heating costs combined play a more important role. Notably, in the first period, The Netherlands, where intensive horticulture is done in heated greenhouses, exhibited the highest share of heating (64%), followed by electricity (24%); the share of fuel and lubricant cost represented only 11% in the country. The distribution of energy shares across Member States in the second period is almost identical.

Figure 4.1: Composition of the energy cost in the period 1989–2009



Source: Authors, based on FADN data.

Figure 4.2: Composition of the energy cost in the period 2004–2012



Source: Authors, based on FADN data.

4.3. The Importance of Energy for European Farmers' Cost Structure

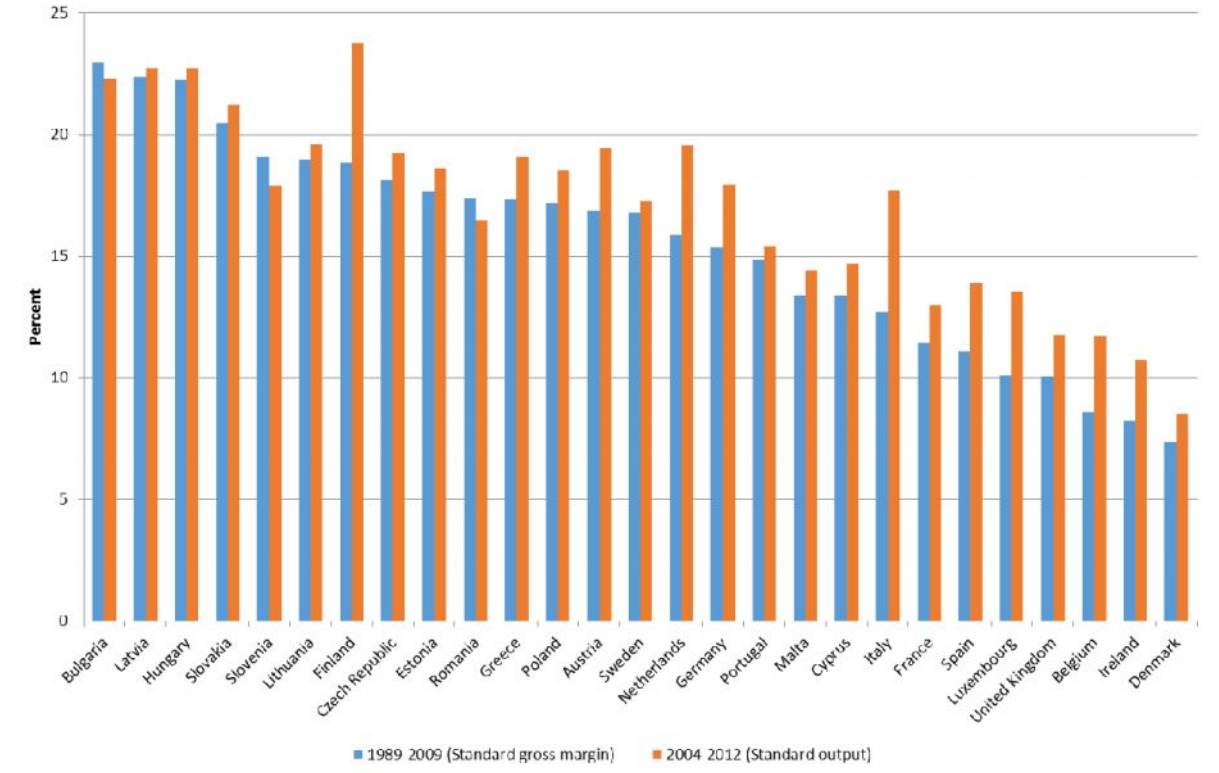
The importance of energy inputs such as electricity, natural gas, and petroleum significantly varies by the farm type (e.g., crop production versus dairy) and by cultivated crops (e.g., wheat, versus sugar beet). Energy takes up a considerable share of total costs of EU farms and this share varies across Member States. For example, in the period 1989–2012 it reached less than 10%, on average, in Denmark, but amounted to more than 20% in Bulgaria. Figure 4.3 provides more details by plotting the average energy shares for the EU-27 over the two time periods.

We order the Member States by the average shares in the period 1989–2009 (the left-hand bar). Farms in Bulgaria, Latvia, and Hungary spent more than a fifth of their total expenditures on energy. With the exception of Cyprus and Malta, Member States entering the EU in and after 2004 are all located to the left in the figure, indicating a relatively high share of energy in total costs for those countries.

The order of countries differs slightly in the period 2004–2012. Possible reasons include a different length of the two time periods; possibly different time trends for the energy share; and a change in the farm typology. That said, six new Member States still appear in the list of countries with the highest energy share. On the other hand, Belgium, Ireland, and Denmark consistently exhibit the smallest share of energy in their total costs.

Overall, Figure 4.3 indicates that the agricultural sector has become more energy-intensive. This appears to be the case for the old EU Member States and especially for Finland, Italy, and The Netherlands.

Figure 4.3: Average energy cost shares in the EU-27



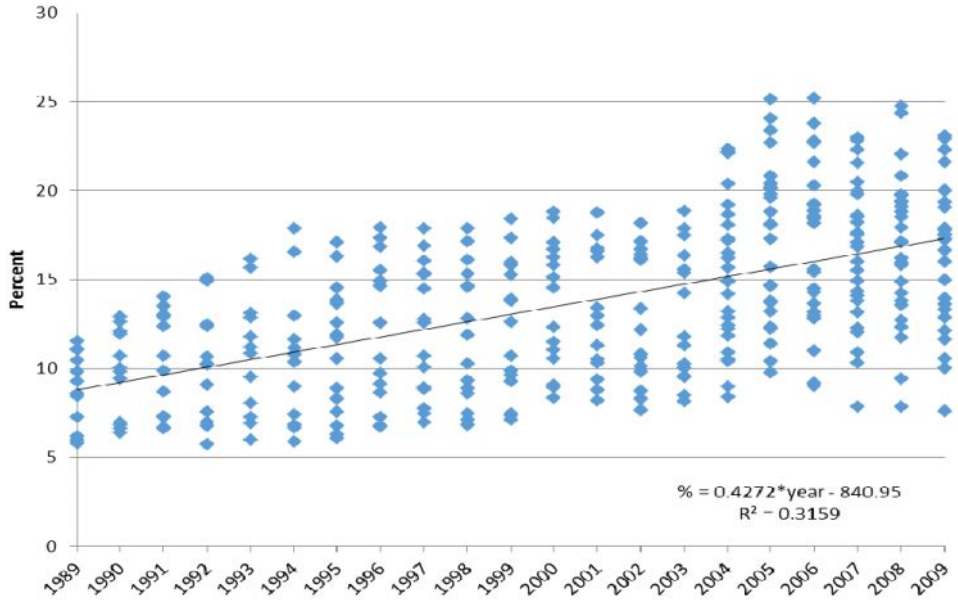
Source: Authors, based on FADN data.

Although informative, the average shares presented in Figure 4.3 necessarily hide any time trend in the energy cost share. This can be seen in Figure 4.4, where we plot the percentage share of energy cost for all Member States against time. The figure shows a significant and positive trend in the share of energy costs. Moreover, starting in 2004 the variation of shares increases, which is consistent with the observation in Figure 4.3, where new Member States exhibited significantly higher shares. A closer inspection of Figure 4.4 also suggests that the time trend is largely driven by the countries entering in and after 2004. This is confirmed in Figure 4.5 where we plot the shares of energy against time in the period 2004–2012.Here, the time trend is insignificant and the variation in energy shares is consistent with the variation after 2004 in Figure 4.4.

Even though Figure 4.4 shows a positive and increasing time trend (Figure 4.5 to a much lesser extent), the increase in the energy share may be true for the EU-27 as a whole, but it does not reflect some other important features. First, both figures assume a linear trend, albeit it could be non-linear. It means that, for example, the share of energy costs could be increasing over time but at a decreasing rate. Second, the trends depicted earlier do not consider country (NUTS2)-specific effects, that is, some events specific to a country (NUTS2 region) that the FADN database does not quantify. Third, the simple trends in Figures 4.4 and

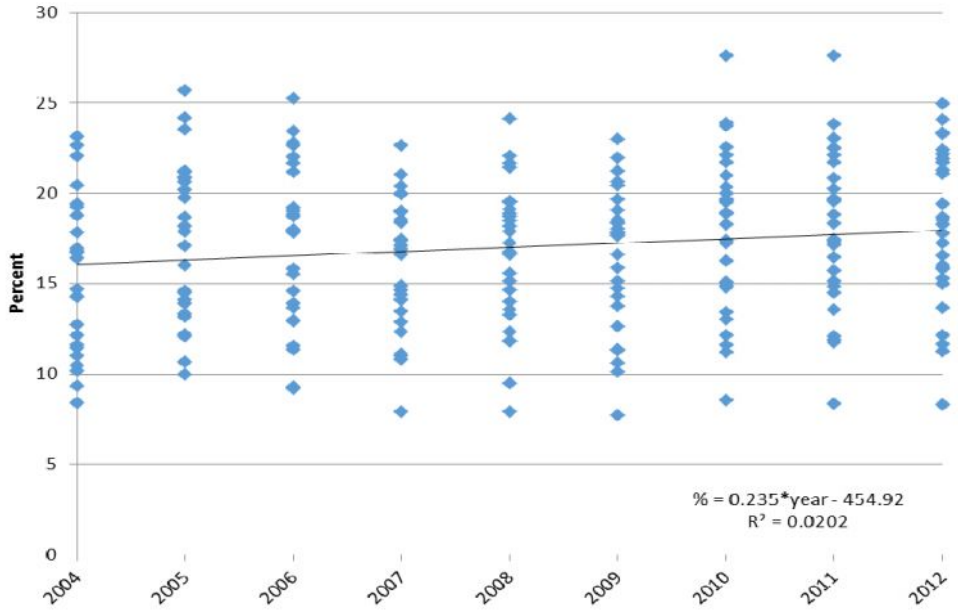
4.5 do not take into account higher variation in energy shares post-2004 (see the right-hand side of Figure 4.4). To take these important features into account, we estimate the parameters of the regression model described in the introduction of this study.

Figure 4.4: Share of energy in total farm cost for EU-27 in the period 1989–2009



Source: Authors, based on FADN data.

Figure 4.5: Share of energy in total farm cost for EU-27 in the period 2004–2012



Source: Authors, based on FADN data.

Table 4.1 summarizes the regression results. The first panel of the table presents results for all Member States. We have used the enlargement dummy (D2004) only in this panel and only for the period 1989–2009 to control for the higher variation in the energy shares due to the new Member States. The second panel presents results for the old Member States (EU-15) alone. The third panel does the same for the Member States entering in or after 2004 (PEMS). It should be noted that the reference country (NUTS2 region) in the third panel is Cyprus, as the observations for Luxembourg were, by definition, not available.

These conditions are graphically depicted in Appendix 3 in Figure A3.1 for the period 1989–2009. Each point on a line in Figure A3.1 represents a value of the time trend in a given year; that is, how the energy share changes in that particular year. If the value is positive, the energy share increases. In addition, if a line is upward-sloping (e.g., EU-15, the country level), the increase accelerates over time. On the other hand, if it is downward-sloping but everywhere positive (e.g., EU-27, country level), then the energy share increases over time, but each year less and less. A third possibility is the flat line, represented by PEMS at the country level (whose values are on the right-hand side vertical axis). This tells us that there is no change in the time trend over time (the line is flat) and, more importantly, the share of energy costs is almost constant, as the line goes through zero on the vertical axis.

The pattern depicted in Figure A3.1 differs from the pattern in Figure A3.2. The key difference is that almost all regressions show a linear trend in the energy share (represented by flat lines in Figure A3.2). For example, the share of energy in EU-15 countries (the red dashed line) has been increasing, on average, by almost 0.4% annually, starting in 2004. The only exception appears to be PEMS where the energy share was decreasing between 2004 and 2007 (the values on the green line are negative) and this decrease was gradually slowing down. In 2007, these countries experienced a U-turn and the energy share has been on its accelerating rise since then.

Table 4.1: Trend analysis regression results for energy

		1989–2009				2004–2012			
		Country-level		NUTS2-level		Country-level		NUTS2-level	
EU-27	Constant	7.369	***	7.156	***	12.984	***	12.850	***
		(-0.362)		(0.304)		(0.638)		(0.588)	
	Time	0.327	***	0.343	***	-0.026		0.168	**
		(0.064)		(0.030)		(0.169)		(0.071)	
	$Time^2$	-0.008	**	-0.006	***	0.029		0.001	
		(0.004)		(0.002)		(0.019)		(0.008)	
	D2004	1.863	***	1.390	***				
		(0.390)		(0.184)					
	R^2	0.896		0.813		0.864		0.854	
	N	363		4111		237		2169	
EU-15	Constant	7.622	***	7.292	***	12.546	***	12.792	***
		(0.359)		(0.306)		(0.666)		(0.598)	
	Time	0.173	***	0.248	***	0.346	*	0.243	***
		(0.060)		(0.028)		(0.183)		(0.080)	
	$Time^2$	0.006	*	0.002	*	-0.017		-0.009	
		(0.003)		(0.001)		(0.021)		(0.010)	
	R^2	0.882		0.800		0.897		0.863	
	N	297		3829		135		1726	
PEMS	Constant	-27.687		-58.122	***	14.778	***	14.264	***
		(30.384)		(15.097)		(1.129)		(1.042)	
	Time	4.888		8.201	***	-0.535	*	-0.119	
		(3.465)		(1.708)		(0.302)		(0.154)	
	$Time^2$	-0.144		-0.233	***	0.092	***	0.041	**
		(0.099)		(0.048)		(0.032)		(0.017)	
	R^2	0.756		0.780		0.728		0.686	
	N	66		282		102		443	

Source: Authors' calculations.
Note: Dependent variable: percentage share of energy costs in total farm costs. Standard errors in parentheses.
***, **, and * represent 1, 5, and 10% statistical significance, respectively. The change in the energy cost per year can be computed as the coefficient on Time + 2* the coefficient on $Time^2$ * year.
For example, for the EU-15 in the year 2000 (i.e., t=11) a change in the energy cost per year is estimated to be 0.173 + 2*0.006*11 = 0.305%.

A closer look at Figure A3.2 shows that the share of energy cost in total farm cost tends increase more from one year to another for the EU-15 countries than for PEMS countries. Combined with our earlier observation from Figure 4.3 that the PEMS show a higher share of energy costs than the EU-15 countries, this suggests convergence in the long-run of the share of energy cost across the EU Member States. This conclusion should, however, be taken with caution, as the time period in Figure A3.2 is rather short.

4.4. Supply

Unlike other inputs analyzed in this study, energy is not specific to agriculture, but is used in various forms in all sectors of the economy. In this section, we investigate the degree of concentration in the electricity, natural gas, and petroleum markets. The EU electricity and

natural gas markets have been undergoing gradual liberalization since the 1990s.[11] In particular, a distinction was made between competitive parts (e.g., supply to customers) and non-competitive parts (e.g., operation of the networks) of the industry. The operators of the non-competitive parts (e.g., the transmission) are obliged to allow third parties to have access to the infrastructure. By removing market barriers, alternative suppliers of energy are encouraged to enter the market. In addition, customers can more and more easily change their utilities suppliers; independent regulators to monitor the sector have been established as well.

The data we use in this section come from the Forbes magazine's Global 2000 ranking that annually lists the Top 2000 public companies in the world. The ranking is based on a mix of four metrics: sales, profit, assets, and market value. We focused on the sales variable and of all listed companies we selected the ones whose headquarters are Europe (including Russia) and that operate in "Electric utilities" and "Oil and gas." We were able to find data for the years 2010, 2011, 2013, and 2014. The values of the concentration indicators (CR and HHI) can give an indication of changing market concentration.

Before we proceed, we would like to draw the reader's attention to some data caveats. First, although the companies we identified have their headquarters in Europe, it does not mean that their sales come solely from the European market. This is especially true for crude oil extractors and refineries. The Global 2000 ranking does not specify how much revenues come from Europe. Second, the companies in the list are more often than not multiproduct companies, meaning that they either produce or supply (often both), two or even three products at the same time (e.g., natural gas and electricity). Again, the Global 2000 ranking does not provide a breakdown of the sales by the source. Third, the composition of the ranking changes from one year to another. Therefore, we do not observe the same companies in each year; this is especially true of relatively small companies. However, we argue that the big players are present every year and so the concentration indicators are robust. Related to this last point is the fact that the Global 2000 ranking does not include all energy companies. Consequently, we do not know the actual size of the market. However, we believe that the sum over the identified biggest players provides a good proxy for the size of the overall market as the unobserved companies are likely very small relative to the observed companies.

Table 4.2 presents the Top 10 companies in the electricity, natural gas, and oil markets in the year 2015. The four biggest players in the electricity market are E.ON (18.9%), GDF SUEZ (12.7%), Enel (12.4%), and EDF (12.4%). Notice that three out of the Top 10 electricity companies are located in Germany. The first panel of Table 4.2 also shows that the Top 10 electricity companies took up 85% of the market.

The second panel shows the situation in the gas production/supply. The four biggest companies include Royal Dutch Shell (24.6%), Total (12.4%), Gazprom (9.3%), and E.ON (8.7%). E.ON also enters the natural gas list because it does business in both electricity and natural gas markets. The share of Top 10 companies in the natural gas market in 2015 amounts to 88%.

[11] http://ec.europa.eu/competition/sectors/energy/overview_en.html

Finally, the last panel gives the list of Top 10 companies engaged in crude oil extraction and/or refining. Royal Dutch Shell dominates the list with a 23.6% market share, followed by British Petroleum (20.1%), Total (12.0%), and ENI (8.3%). The share of Top 10 companies in the oil market in 2015 amounts to 92%.

Table 4.2: Top 10 European energy companies by sales in 2014

	Headquarters	Sales (billion dollars)	Market share (%)
	Electricity		
E.ON	Germany	148	18.9
GDF SUEZ	France	99	12.7
Enel	Italy	97	12.4
EDF	France	97	12.4
RWE Group	Germany	62	7.9
SSE	UK	49	6.2
Iberdrola	Spain	40	5.1
EnBW-Energie Baden	Germany	28	3.6
National Grid	UK	24	3.1
IDGC Holding	Russia	23	3.0
	Natural gas		
Royal Dutch Shell	The Netherlands	420	24.6
Total	France	211	12.4
Gazprom	Russia	158	9.3
E.ON	Germany	148	8.7
Eni	Italy	146	8.6
GDF SUEZ	France	99	5.8
Enel	Italy	97	5.7
Statoil	Norway	95	5.6
RWE Group	Germany	62	3.6
Repsol YPF	Spain	61	3.6
	Oil		
Royal Dutch Shell	The Netherlands	420	23.9
British Petroleum	UK	353	20.1
Total	France	211	12.0
Eni	Italy	146	8.3
Rosneft	Russia	129	7.3
LukOil	Russia	121	6.9
Statoil	Norway	95	5.4
Repsol YPF	Spain	61	3.5
OMV Group	Austria	48	2.7
PKN Orlen	Poland	34	1.9

Source: Authors' calculations based on Forbes' Global 2000 data.

4.5. Market Concentration

Table 4.3 provides more details on the development of concentration in individual energy markets by listing various concentration ratios for individual years. Two pieces of information stand out in the table.

First, concentration ratios are, on average, highest in the oil sector, followed by the natural gas sector; the electricity sector exhibits the lowest concentration ratios.

Second, the share of three, five, and ten biggest companies increases over time for all energy sectors. For example, the share of three biggest companies (CR3) in the electricity, gas, and oil sectors increase by 5, 8, and 18 percentage points between 2010 and 2014.

Because the concentration ratio indicator does not take into account the size of companies, in Table 4.4 we also present the HHIs for the energy sectors. Consistent with previous observations, the HHIs are highest for oil, followed by natural gas, and lowest for electricity. The indices increase over time, implying a gradual increase in the market concentration in individual energy sectors.

Because many of the key players in the EU energy market are integrated producers of oil and natural gas or of natural gas and electricity, the concentration indicators presented in Table 4.3 are lower bounds for the actual concentration in the energy industry. The increasing trend in the concentration ratios as well as HHIs warrants careful investigation of the future mergers and acquisitions in the energy market.

Table 4.3: Concentration ratios and HHIs for EU energy sectors

	2010	2011	2013	2014
Electricity				
CR3	39	39	42	44
CR5	58	57	58	64
CR10	79	78	79	85
HHI	819	812	871	1008
Natural gas				
CR3	38	43	44	46
CR5	54	58	60	64
CR10	83	84	85	88
HHI	875	1010	1053	1137
Oil				
CR3	38	55	55	56
CR5	54	69	69	72
CR10	83	86	88	92
HHI	1159	1261	1255	1351

Source: Authors' calculations based on Forbes' Global 2000 data.

4.6. Mergers and Acquisitions

The Royal Dutch Shell has recently made a nearly $70 billion offer for Britain's British Petroleum (BG). If successful, Shell's acquisition of BG, expected to close in 2016, would be the largest in the sector since the $82 billion megamerger that created Exxon Mobil in 1998. Many observers predict that declining crude oil prices may give rise to more mergers in the oil sector.

In 2015, the European Commission opened an in-depth investigation to assess whether General Electric's proposed acquisition of the Thermal Power, Renewable Power & Grid businesses of Alstom is in line with the EU Merger Regulation. The preliminary investigation indicates potential competition concerns in the market for heavy-duty gas turbines.

In 2014, the European Commission opened an investigation to assess whether the proposed acquisition of the Greek gas transmission system operator DESFA by the State Oil Company of Azerbaijan Republic (SOCAR), is in line with the EU Merger Regulation. SOCAR's activities include the production of natural gas and the upstream wholesale sale of gas in Greece in the context of the Southern Gas Corridor.

In 2013, the European Commission cleared the proposed acquisition of (i) joint control over WINZ and Wintershall Services of the Netherlands and (ii) sole control over Wingas and WIEH of Germany by the Russian energy company Gazprom. The Commission concluded that the proposed transaction would not raise any competition concerns. WINZ and Wintershall Services are active in oil and gas exploration and production in the North Sea, while Wingas and WIEH supply gas, mainly in Germany.

5. FERTILIZERS

KEY FINDINGS

- Consumption of fertilizers has been declining in the EU-27; the decline in consumption of N-based products is less marked than for K and P.
- Differences in relative usage of the three types of fertilizers (N, K, and P) can be found across geographic areas, with Mediterranean areas showing less consumption of N-based products and higher consumption of P-based products than other countries.
- The share of fertilizers costs over total specific cost has followed a positive but declining trend over time.
- Among the EU-15, the share of soil improvers increased in the previous decades to decline in the recent years; among PEMS, one can observe a growing and increasing cost share of fertilizers.
- The total value of sales of fertilizers' company operating in EU Member States has increased in the period 2003-2012, recovering from the sharp decline marking the years of the economic recession.
- The number of enterprises producing fertilizers and soil improvers has increased in the period 2003-2012.
- Germany, France, Poland, the United Kingdom, and The Netherlands are the countries with the largest values of fertilizer sold, accounting for more than 50% of the total fertilizer turnover realized in the EU-27.
- The European fertilizer industry appears only moderately concentrated with an estimated range of the CR5 spanning from 22.23% to 29.48%, and simulated HHIs that vary between 205 and 302.
- Firms in the European fertilizer industry appear actively engaged in operations of mergers and acquisition.

5.1. Overview

As noted in the Eurostat glossary, a fertilizer is "…a substance used in agriculture to provide crops with nutrients to grow such as Nitrogen (N), Phosphorus (P), and Potassium (K)." Fertilizers are divided into inorganic (or mineral) and organic fertilizers. Mineral fertilizers, manufactured by firms in the agro-chemical industry, are commercial products that can either encompass one macronutrient (simple nutrient fertilizers, such as urea) or made of compounds mixtures (mineral fertilizers containing NP, NK, and NPK, such as diammonium phosphate). Organic fertilizers include instead, for example, manure or compost and their production is not necessarily associated with the agro-chemical industry.

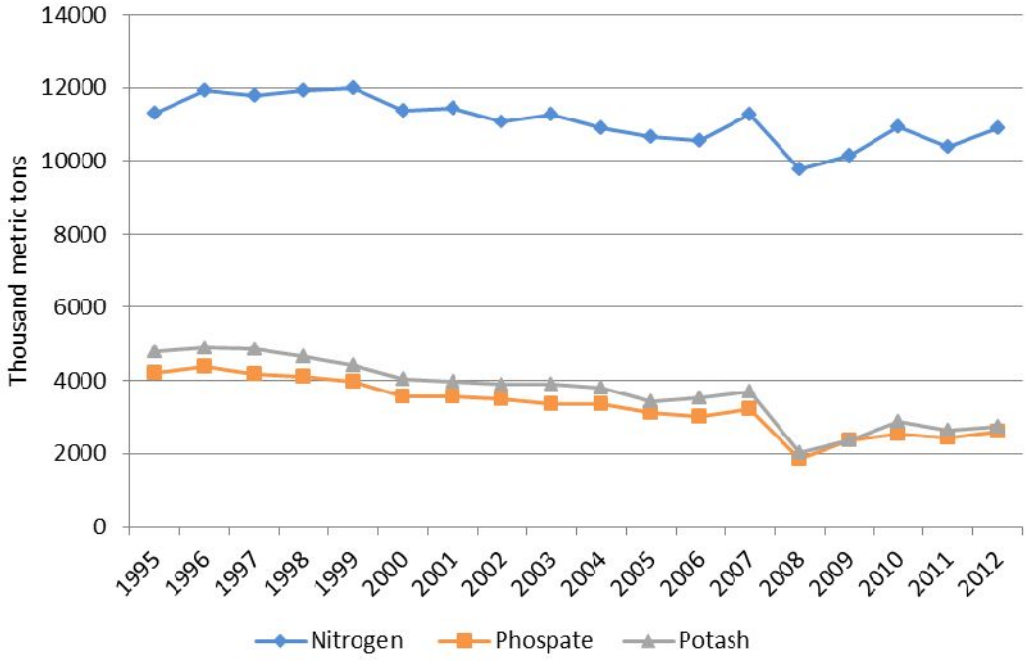
The directions taken by the mineral fertilizers market, industry, and farmers' usage will be impacted by that of agricultural policies, and, as a consequence, by the intensiveness of different practices and crops produces. A report by the European Fertilizers Manufacturers Association, now Fertilizerseurope, (Aldinger 2014) indicates that, due to the upcoming CAP reform, changes in cropping patterns will result in a more efficient use of fertilizers and in an

overall downward trend in the general use of fertilizers. The decrease in consumption is balanced by the reduction in supply capacity in most of Western Europe, as consequence of the closure of several processing plants. In terms of usage, the enlargement of the EU is expected to revive the demand side of the market, while the different agricultural practices may lead to increased opportunities for the development of local markets catering to the different needs of specific production conditions.

5.2. Demand and Usage

Figure 5.1 includes data from the International Fertilizer Association On-line database (IFADATA) related to the consumption of fertilizers among the EU-27 Member States.

Figure 5.1: Consumption of fertilizers in EU-27



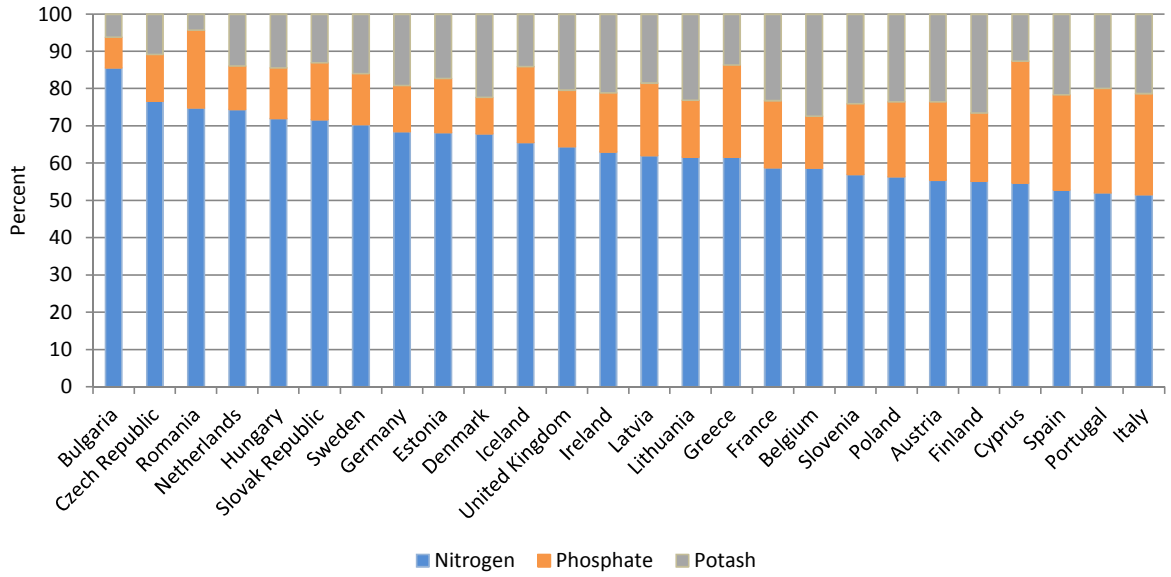
Source: Authors, based on IFADATA data.

The values in Figure 5.1 indicate a reduction in the overall usage of fertilizer in the EU from 20.3 million metric tons in 1995 to 16.2 in 2012. In the period considered, nitrogen-based fertilizers were used in larger amounts compared to potash and phosphates. In 1995, 11.3 million metric tons of N, 4.2 million metric tons of P, and 4.8 metric tons of K were used; the values for 2012 are 10.9, 2.59, and 2.74 million metric tons, respectively. These trends show an overall decline in the total usage of fertilizers of more than 20%, and in particular a decline in the usage of potassium (from 23.6% to 16.9%) and phosphorus (20.7% to 16%) compared to an increase in nitrogen (from 55.7% to 67.2%).

The values reported in Figure 5.2 present the quantity share of N-, K-, and P-based fertilizers consumed in each European country in the period 1995–2012. The values show a dichotomous pattern. Consistent with our earlier findings, nitrogen fertilizers are those most widely used in all EU countries, with shares spanning from 87% in Bulgaria to 52% in Italy. The distribution of the shares of different nutrients follows (on average) a geographic gradient, where the

highest share of N-based fertilizers are recorded for most PEMS, Germany, and The Netherlands, while for most Mediterranean countries (Cyprus, Italy, Portugal, and Spain) the use of N-based fertilizers is less than 55% of the total (the only exception is Greece with 62%). Mediterranean countries also tend to have a relatively high usage of P-based fertilizers, with shares reaching values as high as 33% in Cyprus, and between 25% and 28% for the other Mediterranean countries (including Greece). P represents less than 15% of fertilizers consumed in Belgium, Sweden, Hungary, the Czech Republic, Germany, The Netherlands, Denmark, and Bulgaria. The usage of K-based fertilizers in most of EU-15 Member States represents at least 19% (the exceptions are Sweden, Iceland, The Netherlands, and Greece); on the other hand, most PEMS use 18% or less of K except, Lithuania (23%), Slovenia (24%), and Poland (24%).

Figure 5.2: Share of fertilizers usage by nutrient in EU Member States (average 1995–2012)



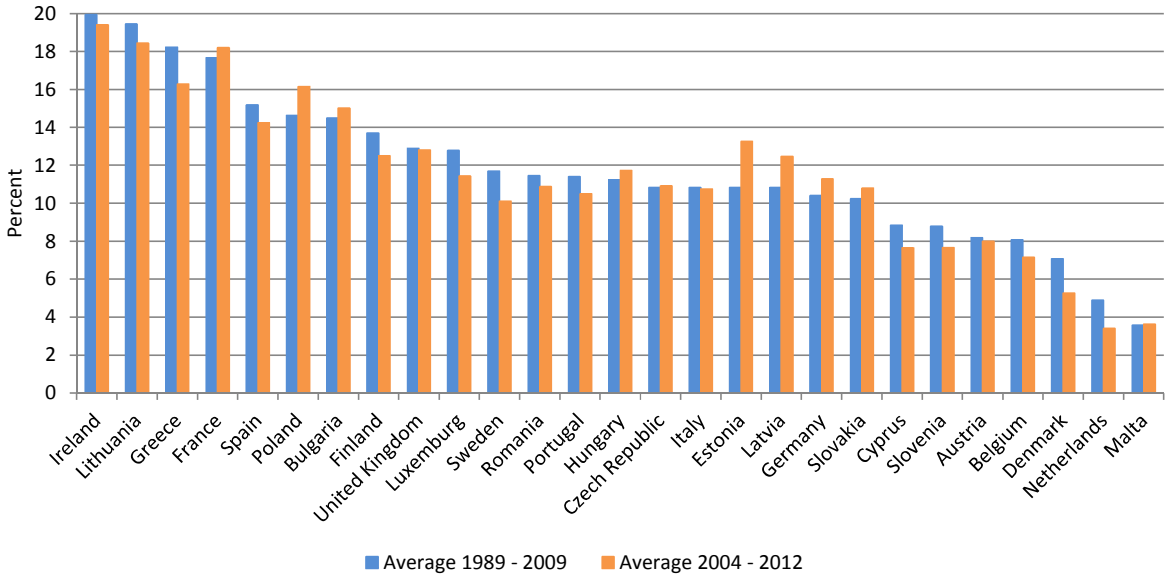
Source: Authors, based on IFADATA data.

5.3. The Importance of Fertilizers for European Farmers' Cost Structure

We use the FADN data to assess the relative importance of the consumption of fertilizers for European farmers. The cost share of fertilizers (in aggregate) is obtained by dividing the fertilizer cost by a revised measure of "total specific cost" as illustrated in the introduction of this report. The average cost shares of fertilizers by Member State, for the periods 1989–2009 and 2004–2012 are reported in Figure 5.3. The values show fertilizers reaching an incidence on farming costs as high as 20% in Ireland and as low as 3.6% in Malta. In spite of the data not showing any clear patterns across states, for the majority of EU-15 Member States (with the exception of France and Germany), the cost shares of fertilizers appear declining, with a decrease as large as 44% for The Netherlands (from 4.9% to 3.4%) and -34.4% for Denmark (from 7.1% to 5.3%). The opposite emerges for the PEMS (with the exception of Cyprus, Slovenia, Romania, and Lithuania) showing an increasing cost share of fertilizers, the largest

(in relative terms) that of Latvia (+13.1%, from 10.8% to 12.5%) and Estonia (+18.2%, from 10.8% to 13.3%).

Figure 5.3: Average fertilizers cost shares in EU Member States



Source: Authors, based on FADN data.

The estimated coefficients and summary statistics of the regression model used to assess the evolution of fertilizers' cost shares over time among the EU-27, EU-15, and PEMS are reported in Table 5.1.[12] The estimates in the third and fourth column of the table are obtained using the 1989–2009 FADN data, while those in the fifth and sixth column use 2004–2012 data. The estimated time trend coefficients with the 1989-2009 FADN data for the EU-27 appear statistically significant at the 1% level and indicate a U-shaped trend, with patterns showing a decline in the cost share of fertilizers until the years 1999–2000 and then an increase afterwards. In particular, at the beginning of the 1990s the shares were declining annually by an estimated percentage of 0.35 to 0.45%, while at the end of the period, the cost share of soil improvers grew on average at an estimated rate of 0.3%. These patterns are highlighted in Figure A4.1 in Appendix 4. Last, the coefficient associated with the indicator variable D2004 are negative and statistically significant at both the country and NUTS2 level, which suggests that farms in the PEMS were, on average, characterized by a lower cost share of fertilizers. Among EU-15 Member States, a similar pattern is found, with declining shares in the first fifteen years of the data (see the lines in Figure A4.1 for EU15 to lay on the negative side of the "Slope of time trend" axis), and a reversal in trend indicating increasing shares in the last five years of the period considered. The share of fertilizers costs grows instead at increasing rates among the countries joining the EU in 2004 and 2007. Even though the estimated coefficients are not statistically significant, the estimated growth rates, calculated from the combinations of the coefficients are as large as 1.3% annually (NUTS2-level estimates) and statistically significant (see Figure A4.1 for a graphical representation of these patterns).

[12] For more details, please see the "Materials and methods".

The results presented in the fifth and sixth columns of Table 5.1, obtained using the 2004–2012 data, depict a development consistent with the trends observed for the period 1989–2009. We find an overall increase in the cost share of soil improvers in the EU-27 for the 2004–2012 period; the growth of fertilizers cost shares appear positive but declining over time. Such patterns are the outcomes of two different trends: among the EU-15 the share of soil improvers increases at the beginning of the period and then declines in the recent years; among PEMS, one can observe a growing cost share of fertilizers, estimated to grow from 0.2% per year to 0.6% per year (NUTS-2 level data). These upward-sloping trends can be seen in Figure A4.2 in Appendix 4.

Table 5.1: Trend analysis regression results for fertilizers

		1989–2009				2004–2012			
		Country-level		NUTS2-level		Country-level		NUTS2-level	
EU-27	Constant	14.478	***	14.825	***	10.496	***	10.432	***
		(0.410)		(0.346)		(0.655)		(0.605)	
	Time	-0.375	***	-0.460	***	0.257	*	0.350	***
		(0.058)		(0.033)		(0.159)		(0.066)	
	$Time^2$	0.018	***	0.021	***	-0.004		-0.018	**
		(0.003)		(0.002)		(0.019)		(0.008)	
	D2004	-1.181	***	-0.929	**				
		(0.295)		(0.157)					
	R^2	0.919		0.860		0.886		0.907	
	N	363		4111		237		217	
EU-15	Constant	14.280	***	14.692	***	11.036	***	10.526	***
		(0.415)		(0.349)		(0.687)		(0.622)	
	Time	-0.263	***	-0.380	***	0.247		0.403	***
		(0.058)		(0.031)		(0.158)		(0.074)	
	$Time^2$	0.008	***	0.014	***	-0.026		-0.031	***
		(0.003)		(0.001)		(0.019)		(0.009)	
	R^2	0.918		0.858		0.929		0.914	
	N	297		3829		135		1762	
PEMS	Constant	23.056		37.691	***	5.874	***	6.156	***
		(20.156)		(10.979)		(0.728)		(0.534)	
	Time	-2.117		-4.015	***	0.346		0.239	*
		(2.293)		(1.230)		(0.268)		(0.324)	
	$Time^2$	0.074		0.134	***	0.017		0.024	
		(0.065)		(0.035)		(0.032)		(0.017)	
	R^2	0.928		0.927		0.867		0.882	
	N	66		282		102		443	

Source: Authors' calculations.
Note: Dependent variable: percentage share of fertilizers costs in total farm costs. Standard errors in parentheses. ***, **, and * represent 1, 5, and 10% statistical significance, respectively. The change in the fertilizer cost share per year can be computed as the coefficient on Time + 2* the coefficient on $Time^2$ * year. For example, for the EU-15 in the year 2000 (i.e., t=11) a change in the fertilizer cost share per year is estimated to be -0.263 + 2* 0.008*11 = -0.087%.

5.4. Supply

Looking at the supply-side of the market, data from Fertilizerseurope indicate that the supply of all the nutrients are expected to maintain relatively steady in Central and Western Europe, while Eastern Europe and Central Asia are expected to contribute to the growth in the global supply of nutrients in reason of 7% for N, 8% P, and 33% K. Overall, one can observe two different patterns for this industry: not only the use, but also the supply of fertilizers seem destined to decline in the Member States of the EU15, while they both increase for the new Member States. However, data from the IFA indicate that Eastern Europe and Central Asia (including Russia and Belarus) represent a region of a high increase in potential supply of K with 3.4 million metric tons (Heffer and Prud'homme 2014); this region is also the major contributor of the surplus of nitrogen, phosphate and potash, as reported by FAO (2011). Thus, from the supply-side of the market, there could be potential of expansion.

The production and sales of the different types of fertilizers appears concentrated in a few countries. Figures collected from the Structural Business Statistics (SBS) database of Eurostat for NACE C20.1.5 Manufacturers of fertilizers and nitrogen compounds presented in Table 5.2 include turnover (in million euros) for the Top 10 producing Member States for the period 2003–2012. In terms of turnover, the EU-27 fertilizer sector was considerably hit in 2009 due to the economic recession that saw a decline in sales values departing from an otherwise growing trend. Overall, in the 10-year period considered, the EU-27 sales for this industry have nearly doubled from €13.8 billion in 2003 to €26.3 billion in 2012 (note that the 2012 levels refer to the EU-28), in stark contrast with the decline in quantity used, suggesting an increase in unitary value of the products in the market. Companies in the Top 10 producing Member States sold between 74.8% and 84% of the total sales in the EU market. Such an increase in unitary value of fertilizers may be due to the high and increasing oil prices that have overall (excluding the plunge of the mid-2008 to early 2009) driven up prices of many other commodities (Gnutzmann and Spiewanowski 2014).

Table 5.2: Top 10 EU Member States by total fertilizer sales in 2012 (million euros)

	2003		2006		2009		2012	
	Sales	% (EU-27)	Output	% (EU-27)	Output	% (EU-27)	Output	% (EU-28)
Germany	2382	17.3	3076	17.9	3228	19.8	4711	17.9
France	2391	17.4	2747	16.00	2591	15.9	2815	10.7
Poland	1098	8.00	1184	6.9	1040	6.4	2402	9.1
UK	1410	10.3	1887	11.0	N/A	-	2179	8.3
Netherlands	1192	8.7	1739	10.1	1348	8.3	2068	7.9
Spain	905	6.6	1051	6.1	1109	6.8	2026	7.7
Italy	944	6.9	1360	7.9	1295	8.0	1838	7.0
Belgium	401	2.9	461	2.7	400	2.5	1572	6.0
Lithuania	312	2.3	487	2.8	585	3.6	1167	4.4
Finland	366	2.7	430	2.5	493	3.0	856	3.
Top 10	11400	82.9	14422	83.9	12088	74.2	21633	82.1
EU-27[13]	13759		17185		16295		26337	

Source: Authors' calculations based on Eurostat data. NACE.C.20.15 Manufacture of fertilizers and nitrogen compounds.

[13] Turnover and production value aggregates in 2012 are only available for EU-28.

Note: N/A refers to a data entry that was suppressed or was not available because of disclosure issues.

For the period considered, Germany is the EU Member State with the highest sales of fertilizers; its market share ranges from 17.3 to 19.8%, followed by Poland France, the UK, and The Netherlands (according to 2012 rankings). It should be noted that, in spite of the growing turnovers, the relative importance of the Top 5 producers in terms of sales has been dwindling, in favor of other Member States, in particular Belgium and Lithuania.

5.5. Market Structure: Number of Enterprises and Size

The first indicator of market structure considered is the number of enterprises and their average size. The number of enterprises is only an imperfect proxy of the number of companies operating in the sector,[14] as one company can have different subsidiaries that are individual legal entities. In spite of not necessarily being related to the number of companies, looking at the number of enterprises and at their average size can provide an indication of the number and scale of operations in each country. The number of enterprises and their average size, for the Top 10 producing Member States (referred to the year 2012) are presented in Table 5.2.

Table 5.3: Number of enterprises and average enterprise size (AES) in million euros of the Top 10 fertilizer-producing EU Member States

	2003		2006		2009		2012	
	Number	AES	Number	AES	Number	AES	Number	AES
Germany	37	64.36	76	40.48	87	37.10	90	52.34
France	195	12.26	169	16.25	114	22.73	128	21.99
Poland	86	12.77	77	15.37	90	11.56	94	25.55
UK	81	17.41	81	23.30	66	-	59	36.93
Netherlands	25	47.69	25	69.54	31	43.47	32	64.62
Spain	214	4.23	268	3.92	274	4.05	264	7.67
Italy	190	4.97	185	7.35	164	7.90	182	10.10
Belgium	29	13.82	32	14.41	21	19.05	49	32.08
Lithuania	4	78.03	7	69.51	8	73.10	8	145.8
Finland	11	33.25	13	33.11	16	30.78	13	65.82
EU-27[15]	1027	13.39	1100	15.62	1116	14.60	1244	21.17

Source: Authors' calculations based on Eurostat data. NACE.C.20.15 Manufacture of fertilizers and nitrogen compounds.
Note: N/A refers to a data entry which was suppressed or was not available because of disclosure issues. AES – average enterprise size.

[14] For enterprise it is intended the "smallest combination of legal units that is an organizational unit producing goods or services, which benefits from a certain degree of autonomy in decision-making, especially for the allocation of its current resources. An enterprise carries out one or more activities at one or more locations." Source publication: Council Regulation (EEC) No 696/93 of 15 March 1993 on the statistical units for the observation and analysis of the production system in the Community, OJ No L 76, p.1, section III/A of the annex. Council Regulation (EEC) No 696/93 of 15 March 1993 on the statistical units for the observation and analysis of the production system in the Community, OJ No L 76, p.1, section III/A of the annex. Source: OECD Glossary of statistical terms https://stats.oecd.org/glossary/detail.asp?ID=805.

[15] Turnover and production value aggregates in 2012 are only available for EU-28.

In spite of the slump in sales in the year 2009, the number of enterprises producing fertilizers has been increasing over the period 2003–2012, from 1027 to 1244, and the average economic size of each enterprise has been growing from €13.39 million in 2003 to €21.17 million in 2012. Lithuania and The Netherlands present fertilizers enterprises with the largest average size, along with Finland, but only for the year 2012. While fertilizer enterprises among the Top 10 countries appear growing, in terms of their average size, Germany seems to be following the opposite trend. In particular, the average size of enterprises in Poland and the UK has doubled in the last decade, to reach values above the EU-27 average, but while the number of enterprises has grown in the former from 86 to 94, for the latter there has been a decline, suggesting intensification of operation of the existing companies. The two countries that show the highest number of enterprises are Spain and Italy, jointly encompassing more than 39% (404 enterprises; 214 in Spain and 190 in Italy) of the total number of enterprises in 2003 and 36% (446 enterprises; 264 in Spain and 182 in Italy) in 2012. Both countries show, among the Top 10 producing ones, the smallest average size in terms of sales per unit, well below the EU-27 average, indicating that those countries present a highly fragmented fertilizer industry.

5.6. Market Concentration

Concentration in the fertilizer market represents a worldwide concern: Hernandez and Torero (2013)'s analysis indicates that the industries increasing concentration may lead to higher prices. As highlighted elsewhere in this document, the major players in some of the agricultural input markets operate in more industries. Even in the case of fertilizers, some notorious European-based agrochemical producers, (e.g., Bayer, BASF, Isagro, Yara) appear prominently also among the leaders in this industry.

However, according to data published in an ECT Group report (ECT Group 2013), the Top 10 fertilizers firms controlled approximately two fifths of the global market in 2011, for a CR4 of less than 25% (Table 5.4). Of the companies listed in Table 5.4, most are global players also operating in the European market.

Table 5.4: The World Top 10 fertilizer producing companies

Company	2011 sales (million	Market share (%)
Yara	10,277	6.4
Agrium	10,113	6.3
The Mosaic Company	9,938	6.2
PotashCrop	8,715	5.4
CF Industries	6,098	3.8
Sinofert Holdings Ltd.	5,760	3.6
K+S Group*	4,349	2.7
Israel Chemicals ltd.	3,836	2.4
Uralkali	3,469	2.2
Bunge ltd.	3,147	2.0
Total Top 10	65,719	41.0
CR3		18.9
CR5		28.1
HHI		316

Source: ETC Group, Communiqué no. 111, September 2013, page 13; CR3, CR5, and HHI authors' calculations.

According to existing research (Hernandez and Torero 2013), the European market presents different levels of concentration across Member States and nutrients; the concentration spans from a 100% CR4 in the German market of potash in 2008–2009 to 80.7% of the NPK market in France. Although the data at our disposal did not allow us to assess the value of concentration at the country/nutrient levels, we collected various information from annual reports of some of the major fertilizers producers operating in the EU market and calculated concentration ratios (CR4 and CR5) as well as an approximation of the HHI for this industry.

Sales for fertilizers and soil improvers[16] were collected from financial reports of the publicly quoted companies.[17] As in some cases the companies did not disclose sales of fertilizers sales for the European market, a series of approximations and assumptions were necessary; these are detailed in footnotes for each of the company considered. Estimates of the total market size were calculated by multiplying the quantity of fertilizers consumed in the EU-27 (total nitrogen, potash, and phosphate) from the IFA, times the average, aggregate, unitary value of fertilizers produced in the EU-27, obtained by dividing the EU-27 production values from the Eurostat's SBS by the IFA production quantities.

[16] Sales reported in currencies other than the euro were converted using exchange rates at the 31st December of the year for which the financial reports referred to collected at http://www.xe.com/currencytables/#

[17] This resulted in the limitation of not having information regarding several global players which could play an important role for the market in analysis, for example, Koch Fertilizer LLC.

Table 5.5: Estimated market shares and concentration ratios for the Top 10 companies operating in the EU-27 fertilizer market

Company	2005	2006	2007	2008	2009	2010	2011	2012
Yara International ASA[18]	9.45	9.18	8.91	12.36	10.50	10.81	12.18	11.39
K+S Group[19]	-	-	-	-	4.22	5.82	5.58	5.07
Eurochem[20]	1.69	2.82	3.34	2.92	2.38	2.56	2.11	4.91
Israel Chemicals Ltd[21]	-	-	-	4.78	2.55	3.78	4.52	4.18
Fertiberia S.A.[22]	-	-	-	3.79	2.58	3.78	3.75	3.93
Agrium Inc.[23]	-	-	-	1.72	2.34	2.47	3.40	3.02
Grupa Azoty S.A. Group[24]	-	-	0.83	0.79	0.88	0.79	2.31	1.67
ANWIL S.A.	0.96	1.05	1.08	1.29	1.21	1.20	1.23	1.18
Uralkali Group[25]	-	-	-	0.44	0.68	1.14	1.57	1.13
Acron Group[26]	0.73	0.69	0.78	1.06	0.95	1.05	0.99	0.94
TOTAL mkt. share Top 10	-	-	-		28.30	33.38	37.65	37.40
CR3	-	-	-		17.10	19.19	19.87	21.37
CR5					22.23	26.75	28.14	29.48
HHI_{max}					205	249	302	286

Source: Authors' calculations based on shareholders annual reports; quantity of fertilizers consumed from IFADATA; production values from Eurostat.
Note: For computation of the HHI_{max}, see Appendix 2.

The values reported in Table 5.5 indicate that the European fertilizer market presents only a limited/moderate level of concentration. The CR4 exceeds slightly one fourth of the market in the years 2011 and 2012, while the combined estimated shares of the Top 10 companies reach a maximum of 37.65% in 2011. The values presented in Table 5.5 are in line with those in Table 5.4 which suggest similar levels of concentration for the European and the global markets. Five of the companies figuring on the list of the main global fertilizers suppliers are also on the list of the Top 10 companies operating in the EU (Yara International ASA, Agrium Inc, K+S Group, Israel Chemicals Ltd, and Uralkali Group). Yara International ASA shows a

[18] The financial figures considered where those of the fertilizers manufacturing segment. Financial results in annual reports originally expressed in Norwegian crowns.

[19] For the years 2009-2012 the values available from the annual reports are total sales, sales in the EU, and sales of fertilizers. A proxy for the EU fertilizer sales is calculated assuming that the same ration of EU/global sales applied to the fertilizer segment. Until 2010, K+S group managed plants producing N, K, and Mg; in 2011 the nitrogen plants were sold. For the years 2005-2009, the share of fertilizers sales in the EU market is estimated using the average share of fertilizers sales in EU markets for the years 2009, 2010, 2011, 2012

[20] Financial results in the annual reports originally expressed in dollars and rubles.

[21] Financial results in the annual reports originally expressed in dollars.

[22] For the years 2005, 2006 and 2007 fertilizers sales in the EU are assumed to be 94.8%. This percentage is obtained as an average of EU sales over total sales for the years 2008-2013.

[23] Agrium is present in the EU market since 2008, by acquiring 70% of CMF. Financial results in the annual reports originally expressed in dollars.

[24] Financial information available only from 2007. The only information available are total sales in EU markets and fertilizers sales; sales of fertilizers in the EU are estimated assigning a share equal to the share of total EU sales over the total of the group. Financial results are expressed in Polish zloty.

[25] Uralkali produces only potash. The annual report only shows sales aggregates at EU and US level. As the annual reports of the years 2006-2010 state that sales in the United States and the European Union represent the same percentage of the total sales, and the 2010 annual report states that "the group maintains a balance between dollar and euro sales to mitigate the risk...", the EU sales are estimated as the 50% of the aggregate sales in the United States and the European Union. Until 2010, financial results are expressed in rubles, since 2011 in dollars.

[26] Until 2008, no information available regarding fertilizers sales. For the years 2009-2013, the company declared that revenue in the EU market was 15% of the average sales; the same value (15%) is assumed to apply for fertilizers sales.

larger presence in Europe than it does in the global arena (6.4%) with estimated shares approaching or exceeding 10% in most of the years considered, for values as high as 12.36% in 2008 and 12.18% in 2011. K+S Group, ranked as the seventh largest fertilizer company be ECT, is instead the second largest in Europe according to our calculation, although with shares that do not exceed 6% (5.07 in 2012). None of the other companies listed in Table 5.4 shows a market share of 5%, with the exception of Eurochem in 2012, whose values approaches it (4.91%).

The calculations of the proxy HHI for the European fertilizer industry was performed for the years 2009–2012. While market shares for the top 10 companies are available from Table 5.5, the shares for companies representing the remaining portion of the market were approximated using the formulas reported in Appendix 2. The values of the proxy for the HHI are 205, 249, 302, and 286 for the years 2009 to 2012, respectively, which suggest that the European fertilizer market does not represent a concentrated industry.

5.7. Mergers and Acquisitions

During the last two decades, the European fertilizer industry has seen several acquisitions as fertilizers manufacturers have used takeovers of other companies as a way to increase their presence in the European market. A list of some of the most important mergers and acquisitions occurred in the European fertilizers market is presented in Appendix 4. An illustration of these acquisitions follows.

The leader of the industry in terms of market share, Yara International ASA, acquired six different fertilizer manufactures in Europe between 1978 and 1990: NSM (The Netherlands), Supra (Sweden), Fisons (the UK), Ruhr Sticstoff (Germany), Windmill (The Netherlands), Cofaz (France) (Yara International ASA, 2015). Furthermore, in 2007 Yara International set up GrowHow UK Limited in the UK, a 50-50 joint venture with CF industries, an American fertilizer producer (Yara International ASA 2015).

Borealis Group, a leader in the European chemical industry, has been expanding its presence in the fertilizer sector thanks to the recent acquisitions of PEC-Rhin SA (France) in 2012 (Borealis Group 2012), Rosier SA (Belgium) and GPN SA (France) in 2013 (Borealis Group 2013).

In 2012, BASF SE sold its nitrogen-based fertilizers production plant in Antwerp to the Russian producer Eurochem. This allowed Eurochem to develop its network in Europe (ICIS 2012). In the same year, Eurochem bought K+S Nitrogen from K+S Group, continuing its strategy of expansion in the European market. Instead, K+S Group diverted its focus to the potash, magnesium, and salt business segments (K+S Group 2015).

In 2006 the Polish manufacturer Anwil SA acquired Spolana SA, the leader in the Czech fertilizer industry. In turn, Anwil SA is a fully owned subsidiary of PKN ORLEN S.A., a Polish petrochemical and energy company.

Israel Chemicals Ltd is present in Europe with the division ICL Fertilizers Europe CV and several subsidiaries. For example, in 2002 it acquired Cleveland Potash Ltd, a potash mining company in the United Kingdom (Israel Chemicals Ltd, 2015). The Italian market is served by its subsidiary PM Chemicals (Israel Chemicals Ltd, 2015). Ameropa AG is a Swiss company

involved in trading of agricultural products and fertilizers at global level. The presence of Ameropa AG as a producer is increasing due to the building or acquisition of production plants (Ameropa AG 2015). It is noteworthy the acquisition of Azomures, a Romanian producer of nitrate and ammonia in 2012 (ICIS 2012).

6. PLANT PROTECTION AGENTS

KEY FINDINGS

- Consumption of plant protection agents in Europe increased in value until 2008, to show a decline for the following years. Quantity consumed has overall declined, suggesting an increase in unitary value of these products.
- Herbicides are the plant protection agents consumed in largest amounts, especially in northern Member States. Fungicides are the second most consumed. Mediterranean countries show the largest consumption share of insecticides and the lowest share of herbicides over the total plant protection agents consumed.
- The incidence of plant protection agents' costs over total farming cost in the EU-15 has declined over the last two decades, while there is an uptrend for PEMS.
- The total value of sales of plant protection agents' companies operating in EU Member States has seen a slight decline in the period 2003-2009, followed by a marked increase in the following years.
- The number of enterprises producing plant protection agents has maintained relatively steady, varying between 630 and 655 in the period 2003–2012.
- Germany, France, UK, Italy and Spain are the countries where the highest values of plant protection agents turnover is realized, concentrating more than 80% of total sales.
- The European plant protection agents industry appears concentrated, with an estimated range of the CR5 spanning from 79 to 83%, and calculated HHI values varying between 1556 and 1717.
- The number of patents in the plant protection agents industry in Europe has declined considerably in the last decades.
- Investments cost for R&D and product development for companies operating in the EU crop protection agents industry are large and can play a role of sunk costs acting as barriers to entry and fostering further consolidation.

6.1. Overview

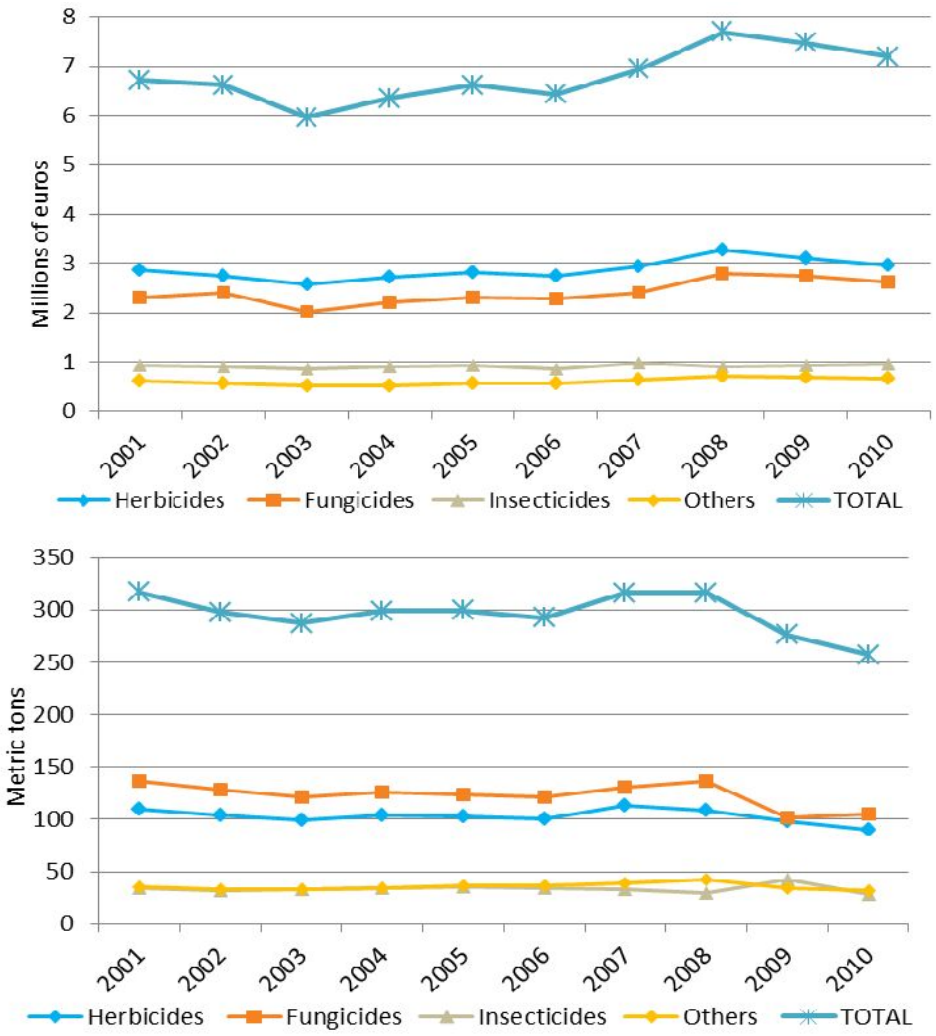
The plant protection agents (i.e., crop protection) market can be segmented by the type of product (herbicides, fungicides, insecticides, and others) and the type of crop the compounds are used to protect (cereals and grains, oilseeds and pulses, fruits and vegetables, and others).

Data from the European Crop Protection Agency (ECPA) reported in Figure 6.1 show for the ten-year period 2001–2010 changes in value (top panel) and quantity (bottom panel) of plant protection agents used in Europe.[27] The values in Figure 6.1 show that in terms of values, after an uptrend that continued until 2008, the value of the market for herbicides and fungicides

[27] ECPA figures used for figure 6.1 include values for the following 19 Member States: Austria, Belgium, Cyprus, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, The Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, and the UK.

were declining, while the value of the insecticides market maintained steady, and the market for "others" was increasing. These trends dominate the value of the total market, which is characterized first by a decline from €6.7 billion in 2000 to €6 billion in 2001, and then increasing to reach €7.7 billion in 2008 and declining to €7.2 billion in 2010. Herbicides have the largest share of the market in terms of value (€2.95 billion in 2010), followed by fungicides (€2.61 billion in 2010), insecticides (€0.96 billion in 2010) and "others" (€0.67 billion in 2010).

Figure 6.1: Values (top panel) and volume (bottom panel) of plant protection agents used in Europe (2001–2010)



Source: Authors, based on data from the European Crop Protection Association.

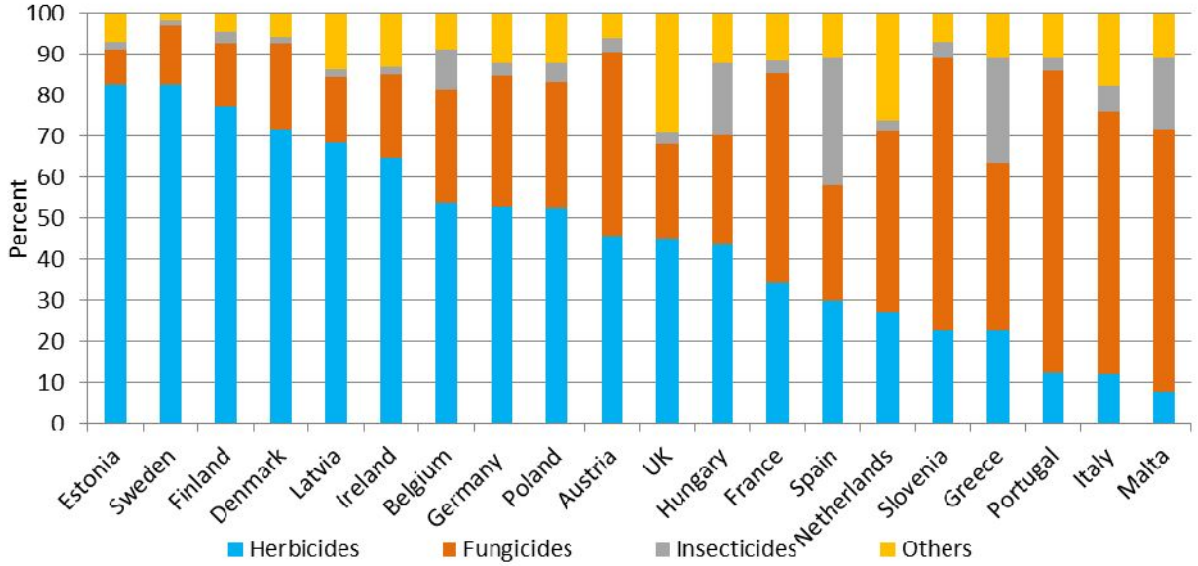
In terms of volumes, the products consumed the most are fungicides (105,000 metric tons in 2010), followed by herbicides (90,000 metric tons in 2010) while insecticides and "others" alternate across years. The data show that herbicides and fungicides jointly cover more than two-thirds of the market in both value and volume. It should be noted that, even though after 2003, the value of all the products seems to increase, the number of metric tons of products

was decreasing until the year 2006, suggesting that the unitary value of all plant protection agents types increased. The overall growth in the value of the plant protection agents market (slowed down for herbicides, insecticides, and “others” after the year 2007) may, perhaps, be due to the companies adapting to the new regulatory requirements of Regulation (EC) No 1107/2009. The drop in quantity used of all the plant protection agents types starting in the years 2007 for herbicides, and then in 2008 and 2009 for the other crop protection agents was steeper than the drop in value of sales, suggesting an overall, average increase in the unitary value of products in the EU. The unitary value of most products declined from 2001 to 2003, to rise again in the following years. The unitary value of herbicides has increased from €25.8 per kilogram in 2000 to €32.6 per kilogram in 2010; for fungicides the unitary values went from €17 per kilogram in 2003 to €24.8 per kilogram in 2010 (with a peak of €27 per kilogram in 2009); insecticides from €26.4 per kilogram in 2003 to €32.6 per kilogram in 2010 (with a decrease in 2009).

6.2. Demand and Usage

To assess the usage of crop protection agents by product type, we calculated the shares of each class of products over the total usage (in quantity) for the two periods 1999–2008 and 2011-2013, for which data on Pesticide sales are available from EUROSTAT. The calculations are based on percentages of the total usage (metric tons). It should be noted that the data for the figures for the period 2011-2013 include a larger number of Member States, thanks to the compliance in reporting due to Reg. 1185/2009. The values in both panels of Figure 6.2 show a differentiated pattern of usage for the different crop protection agents. This indicates that the different climates and agronomical conditions in the Member States agricultural systems, call for farmers to adopt different measures to protect against different types of pests. Consistent with the general market figures presented above, the plant protection agents that seem to be used in higher amounts are herbicides, although predominantly in colder/northern climates, with Estonia, Sweden, Denmark, Ireland, and Finland showing shares exceeding 70% in both periods considered. The Netherlands, Greece, Slovenia, Spain, Portugal, Italy and Malta show usage share of herbicides below 35% in the period 1999-2008 and below 30% in the period 2011–2013. The second plant protection agents type by quantity share are fungicides, whose shares in the period 2011–2013 exceeds 70% in Italy, Slovenia, Portugal and Malta. The countries showing the highest share of insecticides use over the total plant protection agents consumed, are the Mediterranean counties: Spain, Greece, Italy, and Belgium.

Figure 6.2: Share of crop protection agents in volume by type of product in EU Member States. Average values 1999–2008 (top panel) and 2011-2013 (bottom panel)

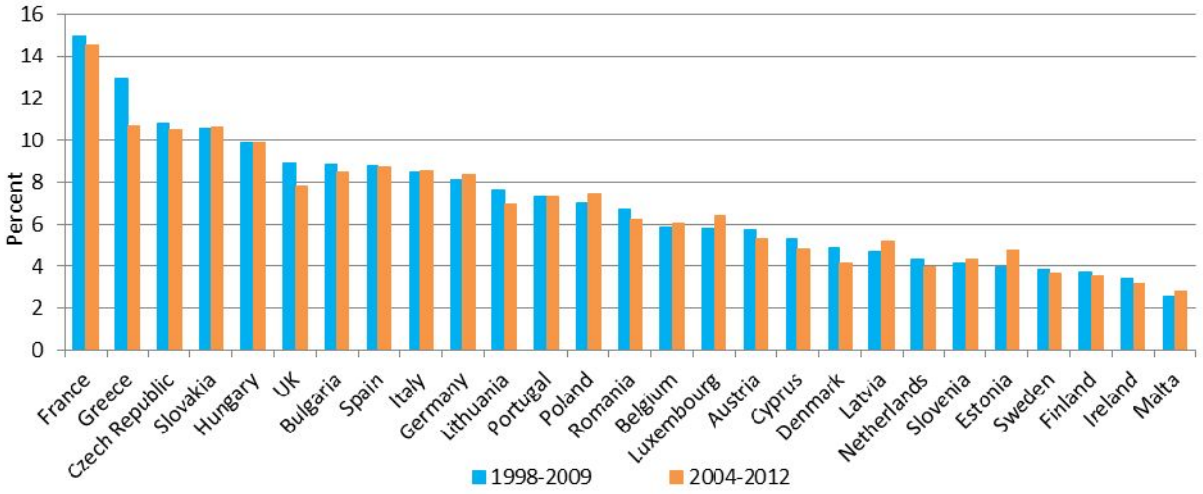


Source: Authors, based on data from Eurostat.

6.3. The Importance of Crop Protection Agents for European Farmers' Cost Structure

Figure 6.3 reports the average value shares of crop protection agents by Member State for the periods 1989–2009 and 2004–2012 using FADN data. The values in Figure 6.3 show plant protection agents' share in farming costs varying from as high as 14.9% for France and 12.9% for Greece (for the period 1989–2009), to as low as 3.4% for Ireland and 2.6% for Malta (for 1989–2009 data). The data show that, for most EU-15 Member States, with the exception of Italy, Belgium, Germany, and Luxembourg, the cost shares of plant protection agents have been declining, for a decrease as marked as 20.9% for Greece (from 12.9% to 10.7%) and 17.3% for Denmark (from 4.9% to 4.2%). Among PEMS instead, five countries show declining cost shares of plant protection agents (Bulgaria, Cyprus, the Czech Republic, Lithuania, and Romania) while the others show increasing shares, with values as high as +10.3% for Latvia (from 4.7% to 5.2%) and +16.6% for Estonia (from 3.9% to 4.7%).

Figure 6.3: Average plant protection agents cost shares in EU countries



Source: Authors, based on FADN data.

The estimated coefficients and summary statistics of the regression model used to assess the evolution of pesticides' cost shares over time among the EU-27, EU-15, and PEMS are reported in Table 6.1.[28] The estimates in the third and fourth column of the table are obtained with the 1989–2009 FADN data. A graphical representation of the slope of the time trends discussed below is reported in Figure A5.1, Appendix 5. The results for EU-27 indicate an inverted U-shaped trend of the cost shares and statistically significant time trend coefficients (the linear positive and the quadratic negative) showing that the cost shares of plant protection agents increased for the first twelve years in the data period but at declining rates; this uptrend is followed by a stagnation period and then by a decline, reaching rates as low as -0.13% per year.

The patterns observed are pretty much identical for both the regression coefficients obtained with country-level or NUTS2-level data. The coefficients for the indicator for the years following the enlargement are negative and statistically significant in both the country level and the NUTS2-level data, which suggests that farms in the new Member States presented, on average, a lower cost share of crop protection agents. Patterns substantially identical in shape, but slightly more marked in magnitude than the EU-27 are observed for the EU-15 that show the same inverted U-shaped relationship and statistically significant coefficients, resulting in a market growth of 0.27 for the year 1989 to a decline rate of -0.2 in 2009. For PEMS instead, the cost shares for plant protection agents increasing over time since 2004, albeit none of the estimated trend coefficients is statistically different from zero.

The estimated coefficients representing the changes of plant protection agents' cost shares obtained using the 2004–2012 FADN data, reported in the fifth and sixth columns of Table 6.1 appear not statistically different from zero, which may suggest that the incidence of plant protection agents on farming cost has not changed significantly in the period 2004–2008 A graphical representation of the slopes of the time trends are reported in Appendix 5, Figure

[28] For more details, please see the "Materials and methods" section and the explanation reported on page 16.

A5.2. The estimated year-specific trends for the EU-15 and PEMS subsamples behave differently, supporting the patterns obtained with the 1989-2009 coefficients: the share of plant protection agents' cost in the EU-15 declines slightly, reaching annual changes of -0.15% per year, while there is an uptrend for PEMS (in particular after 2006) reaching values as high as 0.6% per year.

Table 6.1: Trend analysis regression results for plant protection agents

		1989–2009				2004–2012			
		Country-level		NUTS2-level		Country-level		NUTS2-level	
EU-27	Constant	4.712	***	4.945	***	6.610	***	6.711	***
		(0.304)		(0.300)		(0.280)		(0.376)	
	Time	0.243	***	0.212	***	-0.091		-0.071	
		(0.033)		(0.023)		(0.072)		(0.047)	
	$Time^2$	-0.009	***	-0.009	***	0.007		-0.001	
		(0.002)		(0.001)		(0.009)		(0.006)	
	D2004	-0.381	**	-0.279	**				
		(0.164)		(0.131)					
	R^2	0.947		0.905		0.939		0.939	
	N	363		4111		237		2169	
EU-15	Constant	4.664	***	4.898	***	6.827	***	6.754	***
		(0.308)		(0.302)		(0.395)		(0.376)	
	Time	0.278	***	0.239	***	-0.093		-0.047	
		(0.034)		(0.023)		(0.085)		(0.054)	
	$Time^2$	-0.012	***	-0.011	***	-0.002		-0.007	
		(0.002)		(0.001)		(0.010)		(0.006)	
	R^2	0.945		0.9047		0.962		0.949	
	N	297		3829		135		1762	
PEMS	Constant	18.121	*	12.576	**	4.679	***	4.891	***
		(9.503)		(8.112)		(0.272)		(0.239)	
	Time	-1.433		-0.927		-0.058		-0.122	
		(1.085)		(0.923)		(0.118)		(0.092)	
	$Time^2$	0.040		0.029		0.016		0.018	
		(0.031)		(0.026)		(0.015)		(0.012)	
	R^2	0.962		0.923		0.917		0.832	
	N	66		282		102		443	

Source: Authors' calculations.
Note: Dependent variable: percentage share of pesticides costs in total farm costs. Standard errors in parentheses. ***, **, and * represent 1, 5, and 10% statistical significance, respectively. The change in the PPA cost share per year can be computed as the coefficient on Time + 2* the coefficient on $Time^2$ * year. For example, for the EU-15 in the year 2000 (i.e., t=11) a change in the PPA cost share per year is estimated to be 0.278 + 2* (-0.012)*11 = 0.014%.

6.4. Supply

Official Eurostat data report a relatively large number of companies manufacturing plant protection agents. In 2007, there were more than 600 companies declaring to be involved in the production of plant protection agents and other agrochemical products (old NACE Rev 1 24.1 – replaced 2008 onward with NACE Rev 2020) in 2005. This sector generated €2.7 billion

of value added in 2006, and more than one third of this value was produced in Germany (Eurostat 2009).

The values of total sales (turnover) for the plant protection agents and agrochemical sector for the Top 10 EU countries from SBS are reported in Table 6.2, along with the shares of total values in each over the total value of the sales in the EU-27 (EU-28 for 2012). The total value of sales of plant protection agents and agrochemical products in Europe declined through the previous decade, to increase again in 2012 and reached a value exceeding €15 billion. During the ten-year period considered, the production and sales of plant protection agents appear highly concentrated in four Member States: Germany, France, the UK, and Italy that together achieve more than 80% of sales in the European market. If one considers the share of the turnover of companies located in the Top 10 states, these have accounted for a growing share of the market, which in the year 2012, claim more than 93% of the EU-28 total value of sales.

Table 6.2: Top 10 EU Member States by turnover in crop protection agents

	2003		2006		2009		2012	
	Turnover	% (EU27)	Turnover	% (EU27)	Turnover	% (EU27)	Turnover	% (EU28)
Germany[29]	2455	20.0	4346.7	36.2	4558.5	38.8	6371.7	42.3
France	4603.6	37.5	3196	26.6	2755.5	23.4	3709.8	24.6
UK	1690.2	13.8	1148.3	9.6	1108.3	9.4	1359.3	9.0
Italy	878.6	7.2	908.1	7.6	1018.3	8.7	946.4	6.3
Spain	599.5	4.9	684.3	5.7	627.9	5.3	799.8	5.3
Belgium	N/A	-	139.3	1.2	359.2	3.1	315.8	2.1
Austria	N/A	-	141.3	1.2	209.9	1.8	205.9	1.4
Poland	132.2	1.1	192.2	1.6	86.1	0.7	146.1	1.0
Greece	131.5	1.1	154.5	1.3	94.2	0.8	118.6	0.8
Portugal	69.5	0.6	89.7	0.8	78	0.7	108.1	0.7
Top 4	9627.4	78.4	9599.1	79.9	9440.6	80.3	12387.2	82.2
Top 10	10560.1	86.0	11000.4	91.6	10895.9	92.6	14081.5	93.4
EU-27[30]	12278.0		12012.1		11764.3[31]		15076.8	

Source: Authors elaborations on Eurostat data. NACE R.1 24.1 and NACE.R2.20.20 Manufacturers of pesticides and other agrochemical products.
Note: N/A refers to a data entry which was suppressed or was not available because of disclosure issues.

Germany-based companies have the largest shares of the market, reaching up to 43.26% in 2012, followed by France (24.61%), and the UK (9.02%). It should be noted that the relative importance of France and the UK-based companies, in terms of sales value, has been

[29] Production and turnover values for Germany in the years 2008 and 2009 reported by the SBS were not in line with the other data, as they suggested a decline in 80% in production value from 2008 to 2007, and then an increase of more than 400% from 2009 to 2010. These patterns were not consistent with production data as reported by Statista, indicating an increased production in 2008. Thus, production values for Germany for the years 2008 and 2009 were imputed multiplying the amounts produced in 2008 and 2009, as reported by the Statista, by the average unitary value (€35,243 per metric ton) for the years 2005-2008 obtained by dividing SBS production values by the Statista production amounts. Revised figures for Germany's plant protection agents manufacturers turnover for the same years were obtained multiplying the production values times 1.35, the average ratio between turnover and production value for the years 2005-2007 and 2010-2012. 2008 and 2009 EU-27 production values and turnover were imputed using the updated Germany production values and turnover in place of those reported by the SBS.

[30] Turnover and production value aggregates in 2012 are only available for EU-28.

decreasing over time. While France-based companies still manage to have sales that count for one fourth of the European markets, the UK's turnover values account for only 9%.

6.5. Market Structure: Number of Enterprises and Size

Table 6.3 shows the number of enterprises and the average enterprise size. The number of enterprises increased slightly from 628 to 657 in the period 2003–2009 to decrease to 623 in 2012. In terms of average size, expressed in sales, enterprises' size declined form €19.5 million in 2003 to €17.9 million in 2009 to show an upward trend in more recent years, reaching €24.2 million.

Overall, the European crop protection industry seems to be characterized by larger companies, mostly located in some of Top 10 Member States with the largest sales. Germany crop protection enterprises present the largest, and growing, average size among all EU-27 Member States, from €55.8 million in 2003 per unit and €99.6 million per unit in 2012. In spite of the number of enterprises in the EU-27 not changing considerably, Germany's number of enterprises has been steady overall after an increase. Among most other Member States with the highest sales, one can observe steady or shrinking numbers, such as in France (from 133 to 80), the UK (from 71 to 59), and Spain (from 100 to 85); but the share is increasing in some other Member States (e.g., Greece, from 11 to 23). Among Member States showing a decline in the number of companies, for both France and the UK the average size showed a decline at the beginning of the previous decrease to then increase again, in some cases considerably. For example, in France, the AES declined from €34.6 million in 2003 to €27.1 million in 2006, to present an AES of €46.4 million in 2012.

Table 6.3: Number of enterprises and average enterprise size (AES) in million euros per establishment for the Top 10 plant protection agents producing Member States

	2003		2006		2009		2012	
	Number	AES	Number	AES	Number	AES	Number	AES
Germany	44	55.80	66	65.86	69	66.07	64	99.56
France	133	34.61	118	27.08	90	30.62	80	46.37
UK	71	23.81	73	15.73	68	16.30	59	23.04
Italy	40	21.97	39	23.28	56	18.18	45	21.03
Spain	100	6.00	100	6.84	93	6.75	85	9.41
Belgium	N/A	-	12	11.61	12	29.93	11	28.71
Austria	3	-	6	23.55	7	29.99	8	25.74
Poland	41	3.22	49	3.92	44	1.96	42	3.48
Greece	11	11.95	15	10.30	25	3.77	23	5.16
Portugal	5	13.90	6	14.95	5	15.60	5	21.62
EU-27	628	19.55	654	18.37	657	17.91	623	24.20

Source: Authors elaborations on Eurostat data. NACE.R1.24.1 and NACE.R2.20.20 Manufacturers of pesticides and other agrochemical products.
Note: N/A refers to a data entry that was suppressed or was not available because of disclosure issues. AES – average enterprise size.

[31] Estimated using the procedure explained in Section 5.

6.6. Market Concentration

The agrochemical market can be considered a highly concentrated industry: a report by ETC Group (ETC Group 2013) indicates that in 2011 six firms controlled three quarters of the global agrochemical market. The values presented in Table 6.4 indicate that Syngenta, Bayer Crop Science, BASF, and Monsanto control more than 60% of the market.

Table 6.4: The World Top 10 crop protection agents producing companies

Company	2011 sales (million dollars)	Market share (%)
Syngenta	10,277	23.1
Bayer CropScience	10,113	17.1
BASF	9,938	12.3
Dow AgroScience	8,715	9.6
Monsanto	6,098	7.4
DuPont	5,760	6.6
Makhteshim-Agan Industries	4,349	6.1
Nufarm	3,836	5.0
Sumitomo Chemicals	3,469	3.9
Arysta LifeScience	3,147	3.4
Total Top 10	65,702	95.0
CR3		52.5
CR5		69.5
HHI		1274

Source: ETC Group, Communiqué no. 111, September 2013, page 13; CR3 and CR5 authors' calculations.

As for the situation in the European market, a report by the Pesticides Action Network Europe (PANE 2012) indicates that some of the largest biotechnology companies worldwide have also a relevant role in the market of crop protection agents (e.g., Bayer, DuPont, Monsanto, and Syngenta), and that plant protection agents sales of the market leader, Bayer, amounted to €5.5 billion in 2010, exceeding two-fifths of its total sales in Europe.

To assess in more detail the level of concentration of the European crop protection and agrochemical industry, sales for crop protection agents in Europe[32] were collected from financial reports of the publicly quoted companies. Since not all of the companies included in the analysis disclosed sales of plant protection agents for the European market, a series of approximations and assumptions were necessary. These assumptions are presented in the footnotes for each of the company considered as listed in Table 6.5. As it was not possible to reconcile the different figures reported by the ECPA with an accurate representation of the market size, we approximated the values of the plant protection agents consumed in Europe (assuming no changes in inventories) as

$$\text{Consumption Value} = \text{Export Value} + \text{Production Value} - \text{Import Value}.$$

[32] Sales reported in currencies other than euro were converted using exchange rates at the 31st December of the year for which the financial reports referred to collected at http://www.xe.com/currencytables/#

Production values are obtained from Eurostat's SBS. Export and import values were collected via FAOSTAT for the EU-27, and then converted in euros using exchange rates at the 31st of December for each calendar year. We performed these calculations for the period 2003–2010; for the period 2000–2002, for which Eurostat SBS production values were not available, we projected ECPA figures (EUtotal) to EU-27 Consumption values using the ratio between the estimated consumption value in 2003–2010 and ECPA (EUtotal) figures.

Table 6.5: Estimated market shares and concentration ratios for Top 7 crop protection agents' companies operating in the EU-27 market

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Syngenta[33]	19.4	22.1	22.6	29.1	24.1	24.3	24.7	26.5	25.5	24.4
Bayer[34]	13.5	23.9	27.8	28.1	22.5	23.4	22.0	21.6	23.6	21.0
BASF[35]	22.3	20.9	22.0	26.5	21.7	17.0	15.6	14.5	16.4	15.9
Dow[36]	-	-	-	-	-	-	10.2	11.7	11.3	12.8
Adama[37]	-	-	-	-	-	-	6.63	6.35	6.48	6.91
DuPont[38]	6.44	5.85	4.55	5.29	4.92	4.94	4.35	4.55	3.99	4.29
Monsanto[39]	3.63	3.01	2.62	2.94	3.17	3.04	3.02	4.71	3.97	2.70
Top 7	65.4	75.8	79.7	92.0	76.5	72.8	86.6	90.0	91.4	88.2
CR3	55.3	67.0	72.5	83.8	68.4	64.8	62.3	62.6	65.6	61.4
CR5							79.2	80.8	83.4	81.2
HHI_{max}							1556	1646	1717	1566

Source: Authors' calculations based on shareholders annual reports; value of total plant protection agents market obtained from Eurostat production values, ECPA, and FAOSTAT data.

Before illustrating in detail the different facets of the concentration level in the European plant protection agents market, a few caveats should be mentioned.

1. For some of the companies considered, sale considered may not come from the European market alone but may also include sales in other markets (such as Middle East or Africa).
2. For six out of seven companies we could not isolate "crop protection agents" within the activities of the companies; this may overestimate the amounts attributed to crop protection agents (see Appendix 5).

[33] European plant protection agents' sales obtained subtracting "professional products & seed care" values from European sales of agricultural products. Values in the annual reports are in dollars.

[34] European crop protection sales obtained multiplying the share of European sales times the global value of crop protection sales. For some years, European sales' share calculated dividing European sales by global sales.

[35] For 2001, European plant protection agents' sales calculated using the method illustrated in footnote 22 for BAYER. For other years, if European sales were not available EMEA sales (Europe, Middle East, and Africa) were used instead.

[36] Market shares were calculated using the methods illustrated in footnote 27 for BAYER. Values in the annual reports are in dollars.

[37] Plant protection agents sales were calculated multiplying the share of crop protection products times the value of regional sales in Europe. Values in the financial reports were given in dollars.

[38] Plant protection agents sales calculated by multiplying the share of the EMEA sales (European, Middle East, and Africa) over the total sales times the shares of sales for crop protection agents. Values in the financial reports were given in dollars.

[39] Crop protection agents sales obtained multiplying the value of crop protection sales (Roundup and other glyphosate-based herbicides) times the ratio of the share of sales in Europe and Africa over the total Global sales value. Values in the financial reports were given in dollars.

3. The calculated EU-27 plant protection agents' market value may be underestimated as it depends on production values which, in coming years may be biased downwards.

For these reasons, the market shares presented in Table 6.5 are likely overestimated, and we warn the reader to consider them as such.

The shares presented in Table 6.5 appear large. For the market leader, Syngenta, the calculated market shares vary from 19.4% (2001) to 29.1% (2004), stabilizing at approximately 25% in the period 2007–2010. BAYER's shares vary between 21% and 23%, with peaks of 28% in 2003 and 2004. The market shares of BASF, the third largest company, seem to have slightly declined, averaging between 15% and 17% in the last four years considered; while the share of Dow slightly increased from 10% to 13% in the period 2007–2010. Overall, the values of CR5 are large and appear higher than those illustrated in Table 6.4 for the Global market (69.5), varying from 79.3 (2007) to 83.5 in 2009.

A proxy for the HHI was calculated for the years 2007–2010, using the formula of the HHI_{max} as illustrated in Appendix 5. The values of the approximated HHI are 1556, 1646, 1717, and 1566 for the years 2007 to 2010, respectively. The HHI values suggest that the European plant protection agents and crop protection industry is concentrated; the calculated HHIs are, however, below the 2500 point threshold which identifies a "highly concentrated" industry according to the US DOJ (US Department of Justice 2010).

6.7. Product Development, Patents, and Concentration in the European Plant Protection Agents Industry

Given the level of concentration illustrated above for the plant protection agents industry, one could expect investments in activities that could be classified as "sunk costs."[40] According to Sutton's theory (Sutton 1991), not all sunk costs are exogenous but some are endogenous, whose magnitude can be decided by a firm. One of the traditional examples of endogenous sunk costs is expenditure in R&D (another is advertising). The main incentive in investing in sunk cost is that of obtaining larger margins in a way that is independent on the level of sales. As firms compete increasing their investments, the level of sunk costs needed to successfully operate in a market may increase to such a level where no growth in demand can generate enough additional revenue to cover the additional costs. Thus, even though some firms can endure such higher investments and gain a competitive advantage, the number of entrants will decrease and concentration will rise. As a result, industries characterized by high (endogenously determined) R&D costs can be organized as a natural oligopoly made by few large firms.

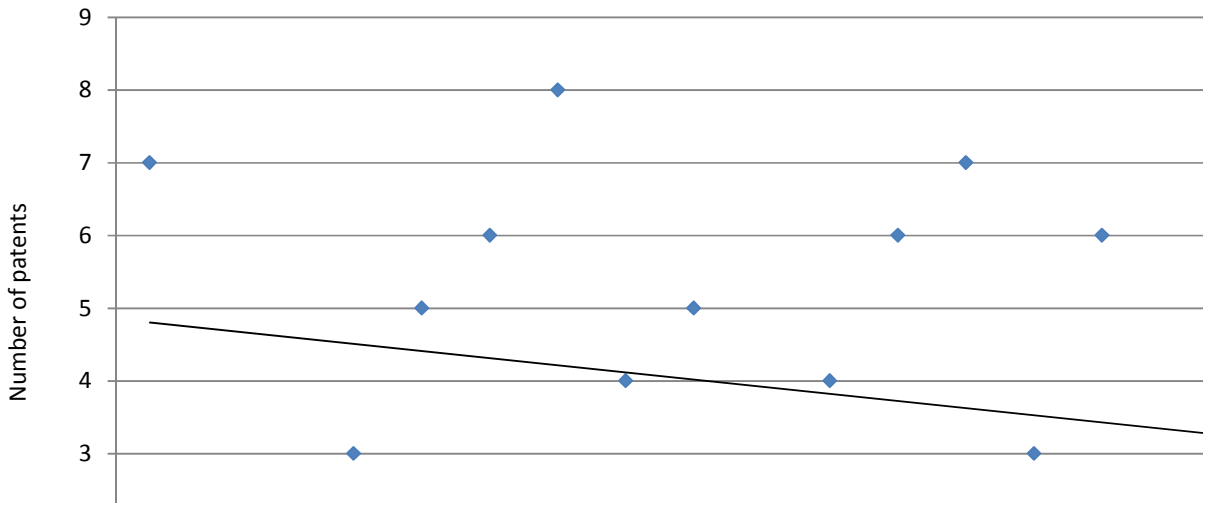
According to a report commissioned by the European Crop Protection Authority (Phillips McDougall Consulting 2013) the number of companies actively involved in research in the crop protection sector in Europe has decreased from 8 in 1995 to 4 in 2012 (Bayer, Syngenta, BASF, and Isagro). While in 2000 there were 70 new active ingredients in the development pipeline, in 2012 there were fewer than 30. Thus, the European market for crop protection has lost appeal in terms of new product launches and R&D. The share of crop protection R&D

[40] Sunk costs are fixed costs that need to be operated in order for a firm to enter a specific market. Some will be exogenously determined, that is the cost of building an establishment, which may not ever be recovered.

investment attributable to products developed for the European market fell from 25.0% in the 1990s to 7.7% in the 2005–2014 period. Nonetheless, the cost of bringing a new active ingredient to the market has been increasing: such cost rose from $152 million to $256 million in the period 1995–2005. The prohibitive costs of product development and the uncertainty resulting from the tighter regulatory environment because of the implementation of Regulation (EC) No 1107/2009 make the decision of investing in R&D for new product development costly, and may facilitate industry concentration.

Figure 6.4 shows that the number of new active principles patented in the EU has declined considerably during the period 1980–2012. The regression line indicating the declining trend in the number of patents reports that, on average, the number of patents has declined by a rate of circa one less approved patent for each decade, and may suggest that, if the current trend continues, innovation in this sector will shrink and it may likely be dependent by a limited number of firms, and it may result in additional concentration.

Figure 6.4: Number of approved plant protection agents and agrochemical patents over time



Source: Authors, based on data from Phillips McDougall Consulting (2013).

6.8. Mergers and Acquisitions

Given the concentrated nature of the market for plant protection agents and crop protection agents, the issue of merger and acquisitions (M&A) in this industry is subject to considerable attention within Europe (Bloomberg 2015). The lead companies in the market have been very active in processes of M&A and consolidation (in particular Bayer and BASF); a list of relevant activities occurred during the last decade is presented in Appendix 5.

A report by StreetInsider (2014) indicates that M&A activities may increase in the future for the European crop protection market, suggesting further consolidation of the industry. Of particular interest is the possibility that Monsanto and Syngenta could merge, in a way to acquire a better strategic position not only in the crop protection market, but in the seed

market as well.[41] In the example that follows, we use the values from Table 6.4 and Table 6.5 to simulate whether a merge between Monsanto and Syngenta, may lead to worrisome levels of concentration in the EU plant protection agents market. Calculations performed on the data from the ETC Group reported in Table 6.4 show that, at the global level, if the merger came without any divestments, the merging entity share would reach 30.5% (based on 2011 figures). Also, if one considered a "partial" HHI, or rather one based on the 95% of the market only, if the two companies were managed jointly and the shared counted as one company, this "partial" HHI would change from 1257 to 1587, for an increase of 342 points which may be large enough to warrant concerns.

Using our calculated shares in Table 6.5, the simulated increase of the HHI in the PPA EU27 market due to Syngenta's and Monsanto's merger (for the years 2007–2010 only) vary between 149 and 250 points, with post-merger HHIs not exceeding 2000, as reported in Table 6.6. Thus, considered our concerns regarding the overestimation of the market shares for the top 7 firms reported in Table 6.5, and the large difference in simulated changes in the HHI, which only in one case touches the European Commission 250 points change in HHI, increased concentration in the EU plant protection agents' market due to Syngenta's and Monsanto's merger may not be of enough concern to intervene.

Table 6.6: Simulated changes in the HHI for the EU-27 PPA market due to a merger by Monsanto and Syngenta

	2007	2008	2009	2010
HHI_{max}	1556	1646	1717	1566
HHI_{max} (postmerger)	1724	1896	1920	1715
Difference	168	250	203	149

Source: Authors' calculations based on shareholders annual reports; value of total plant protection agents market obtained from Eurostat production values, ECPA, and FAOSTAT data.

[41] During the writing of this report Monsanto placed bids to acquire Syngenta. At the time when this report was completed, the outcome of a potential merger between the two companies is still unclear. See news coverage in the specialized media at Financial Times, 8 May 2015: "Syngenta rejects unsolicited $45bn Monsanto approach" http://www.ft.com/intl/cms/s/0/d95c43d8-f54f-11e4-bc6d-00144feab7de.html#axzz3cBcEHT4x; 2 June 2015 "Improved offer expected after $45bn bid rejected" http://www.ft.com/intl/cms/s/0/9bcdaa3c-0604-11e5-b676-00144feabdc0.html#axzz3cBcEHT4x. Reuters.com 10 June 2015 "Monsanto tells Syngenta investors it wants more info to refine value." http://www.reuters.com/article/2015/06/10/us-syngenta-ag-m-a-monsanto-idUSKBN0OQ2P320150610

7. CONCLUSIONS

Input sector	Main conclusions
Seed and planting material	Expenditure shares for seeds show a declining trend supporting the absence of market power by the seed industry. Nevertheless, the share of seeds on total farm cost ranges between 2% and 15% among EU Member States. The most important SPM markets by area are forage and grasses (57 million ha), cereals (38.6 million ha), maize (15 million ha), and oil crops (11.1 million ha). There might be regions where seed companies might be more important, but we could not find confirmation at NUTS2 level. Acquisition of seed companies by the World Top 10 seed companies over the past five years concentrated on Latin America, while in Europe and the United States the focus has been on investing in new breeding technologies. Interestingly, the larger seed companies invest in biological control methods and software companies providing micro level weather data. Nevertheless, there are some subsectors of the seed market where the HHIs and the concentration ratios are very high such as for the sugar beet and maize sector. The smaller a market will be the larger the possibility for a high concentration among input providers. As sugar beet and maize farmers can chose to produce alternative corps the power of seed suppliers to raise their price above long-run marginal seed production costs in the EU is limited. The results for the seed sector do not confirm concerns raised by the reports of the ETC Group (2013) and Mammana (2014). The HHI for the seed sector as a whole is below 1000 (673) and the EU seed market is less concentrated than the world seed market.
Feed	The EU-28 produces roughly 16% of global compound feed production. Compound feed is mainly produced and consumed in the same country. The eight biggest EU compound feed producers are Germany, France, Spain, the UK, Italy, The Netherlands, Poland, and Belgium. The turnover of the EU feed companies increased by 50% over the last eight years, whereas the number of companies decreased in most countries by more than 15%. The results of the analysis show that share of expenditures of farm inputs for feed increased. This might indicate that market power within the feed supply sector exists. The analysis of the feed supply sector shows that this is a highly diversified market with the lowest concentration among the input sectors considered within this study, a CR5 of 15% and an HHI of 130. The rise in feed prices has less to do with possible market power than with the overall increase in food prices in 2007 to 2009 mainly

	caused by biofuel production and severe production shortfalls in major agriculture commodity producing countries (de Gorter et al. 2015, Wright 2014). The five largest feed producers in Europe are ForFarmers B.V., Nutreco, DLG Group, De Heus, and Agrifirm Feed, with an average of market share of 53%. Weak market concentration can only be found on a country-level, for example, Germany 38%, the UK 44%, Poland 53%, Belgium 63%, and The Netherlands 69%. Nevertheless, none of the merger decisions of the European Commission showed a concern about competition due to the large number of important, internationally active competitors present in the market.
Energy	Energy is an indispensable factor of the EU agricultural production as documented by its considerable share on total farm costs. Moreover, in Poland it takes 5.8% and in The Netherlands as much as 6.5% of the final national energy consumption. The importance of energy inputs such as electricity, natural gas, and petroleum significantly varies by the farm type (e.g., crop production versus dairy) and by cultivated crops (e.g., wheat, versus sugar beet). To illustrate, farmers in 23 out of 27 EU Member States spent more than 50% of their energy costs on motor fuel and lubricants in the period 2004–2012, but in Denmark, Finland, Belgium, and The Netherlands, electricity and heating costs combined play a more important role. New EU Member States exhibit higher shares of energy on total farm costs compared to the EU-15 Member States. Overall, we find an indication that the EU agricultural sector has become more energy-intensive, especially in Finland, Italy, and The Netherlands. In 2014, the Top 3 players in the EU electricity market were E.ON (Germany), GDF SUEZ (France), and Enel (Italy); in the natural gas market, Royal Dutch Shell (The Netherlands), Total (France), and Gazprom (Russia); and in the crude oil market, Royal Dutch Shell, British Petroleum (the UK), and Total. We find that concentration ratios are highest in the oil sector, followed by the natural gas sector; the electricity sector exhibits the lowest concentration ratios. Moreover, regardless of the sector, the concentration ratios rise over time. The same qualitative conclusions hold for the values of the HHI. Dwindling crude oil prices may increase a chance of more frequent mergers in the energy sector.
Fertilizers	Interestingly, consumption of inorganic fertilizer has been declining in the EU-27; the decline in consumption of N-based products is less marked than for K and P. Differences in relative usage of the three types of fertilizers (N, K, and P) can be found across geographic areas, with Mediterranean areas showing, relatively speaking, less consumption of N-based products and higher consumption of P-based products than other countries. The share of costs over total specific cost has followed a positive trend

	over time that has decelerated, however. Among the EU-15 the share of soil improvers increased in the previous decades to decline in the recent years; among PEMS, one can observe a growing and increasing cost share. The total value of sales of fertilizers' company operating in EU Member States has increased in the period 2003–2012, recovering from the sharp decline marking the years of the economic recession. The number of enterprises producing fertilizers and soil improvers has increased in the period 2003-2012. Germany, France, Poland, UK and the Netherlands are the countries with the largest values of fertilizer sold, accounting for more than 50% of the total fertilizer turnover realized in the EU27. The European fertilizer industry shows limited concentration with calculated HHIs varying between 205 and 302.
Plant protection agents	Consumption of crop protection agents in Europe has been increasing in value until 2008, to show a decline for the following years. Quantity of plant protection agents consumed has overall declined across the board, suggesting and increase in unitary value of these products. Herbicides are the crop protection agents consumed in largest amounts, especially in northern Member States. Fungicides are the second most consumed crop protection agents. Countries showing the largest consumption share of insecticides are Mediterranean countries, also showing the lowest share of herbicides over the total of plant protection agents consumed. The incidence of plant protection agents' costs over total farming cost shows that the share of plant protection agents' cost over total specific cost in the EU-15 has declined over the last two decades, while there is an uptrend for PEMS. The share of fertilizers costs over total specific cost has followed a positive trend over time that has decelerated, however. Among the EU-15 the share of soil improvers increased in the previous decades to decline in the recent years. Among PEMS, one can observe a growing and increasing cost share of fertilizers. The total value of sales of plant protection agents' company operating in EU Member States has seen a slight decline in the period 2003–2009 to show a marked increase in the following years. The number of enterprises producing crop protection has maintained relatively steady, varying between 630 and 655 in the period 2003–2012. Germany, France, the UK, Italy, and Spain are the countries where the highest values of plant protection agents turnover is realized, concentrating more than 80% of overall sales. The European PPA industry appears relatively concentrated, with an estimated range of the calculated HHI which vary between 1550 and 1687. The number of patents in the PPA industry in Europe has declined considerably in the last decades. Investments cost for R&D and product development for companies operating in the EU crop protection agents industry are large and can play a role of sunk costs acting as barriers to entry and foster consolidation. Similar concerns have been raised with

	respect to plant breeding and may explain why European SPM companies allocate their investments on new innovations abroad and not in Europe. The observation of reduced investments in the PSM as well as PPA sector most likely caused by high regulatory costs is of concern. This may support furhter concentration within the two sectors while at the same time reducing innovations.
Taken together	We do not observe a clear pattern on the demand side when it comes to the importance of individual input sectors for EU Member States. The only exception, perhaps, is the feed sector where farmers spend more than 13% in Lithuania and 65% in Malta (and above 30% in most of the remaining Member States). On the supply side, we also observe a mixed concentration structure: sectors with a relatively low Herfindahl-Hirschman indices are feed (130), fertilizer (233), and seed (673), whereas the market concentration in the energy (1008–1351) and plant protection agents markets is much higher. Although all the calculated Herfindahl-Hirschman indices are below the 2000 threshold level, the EU policymakers and regulators should monitor the market carefully, especially when evaluating possible future proposals for mergers of companies.

REFERENCES

- Acron Group (2006), Consolidated Financial Statements and Auditor's Report 31 December 2005. Available online at http://www.acron.ru/upload/iblock/2c0/file_0161.pdf. Last accessed 06/05/2015.
- Acron Group (2007), Consolidated Financial Statements and Auditor's Report 31 December 2006. Available online at http://www.acron.ru/upload/iblock/0e3/file_0158.pdf. Last accessed 06/05/2015.
- Acron Group (2008), Consolidated Financial Statements and Auditor's Report 31 December 2007. Available online at http://www.acron.ru/upload/iblock/5b8/file_0156.pdf. Last accessed 06/05/2015.
- Acron Group (2009), Consolidated Financial Statements and Auditor's Report 31 December 2008. Available online at http://www.acron.ru/upload/iblock/163/file_0151.pdf. Last accessed 06/05/2015.
- Acron Group (2010), Consolidated Financial Statements and Auditor's Report 31 December 2009. Available online at http://www.acron.ru/upload/iblock/556/file_0144.pdf. Last accessed 06/05/2015.
- Acron Group (2011), Consolidated Financial Statements and Auditor's Report 31 December 2010. Available online at http://www.acron.ru/upload/iblock/b41/file_0534.pdf. Last accessed 06/05/2015.
- Acron Group (2012), Annual Report 2011. Available online at http://ar2011en.acron.ru/uploads/1337871970_Acron_AR11_ENG.pdf. Last accessed 06/05/2015.
- Acron Group (2013), Annual Report 2012. Available online at http://ar2012en.acron.ru/uploads/1368527859_6423_Acron_AR12_PRINT_CMYK_(A4).pdf . Last accessed 06/05/2015.
- Adama (2013), MAI Acquires Slovakian Partner Agrovita. Available online at http://www.adama.com/en/media/press-releases/mai-aquires.html. Last accessed 05/05/2015
- Adama (n.d.), 2009 Annual Report. Available online at http://www.adama.com/en/Images/2009%20Annual%20Report_tcm15-1881.pdf. Last accessed 25/04/2015
- Adama (n.d.), 2011 Annual Report. Available online at http://www.adama.com/en/Images/2011%20Annual%20Report_tcm15-1925.pdf. Last accessed 25/04/2015
- Agravis. (2014). Homepage firm description. Retrieved May 9, 2015, from http://www.agravis.de/en/tiere/ueber_uns/index.html
- Agrium Inc. (2010), 2009 Annual Report. Available online at https://www.agrium.com/system/files/2009_annual_report_0.pdf. Last accessed 04/05/2015.
- Agrium Inc. (2011), 2010 Annual Report. Available online at https://www.agrium.com/system/files/2010_annual_report.pdf. Last accessed 04/05/2015.

- Agrium Inc. (2012), 2011 Annual Report. Available online at https://www.agrium.com/system/files/2011_annual_report_0.pdf. Last accessed 04/05/2015.
- Agrium Inc. (2013), 2012 Annual Report. Available online at https://www.agrium.com/system/files/agrium_2012_ar_web_0.pdf. Last accessed 04/05/2015.
- Aldinger, H. (2014). The Fertilizer Industry in the European Union after Enlargement. Available at http://www.firt.org/sites/default/files/Aldinger_Challenges_Today%26Tomorrow_in_European_Fertilizer_presentation.pdf
- Anwil S.A. (2006), Annual Report 2005. Available online at http://www.anwil.pl/EN/Press/AnnualReports/Documents/2005/raport_50.pdf. Last accessed 06/05/2015.
- Anwil S.A. (2007), Annual Report 2006. Available online at http://www.anwil.pl/EN/Press/AnnualReports/Documents/2006/raport_36.pdf. Last accessed 06/05/2015.
- Anwil S.A. (2008), Annual Report 2007. Available online at http://www.anwil.pl/EN/Press/AnnualReports/Documents/2007/raport_84.pdf. Last accessed 06/05/2015.
- Anwil S.A. (2009), Annual Report 2008. Available online at http://www.anwil.pl/EN/Press/AnnualReports/Documents/2008/raport_101.pdf. Last accessed 06/05/2015.
- Anwil S.A. (2010), Annual Report 2009. Available online at http://www.anwil.pl/EN/Press/AnnualReports/Documents/2009/raport_117.pdf. Last accessed 06/05/2015.
- Anwil S.A. (2011), Annual Report 2010. Available online at http://www.anwil.pl/EN/Press/AnnualReports/Documents/2010/raport_152.pdf. Last accessed 06/05/2015.
- Anwil S.A. (2012), Annual Report 2011. Available online at http://www.anwil.pl/PL/DlaMediow/RaportyRoczne/Documents/2011/ANWIL_SA-Annual_Report2011-8.pdf. Last accessed 06/05/2015.
- Anwil S.A. (2013), Annual Report 2012. Available online at http://www.anwil.pl/EN/Press/AnnualReports/Documents/2012/ANWIL-AnnualReport2012.pdf. Last accessed 06/05/2015.
- BASF (2002), Annual report 2001 - Adding value through growth and innovation. Available online at http://globaldocuments.morningstar.com/documentlibrary/document/304fd24f6465a0f3.msdoc/original. Last accessed 23/04.2015
- BASF (2003), Annual report 2002 - Adding value through growth and innovation. Available online at https://bib.kuleuven.be/files/ebib/jaarverslagen/BASF_2002.pdf. Last accessed 25/04.2015
- BASF (2004), Corporate Report 2003. Available online at https://www.basf.com/documents/corp/en/about-us/publications/reports/2004/BASF_Corporate_Report_2003.pdf. Last accessed 23/04/2015

- BASF (2005), Shaping the Future - Corporate Report 2004. Available online at https://www.basf.com/documents/corp/en/about-us/publications/reports/2005/BASF_Corporate_Report_2004.pdf. Last accessed 23/04/2015
- BASF (2006), Shaping the Future - Corporate Report 2003. Available online at https://www.basf.com/documents/corp/en/about-us/publications/reports/2006/BASF_Financial_Report_2005.pdf. Last accessed 23/04/2015
- BASF (2007), Shaping the Future - Financial Report 2006. Available online at https://www.basf.com/documents/corp/en/about-us/publications/reports/2006/BASF_Financial_Report_2005.pdf. Last accessed 23/03/2015
- BASF (2008), BASF finalizes acquisition of Sorex pest control business. Available online at http://www.agro.basf.com/agr/AP-Internet/en_GB/content/news_room/news/P-08-539. Last accessed 05/05/2015
- BASF (2008), Shaping the Future - Report 2007. Available online at https://www.basf.com/documents/corp/en/about-us/publications/reports/2008/BASF_Report_2007.pdf. Last accessed 25/04/2015
- BASF (2012), BASF completes acquisition of Becker Underwood. Available online at http://www.agro.basf.com/agr/AP-Internet/en/content/news_room/news/basf_completes_acquisition_of_becker_underwood. Last accessed 05/05/2015
- BASF (n.d.), BASF Report 2008. Available online at http://www.report.basf.com/2008/en/servicepages/welcome.html. Last accessed 25/04/2015
- BASF (n.d.), BASF Report 2009. Available online at http://www.report.basf.com/2009/en/servicepages/welcome.html. Last accessed 25/04/2015
- BASF (n.d.), BASF Report 2010. Available online at http://www.report.basf.com/2010/en/servicepages/welcome.html. Last accessed 25/04/2015
- BASF (n.d.), BASF Report 2011. Available online at http://www.report.basf.com/2011/en/servicepages/welcome.html. Last accessed 25/04/2015
- Bayer (2002), Financial Report 2001. Available online at http://www.bayer.com/en/gb-2001-en.pdfx. Last accessed 25/04/2015
- Bayer (2003), Financial Report 2002. Available online at http://www.bayer.com/en/gb-2001-en.pdfx. Last accessed 25/04/2015
- Bayer (2004), Financial Report 2003. Available online at http://www.bayer.com/en/gb-2001-en.pdfx. Last accessed 25/04/2015
- Bayer (2005), Scienece for a better life - Annual Report 2004. Available online at http://www.bayer.com/en/gb-2001-en.pdfx. Last accessed 25/04/2015
- Bayer (2006), Scienece for a better life - Annual Report 2005. Available online at http://www.bayer.com/en/gb-2001-en.pdfx. Last accessed 25/04/2015
- Bayer (2007), Scienece for a better life - Annual Report 2006. Available online at http://www.bayer.com/en/gb-2001-en.pdfx. Last accessed 25/04/2015

- Bayer (2008), Scienece for a better life - Annual Report 2007. Available online at http://www.bayer.com/en/gb-2001-en.pdfx. Last accessed 25/04/2015
- Bayer (2009), Scienece for a better life - Annual Report 2008. Available online at http://www.bayer.com/en/gb-2001-en.pdfx. Last accessed 25/04/2015
- Bayer (2010), Scienece for a better life - Annual Report 2009. Available online at http://www.bayer.com/en/gb-2001-en.pdfx. Last accessed 25/04/2015
- Bayer (2011), Scienece for a better life - Annual Report 2010. Available online at http://www.bayer.com/en/gb-2001-en.pdfx. Last accessed 25/04/2015
- Bayer (2012), Scienece for a better life - Annual Report 2011. Available online at http://www.bayer.com/en/ar-2011.pdfx. Last accessed 25/04/2015
- Bayer (n.d.), Acquisitions and Divestitures. Available online at http://www.investor.bayer.de/en/bayer-group/ueberblick/acquisitions-and-divestitures/. Last accessed 05/05/2015
- BCC research. 2014. Compound Feeds and Additives: Global Markets
- Bellussi, G., Rispoli, G., Millini, R., and Pollesel, P. 2014. The Turning Point of the RefiningIndustry in Europe. Chemie Ingenieur Technik. DOI: 10.1002/cite.201400084
- Bloomberg (2015), Monsanto Is Said to Approach Syngenta Again About a Takeover. Available online at http://www.bloomberg.com/news/articles/2015-04-30/monsanto-is-said-to-approach-syngenta-again-about-a-takeover. Last accessed 05/05/2015
- Bloomberg (2015). Monsanto Is Said to Approach Syngenta Again About a Takeover. Available at http://www.bloomberg.com/news/articles/2015-04-30/monsanto-is-said-to-approach-syngenta-again-about-a-takeover. Last accessed on 05/05/2015
- Broering GmbH & Co. KG. (2015). Broering homepage - company description. Retrieved May 9, 2015, from http://www.broering.com/ueber_uns/ueberuns.php
- Current and Historical Rate Tables (n.d.), XE Currency Tables. Available online at http://www.xe.com/currencytables/. Last accessed 26/04/2015
- Current and Historical Rate Tables. XE Currency Tables. Available on http://www.xe.com/currencytables/#. Last accessed 26/04/2015
- de Gorter, H., Drabik, D., and Just, D.R. (2015). The Economics of Biofuel Policies: Impacts on Price Volatility in Grain and Oilseed Markets. Palgrave Studies in Agricultural Economics and Food Policy. Palgrave Macmillan, New York, 316 pages.
- Directorate General for Health and Consumers - EU ACTION ON PESTICIDES http://ec.europa.eu/food/plant/pesticides/eu_policy/docs/factsheet_pesticides_en.pdf
- Dow (2010), The Dow of Tomorrow Here Today. Available online at https://www.google.nl/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0CCIQFjAA&url=http%3A%2F%2Fwww.dow.com%2F~%2Fmedia%2FDowCom%2FCorporate%2FPDF%2Finvestor-relations%2FFinancialReporting%2FAnnualReports%2F2009%2520Annual%2520Report.ashx%3Fla%3Den-US&ei=aRNGVafMK83dav7HgPgG&usg=AFQjCNF4nF1C0xS1gDsDkB8AA0I-dspepg&sig2=P576Kc6-1ELuUFg2X8E8UQ&bvm=bv.92291466,d.d2s. Last accessed 25/04/2015
- Dow (2011), The Right Formula For Growth - Annual Report 2010. Available online at https://www.google.nl/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CCEQFjAA&url=http%3A%2F%2Fwww.dow.com%2F~%2Fmedia%2FDowCom%2FCorporate%2FPDF

%2Finvestor-relations%2FFinancialReporting%2FAnnualReports%2F2010_AR_with_10-K_update.ashx%3Fla%3Den-US&ei=3hNGVeX6KsvlaKXHgLgG&usg=AFQjCNHaLue2exqYhd34BN7yHAfzz5375w&sig2=Ow30_5-pRJCJUer2wJU4sg&bvm=bv.92291466,d.d2s. Last accesssed on 28/04/2015

- Dow (2012), Welcome to Solutionism - Annual Report 2011. Avaiblable on https://www.google.nl/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&ved=0CCoQFjAB&url=http%3A%2F%2Fwww.dow.com%2F~%2Fmedia%2FDowCom%2FCorporate%2FPDF%2Finvestor-relations%2FFinancialReporting%2FAnnualReports%2F2011_Annual_Report_Final.ashx%3Fla%3Den-US&ei=YBRGVc76EZHsaKfMgYAM&usg=AFQjCNFLTV_4omwYVsgDLL8iq6CRfIiJcw&sig2=NYB4TfDAJVcsxgxNMHBttA&bvm=bv.92291466,d.d2s. Last accessed 25/04/2015
- DuPont (2007), 2007 DuPont Databook. Available online at http://investors.dupont.com/files/doc_financials/2007/DuPont_2007_DataBook_CS2.pdf. Last accessed on 26/04/2015
- DuPont (2008), 2008 DuPont DataBook. Available online at http://investors.dupont.com/files/doc_financials/2008/CRP_DuPont_2008_DataBook.pdf. Last accessed 26/04/2015
- DuPont (2009), 2009 DuPont DataBook. Available online at http://investors.dupont.com/files/doc_financials/2009/CRP_DuPont_2009_DataBook.pdf. Last accessed 26/04/2015
- DuPont (2010), 2010 DuPont DataBook. Available online at http://investors.dupont.com/files/doc_financials/2010/Dupont_DataBook2010.pdf. Last accessed 26/04/2015
- DuPont (2011), 2011 DuPont DataBook. Available online at http://investors.dupont.com/files/doc_financials/2011/AR/CRP_DuPont_2011_DataBook.pdf. Last accessed 26/04/2015
- DuPont (n.d.), 2001 DuPont DataBook. Available online at http://www.slideshare.net/finance9/du-pont-2001-data-book. Last accessed 26/04/2015
- DuPont (n.d.), 2002 DuPont DataBook. Available online at http://www.slideshare.net/finance9/du-pont-2002-data-book. Last accessed 26/04/2015
- DuPont (n.d.), 2003 DuPont DataBook. Available online at http://www.slideshare.net/finance9/du-pont-2003-data-book. Last accessed 26/04/2015
- DuPont (n.d.), 2004 DuPont DataBook. Available online at http://www.slideshare.net/finance9/du-pont-2004-data-book. Last accessed 26/04/2015
- DuPont (n.d.), 2005 DuPont DataBook. Available online at http://www.slideshare.net/finance9/du-pont-2005-data-book. Last accessed 26/04/2015
- DuPont (n.d.), 2006 DuPont DataBook. Available online at http://www.slideshare.net/finance9/du-pont-2006-data-book. Last accessed 26/04/2015
- EcoNexus. 2013. Agropoly. A handful of corporations control world food production.
- ECPA (n.d.), Industry statistics. Available online at http://www.ecpa.eu/page/industry-statistics. Last accessed 30/04/2015
- ETC Group. (2013). Putting the Cartel before the Horse ...and Farm, Seeds, Soil, Peasants, etc. Who Will Control Agricultural Inputs, 2013?. Available online at

http://www.etcgroup.org/sites/www.etcgroup.org/files/CartelBeforeHorse11Sep2013.pdf. Last accessed 06/05/2015.

- Eurochem (2006), Annual Report 2005. Available online at http://www.eurochemgroup.com/wp-content/uploads/2005/01/EurochemAR05.pdf. Last accessed 06/05/2015.
- Eurochem (2008), Annual Report 2007. Available online at http://www.eurochemgroup.com/wp-content/uploads/2013/01/EurochemAR07.pdf. Last accessed 06/05/2015.
- Eurochem (2009), Annual Report and Accounts 2008. Available online at http://www.eurochemgroup.com/wp-content/uploads/2013/01/EurochemAR08.pdf. Last accessed 06/05/2015.
- Eurochem (2010), Annual Report and Accounts 2009. Available online at http://www.eurochemgroup.com/wp-content/uploads/2009/01/EuroChem_Annual_Report_2009.pdf. Last accessed 06/05/2015.
- Eurochem (2011), Annual Report and Accounts 2010. Available online at http://www.eurochemgroup.com/wp-content/uploads/2010/01/EurochemAR10.pdf. Last accessed 06/05/2015.
- Eurochem (2012), Annual Report and Accounts 2011. Available online at http://www.eurochem.ru/wp-content/uploads/2012/05/1.0_EuroChem-Annual-Report-2011_eng.pdf. Last accessed 06/05/2015.
- Eurochem (2013), Annual Report and Accounts 2012. Available online at http://ar.eurochem.ru/wp-content/uploads/sites/2/2013/05/EuroChem_Annual_Report_2012_eng.pdf. Last accessed 06/05/2015.
- European Commission (2010) IP/10/1630. Available online at http://europa.eu/rapid/press-release_IP-10-1630_en.htm?locale=en. Last accessed 05/05/2015
- European Commission. (2001). Commission authorises Cargill to acquire Agribrands International [Press release]. Retrieved from http://europa.eu/rapid/press-release_IP-01-232_en.htm
- European Commission. (2010). List of NACE codes. from http://ec.europa.eu/competition/mergers/cases/index/nace_all.html
- European Commission. (2012). Case No COMP/M.6468 - Forfarmers/Hentrix.
- European Crop Protection Association. 2012 Industry Statistics – EU 15 Total. Available at http://www.ecpa.eu/information-page/industry-statistics-eu-15-total
- European Crop Protection Association – ECPA. Industry statistics. Various years. Available on http://www.ecpa.eu/page/industry-statistics. Last accessed on 30/04/2015
- European Parliament. 2013. "The EU seed and plant reproductive material market in perspective. Focus on companies and market shares". DG for Internal Policies. Policy department B: Structural and Cohesion policies. Agriculture and Rural Development
- EUROSTAT. 2012. Agro-Environmental indicators. Consumption of Pesticides.
- EUROSTAT. 2012. Agro-Environmental indicators. Minerals and fertilizers Consumption.

- EUROSTAT. 2014a. Agricultural accounts and prices. Figure 2. http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Agricultural_accounts_and_prices
- EUROSTAT. 2014b. Final energy consumption by sector. http://epp.eurostat.ec.europa.eu/tgm/refreshTableAction.do?tab=table&plugin=1&pcode=tsdpc320&language=en
- EUROSTAT. 2014c. Agri-environmental indicator - energy use. http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Agri-environmental_indicator_-_energy_use
- EUROSTAT. 2014d. Natural gas market indicators. http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Natural_gas_market_indicators
- EUROSTAT. 2014e. Electricity market indicators http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Electricity_market_indicators
- Eurostat. (2015). Annual detailed enterprise statistics for industry (NACE Rev. 2, B-E). Retrieved May 8, 2015 http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=sbs_na_ind_r2&lang=en
- Eurostat Glossary http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Glossary
- Eurostat Structural Business Statistics. Various years. Avialable at http://ec.europa.eu/eurostat/web/structural-business-statistics. Last accessed 05/05/2015
- FAO. 2011. Current world fertilizer trends and outlook to 2015. Available at ftp://ftp.fao.org/ag/agp/docs/cwfto15.pdf
- FEFAC (2012), Feed & Food Statistical Yearbook 2012
- Feed International. (2014). Leeding feed producers ranked by volume. from http://www.wattagnet.com/FeedTable.html
- FEFAC. (2013). Feed & food - Statistical Yearbook 2013.
- FEFAC. (2015). Compound Feed Production (1998-2013). from http://www.fefac.eu/publications.aspx?CategoryID=2061&EntryID=10802
- Fernandez-Cornejo, J, R. Nehring, C. Osteen, S. Wechsler, A. Martin, and A. Vialou 2014. Pesticide Use in U.S. Agriculture: 21 Selected Crops, 1960-2008, EIB-124, U.S. Department of Agriculture, Economic Research Service, May 2014.
- Fertiberia S.A. (2009), Annual Report 2008. Available online at http://docs.grupovillarmir.es/portals/0/ebook/fit/08-ing/index.html. Last accessed 06/05/2015.
- Fertiberia S.A. (2010), Annual Report 2009. Available online at http://docs.grupovillarmir.es/portals/0/ebook/fit/09-ing/index.html. Last accessed 06/05/2015.
- Fertiberia S.A. (2011), Annual Report 2010. Available online at http://docs.grupovillarmir.es/portals/0/ebook/fit/10-ing/index.html. Last accessed 06/05/2015.
- Fertiberia S.A. (2012), Annual Report 2011. Available online at http://docs.grupovillarmir.es/portals/0/ebook/fit/11-ing/index.html#/1. Last accessed 06/05/2015.
- Fertiberia S.A. (2013), Annual Report 2012. Available online at http://acm2.fertiberia.es/ACM2_upload/4-Innovacion-y-

sostenibilidad/Publicaciones/FERTIBERIA_ANNUAL_REPORT_2012.pdf. Last accessed 06/05/2015.

- Fertiberia S.A. (2013), Annual Report 2012. Available online at http://acm2.fertiberia.es/ACM2_upload/4-Innovacion-y-sostenibilidad/Publicaciones/FERTIBERIA_ANNUAL_REPORT_2012.pdf. Last accessed 06/05/2015.
- ForFarmers. (2012). Company report. from http://www.forfarmers.eu/Download.aspx?File=LrkFH94k9gW3GrQUTindons%2BlwG0%2BNmLXKHZOSF9ApCQ9gB%2Fqe73MHOVSUPrArLK
- Fuglie, K., P. Heisey, J King, and D Schimmelpfennig. 2012. Rising Concentration in Agricultural Input Industries Influences new Farm Technologies. Amber Waves, 10(4); 6 pages. VOL10, ISSUE 4
- Gnutzmann, H., and Spiewanowski, P. 2014. Did the Fertilizer Cartel Cause the Food Crisis? http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2534753
- Grupa Azoty S.A. Group (2009), Consolidated financial statements for the period of 12 months ending on 31 December 2008. Available online at http://static.grupaazoty.com/files/1349268584/1330880530consolidated_annual_financial_statements_2008.pdf. Last accessed 06/05/2015.
- Grupa Azoty S.A. Group (2010), Consolidated financial statements for the period of 12 months ending on 31 December 2009. Available online at http://static.grupaazoty.com/files/1349268374/1330881607consolidated_financial_statement_rs2009.pdf. Last accessed 06/05/2015.
- Grupa Azoty S.A. Group (2011), Annual Report 2010. Available online at http://grupaazoty.com/doc/1332765158/annual_report_2010_en.pdf. Last accessed 06/05/2015.
- Grupa Azoty S.A. Group (2012), 2011 Consolidated Annual Report. Available online at http://grupaazoty.com/doc/1332765218/annual_report_2011_en.pdf. Last accessed 06/05/2015.
- Grupa Azoty S.A. Group (2013), 2012 Grupa Azoty Consolidated Annual Report. Available online at http://static.grupaazoty.com/files/1365585447/raport_grupa_azoty_za_2012_en_issuu.pdf. Last accessed 06/05/2015.
- Heffer P. and M. Prud'Homme. 2014. Fertilizer Outlook 2014-2018. Available at http://www.fertilizer.org
- Hernandez M.A. and M. Torero. 2013. Market concentration and pricing behavior in the fertilizer industry: a global approach. Agricultural Economics 44: 723–734
- International Feed Industry Federation (2013), Annual Report 2012/13
- International Fertilizer Industry Association – IFADATA. Various Years. Historical production, trade and consumption statistics. Available online at http://www.fertilizer.org/statistics. Last accessed 06/05/2015.
- Israel Chemicals Ltd (2006), Periodic Report for the period ended December 31, 2005. Available online at
- http://repo.icl-group.com/Lists/ReportsManagement/Financial%20Reports/2005/Periodic%20Report%20Description%20of%20Corporate%20Activity%20-%20December%2031,%202005.pdf. Last accessed 04/05/2015.
- Israel Chemicals Ltd (2007), Periodic Report for the period ended December 31, 2006. Available online at

http://repo.icl-group.com/Lists/ReportsManagement/Financial%20Reports/2006/Periodic%20Report%20Description%20of%20Corporate%20Activity%20-%20December%2031,%202006.pdf. Last accessed 04/05/2015.

- Israel Chemicals Ltd (2008), Periodic Report for 2007. Available online at http://repo.icl-group.com/Lists/ReportsManagement/Financial%20Reports/2007/Periodic%20Report%20Description%20of%20Corporate%20Activity%20-%20December%2031,%202007.pdf. Last accessed 04/05/2015.
- Israel Chemicals Ltd (2009), Periodic Report for 2008. Available online at http://repo.icl-group.com/Lists/ReportsManagement/Financial%20Reports/2008/Periodic%20Report%20Description%20of%20Corporate%20Activity%20-%20December%2031,%202008.pdf. Last accessed 04/05/2015.
- Israel Chemicals Ltd (2010), Periodic Report for 2009. Available online at http://repo.icl-group.com/Lists/ReportsManagement/Financial%20Reports/2009/Annual%20Report%20-%202009.pdf. Last accessed 04/05/2015.
- Israel Chemicals Ltd (2011), Periodic Report for 2010. Available online at http://repo.icl-group.com/Lists/ReportsManagement/Financial%20Reports/2010/Annual%20Report%20-%202010.pdf. Last accessed 04/05/2015.
- Israel Chemicals Ltd (2012), Periodic Report for 2011. Available online at http://repo.icl-group.com/Lists/ReportsManagement/Financial%20Reports/2011/Annual%20Report%202011.pdf. Last accessed 04/05/2015.
- Israel Chemicals Ltd (2013), Periodic Report for 2012. Available online at http://repo.icl-group.com/Lists/ReportsManagement/Financial%20Reports/2012/Annual%20Report%202012.pdf.pdf. Last accessed 04/05/2015.
- K+S Group (2006), Financial Report 2005. Available online at http://www.k-plus-s.com/en/pdf/2005/geschaeftsbericht.pdf. Last accessed 03/05/2015.
- K+S Group (2007), Financial Report 2006. Available online at http://www.k-plus-s.com/en/pdf/2006/geschaeftsbericht.pdf. Last accessed 03/05/2015.
- K+S Group (2008), Financial Report 2007. Available online at http://www.k-plus-s.com/en/pdf/2007/fb2007.pdf. Last accessed 03/05/2015.
- K+S Group (2009), Financial Report 2008. Available online at http://www.k-plus-s.com/en/pdf/2008/fb2008.pdf. Last accessed 03/05/2015.
- K+S Group (2010), Financial Report 2009. Available online at http://www.k-plus-s.com/en/pdf/2009/fb2009.pdf. Last accessed 03/05/2015.
- K+S Group (2011), Financial Report 2010. Available online at http://www.k-plus-s.com/en/pdf/2010/fb2010.pdf. Last accessed 03/05/2015.
- K+S Group (2012), Financial Report 2011. Available online at http://www.k-plus-s.com/en/pdf/2011/fb2011.pdf. Last accessed 03/05/2015.
- K+S Group (2013), Financial Report 2012. Available online at http://www.k-plus-s.com/en/pdf/2012/fb2012.pdf. Last accessed 03/05/2015.
- Lopez, R.; A. Azzam and C. Liron Espana. 2002. Market Power and/or Efficiency: A Structural Approach. Review of Industrial Organization 20: 115–126.
- Mammana, I. (2014), Concentration of the market power in the EU seed market. Study commissioned by the Green/EFA Group in the European Parliament
- Micromarket monitor (2014), Global Animal Feed Market Research Report, forthcoming December
- Monsanto (2002), 2001 Annual Report. Available online at https://bib.kuleuven.be/files/ebib/jaarverslagen/Monsanto_2001.pdf. Last accessed 23/04/2015

- Monsanto (2003), 2002 Annual Report. Available online at https://bib.kuleuven.be/files/ebib/jaarverslagen/Monsanto_2002.pdf. Last accessed 23/04/2015
- Monsanto (2004), 2003 Annual Report. Available online at https://bib.kuleuven.be/files/ebib/jaarverslagen/Monsanto_2003.pdf. Last accessed 23/04/2015
- Monsanto (2005), 2004 Annual Report. Available online at https://bib.kuleuven.be/files/ebib/jaarverslagen/Monsanto_2004.pdf. Last accessed 23/04/2015
- Monsanto (2006), 2005 Annual Report. Available online at http://www.monsanto.com/investors/documents/pubs/2005/mon_2005_annual_report.pdf . Last accessed 23/04/2015
- Monsanto (2007), 2006 Annual Report. Available online at http://www.monsanto.com/investors/documents/pubs/2006/2006annualreport.pdf. Last accessed
- Monsanto (2008), 2007 Annual Report. Available online at http://www.monsanto.com/investors/documents/pubs/2007/2007annualreport.pdf. Last accessed 23/04/2015
- Monsanto (2009), 2008 Annual Report. Available online at http://www.monsanto.com/investors/documents/pubs/2008/annual_report.pdf. Last accessed 23/04/2015
- Monsanto (2010), 2009 Annual Report. Available online at http://www.monsanto.com/investors/documents/pubs/2009/annual_report.pdf. Last accessed 23/04/2015
- Monsanto (2011), 2010 Annual Report. Available online at http://www.monsanto.com/investors/documents/pubs/2010/annual_report.pdf. Last accessed 23/04/2015
- Monsanto (2012), Form 10-K. Available online at http://www.monsanto.com/investors/documents/annual%20report/monsanto_2011_10-k.pdf. Last accessed 23/04/2015
- Orascom Construction Industries (2012), Annual Report and Accounts 2011. Available online at http://www.dmicreative.com/media/article/attachments/AR2011.pdf. Last accessed 06/05/2015.
- Pesticides Action Network Europe. 2012. Is the Pesticide Industry really serious about their slogan? Available a http://www.pan-europe.info/Resources/Briefings/PANE%20-%202013%20%20Is%20the%20Pesticide%20Industry%20really%20serious%20about%20their%20slogan.pdf
- Phillips McDougall Consulting. 2013.http://www.ecpa.eu/files/attachments/R_and_D_study_2013_v1.8_webVersion_Final.pdf
- Platts. 2014. European Refining Faces New Wave of Refinery Closures.http://www.platts.com/latest-news/oil/paris/feature-european-refining-faces-new-wave-of-refinery-26820986
- Rabobank International. (2015). Report: DSM - Nutreco - ForFarmers. Feed the World.
- Shi, G., J.P. Chavas and K. Stiegert. 2010. An Analysis of the Pricing of Traits in the U.S. Corn Seed Market. American Journal of Agricultural Economics 92(5): 1324-1338.
- Statita (2015), “Produktionsmenge von Pestiziden und sonstigen Pflanzenschutzmitteln in Deutschland in den Jahren 1998 bis 2009 (in Tonnen)”. Available online at

http://de.statista.com/statistik/daten/studie/154671/umfrage/entwicklung-der-produktion-von-pestiziden-in-deutschland/. Last accessed 05/05/2015

- StreetInsider (2014), Syngenta (SYT) May Be Targeted by Acquirer or Activist Shareholder, Says Deutsche Bank Available online at http://www.streetinsider.com/Analyst+Comments/Syngenta+(SYT)+May+Be+Targeted+by+Acquirer+or+Activist+Shareholder,+Says+Deutsche+Bank/9876890.html. Last accessed 05/05/2015
- StreetInsider (2014). Syngenta (SYT) May Be Targeted by Acquirer or Activist Shareholder, Says Deutsche Bank Available at http://www.streetinsider.com/Analyst+Comments/Syngenta+(SYT)+May+Be+Targeted+by+Acquirer+or+Activist+Shareholder,+Says+Deutsche+Bank/9876890.html. Last accessed on 05/05/2015
- Sutton J. 1991. Sunk Cost and Market Structure. Price Competition, Advertising and the Evolution of Concentration. MIT Press.
- Syngenta (2002), Syngenta - Financial Report 2001. Available http://www.syngenta.com/global/corporate/en/investor-relations/financial-information-and-presentations/Pages/annual-reports.aspx. Last accessed 28/04/2015
- Syngenta (2003), Syngenta - Financial Report 2002. Available http://www.syngenta.com/global/corporate/en/investor-relations/financial-information-and-presentations/Pages/annual-reports.aspx. Last accessed 28/04/2015
- Syngenta (2004), Syngenta - Financial Report 2003. Available http://www.syngenta.com/global/corporate/en/investor-relations/financial-information-and-presentations/Pages/annual-reports.aspx. Last accessed 28/04/2015
- Syngenta (2005), Syngenta - Financial Report 2004. Available http://www.syngenta.com/global/corporate/en/investor-relations/financial-information-and-presentations/Pages/annual-reports.aspx. Last accessed 28/04/2015
- Syngenta (2006), Syngenta - Financial Report 2005. Available http://www.syngenta.com/global/corporate/en/investor-relations/financial-information-and-presentations/Pages/annual-reports.aspx. Last accessed 28/04/2015
- Syngenta (2007), Syngenta - Financial Report 2006. Available http://www.syngenta.com/global/corporate/en/investor-relations/financial-information-and-presentations/Pages/annual-reports.aspx. Last accessed 28/04/2015
- Syngenta (2008), Syngenta - Financial Report 2007. Available http://www.syngenta.com/global/corporate/en/investor-relations/financial-information-and-presentations/Pages/annual-reports.aspx. Last accessed 28/04/2015
- Syngenta (2009) Syngenta acquires innovative bio-control technology to improve usable crop yields. Available online at http://www.syngenta.com/global/corporate/en/news-center/news-releases/Pages/en-090611.aspx. Last accessed 05/05/2015
- Syngenta (2009), Syngenta - Financial Report 2008. Available http://www.syngenta.com/global/corporate/en/investor-relations/financial-information-and-presentations/Pages/annual-reports.aspx. Last accessed 28/04/2015
- Syngenta (2010), Syngenta - Financial Report 2009. Available at http://www.syngenta.com/global/corporate/en/investor-relations/financial-information-and-presentations/Pages/annual-reports.aspx. Last accessed 28/04/2015
- Syngenta (2011), Syngenta - Financial Report 2010. Available at http://www.syngenta.com/global/corporate/en/investor-relations/financial-information-and-presentations/Pages/annual-reports.aspx. Last accessed 28/04/2015

- Syngenta (2012), Syngenta - Financial Report 2011. Available ay http://www.syngenta.com/global/corporate/en/investor-relations/financial-information-and-presentations/Pages/annual-reports.aspx. Last accessed 28/04/2015
- Syngenta (2012), Syngenta signs global commercial agreement with Novozymes. Available online at http://www.syngenta.com/global/corporate/en/news-center/news-releases/Pages/121026.aspx. Last accessed 05/05/2015
- The Crop Site. (2011) EU Fertilizer Market to grow to Euros 15.3 Billion by 2018. Available at http://www.thecropsite.com/news/9677/eu-fertilizer-market-to-grow-to-153-billion-by-2018
- Uralkali Group (2008), Annual Report 2007. Available online at http://www.uralkali.com/upload/iblock/2cd/Uralkali_AR_2007_Eng.pdf. Last accessed 04/05/2015.
- Uralkali Group (2009), Annual Report 2008. Available online at http://www.uralkali.com/upload/iblock/865/Uralkali_AR_2008_Eng.pdf. Last accessed 04/05/2015.
- Uralkali Group (2010), Annual Report 2009. Available online at http://www.uralkali.com/upload/iblock/c06/Uralkali_AR_2009_Eng.pdf. Last accessed 04/05/2015.
- Uralkali Group (2011), Annual Report 2010. Available online at http://www.uralkali.com/upload/iblock/6d9/Uralkali_AR_2010_Eng.pdf. Last accessed 04/05/2015.
- Uralkali Group (2012), Integrated Report and Accounts 2011. Available online at http://www.uralkali.com/upload/iblock/2d9/SD_Report_11_09.pdf. Last accessed 04/05/2015.
- Uralkali Group (2013), Integrated Report and Accounts 2012. Available online at http://www.uralkali.com/upload/iblock/53e/UralkaliAR2012_ENG.pdf. Last accessed 04/05/2015.
- Uralkali Group (2013), Integrated Report and Accounts 2012. Available online at http://www.uralkali.com/upload/iblock/53e/UralkaliAR2012_ENG.pdf. Last accessed 04/05/2015.
- U.S. Department of Justice. (2010). Horizontal Merger Guidelines.
- Yara International (2006), Annual Report 2005. Available online at http://www.yara.com/doc/2886_Yara_Annual_Report_2005.pdf. Last accessed 03/05/2015.
- Yara International (2007), Annual Report 2006. Available online at http://www.yara.com/doc/2881_yara_annual_report_2006_en.pdf. Last accessed 03/05/2015.
- Yara International (2008), Financial Review 2007. Available online at http://www.yara.com/doc/2873_Yara_Annual_Report_2007_EN.pdf. Last accessed 03/05/2015.
- Yara International (2009), Financial Review 2008. Available online at http://www.yara.com/doc/3743_Financial_review_2008.pdf. Last accessed 03/05/2015.
- Yara International ASA (2010), Yara Financial Report2009. Available online at http://www.yara.com/doc/28899_Yara_Financial_Report_2009.pdf. Last accessed 03/05/2015.
- Yara International ASA (2011), Yara Financial Report 2010.Available online at http://www.yara.com/doc/36562_Annual%20report%202010.pdf. Last accessed 03/05/2015.

- Yara International ASA (2012), Yara Financial Report 2011. Available online at http://www.yara.com/doc/38652_Financialreport2011.pdf. Last accessed 03/05/2015.
- Yara International ASA (2013), Yara Financial Report 2012. Available online at http://www.yara.com/doc/64851_Yara%20FR%20komplett.pdf. Last accessed 03/05/2015.

ANNEXES

ANNEX 1: SEED AND PLANTING MATERIAL STUDY

Table A1.1 Notes on the calculation of the data for the world seed market

Company	Description
DOW	2010 data are based on the reported increase in the ag sector of more than 30% in 2011
	2011 data based on the 19% share of seeds, traist, and oils in ag science
	2012 data based on the 21% share of seeds, traist, and oils in ag science
	2013 data based on the 23% share of seeds, traist, and oils in ag science
	2014 data based on the 22% share of seeds, traist, and oils in ag science
DLF	Data for 2010 to 2012 calculated as 95% from revenues
DuPomt Pioneer	2014 seed sales are 22 per cent of DuPont net sales
	2013 seed sales are 23 per cent of DuPont net sales
	2012 seed sales are 21 per cent of DuPont net sales
	2011 seed sales are 16 per cent of DuPont net sales
	2010 seed sales are 17 per cent of DuPont net sales
Winfield	2010 to 14 net sales crop inputs were used and a share of the seed market of 1300/4734
World seed market	Number for 2014 is the projected trend of 2010 to 2013

Table A1.2 Notes on the calculation of the data for the European seed market

Company	Description
Bayer Crop Science	reported sales in the bioscience section
	2011 data are based on an increase of 6.9% in the field of crop science as detailed data on the European seed sector have not been reported.
	2012 data estimated by a 14.1% increase in global seeds sales as reported in the annual report
	2013 Bayer reported a decline but numbers had not been provided. The same number as for 2012 has been used which is an overestimation on sales
	2014 Bayer reported an increase of about 7.4% for the European market as an average of the crop science sector including seeds.
Dupont	2010: calculated as 2011/1.22 as the sales in EMEA increased from 2010 by 22%.
	2011: share of the EMEA on net sales (10/38=0.26)used to calculate EMEA shares on seeds
	2011: share of the EMEA on net sales of 0.24 was assumed
	2013: share of the EMEA on net sales (8.4/35.7=0.24)used to calculate EMEA shares on seeds
	2014: share of the EMEA on net sales (8.5/34.7=0.24)used to calculate EMEA shares on seeds
Monsanto	2014 seed sales in Europe were calculated based on the average percentage of seed sales on total sales (10740/15855=0.68) times the total sales in Europe
	2013 seed sales in Europe were calculated based on the average percentage of seed sales on total sales (10340/14861=0.66) times the total sales in Europe
	2012 seed sales in Europe were calculated based on the average percentage of seed sales on total sales (9789/13504=0.72) times the total sales in Europe
	2011 seed sales in Europe were calculated based on the average percentage of seed sales on total sales (8582/11822=0.73) times the total sales in Europe
	2010 seed sales in Europe were calculated based on the average percentage of seed sales on total sales (7611/10502=0.72) times the total sales in Europe
Syngenta (dollar)	Region: Europe, Africa, and Middle East
Vilmorin	2010 share field seeds calculated form the 15% increase report for 2011 and a 0.38 share for vegetables
	2011 share for vegetables based on the 0.38 share of 2012
	2012 share Europe based on percent of world share
	2013 share based on percent of world share (page 4-5)
	2014 share for field seeds based on company report, share vegetables calculated as 1418.7*0.53 (share of EU sales) - 563.5 (sales of field seeds in Europe)
Sakata	2014: share Europe, Middle and Near East 8650/53922=0.1604
	2013: share Europe, Middle and Near East 6792/50274=0.1351
	2012: share Europe, Middle and Near East 5611/46988=0.1194
	2011: share Europe, Middle and Near East 5679/47165=0.1204
	2011: share Europe, Middle and Near East 5656/46518=0.1216

DLF	2013 and 2014 Seed sales calculated from worldwide seed sales times the share of all sales in Europe
	2010 to 2012 seed sales for Europe calculated by the average overall share in sales for 2013 and 2014 in Europe
DOW	data for Europe is the Europe, Middle East, Africa, and India region
	2014: 34% sales in EMEAI, 19671 million dollars
	2013: % sales in EMEAI
	2012: sales in EMEA
	2011: % sales in EMEA
	2010: % sales in EMEA

Table A1.3: Average annual exchange rates used to convert different currencies

	2010	2011	2012	2013	2014
USD to EUR	0.785	0.748	0.809	0.783	0.784
USD to YEN	91.342	82.931	83.008	101.517	110.101
YEN to EUR	0.008594	0.00902	0.009746	0.007713	0.007121
USD to DKK	5.847	5.571	6.025	5.843	5.844
DKK to EUR	0.134257	0.134267	0.134274	0.134007	0.134155

Source: http://www.irs.gov/Individuals/International-Taxpayers/Yearly-Average-Currency-Exchange-Rates

Table A1.4: Concentration in the European sugar beet, maize, and tomato seed market

Company	Headquarter	Sugar Beet (2013–2014)	Maize (2013–2014)	Tomato[2]
Bayer Crop Science	Germany	39	19	4
Betaseed	US	3		
Desprez	France	5		
KWS	Germany			
Maribo	Denmark	4		
Monsanto	United States		15	20
DuPont/Pioneer Hi-Breed	United States		22	
Rijkzwaan	Netherlands			4
SES Van der Have[1]	Netherlands/ France	22		
Strube	Germany	18		
Syngenta	Switzerland	8		9
Vilmorin	France		13	9
Others		1	25	55
CR3 (%)		79	56	37
CR5 (%)		92	75	45
HHI		2444	1425	783

Source: Based on a report by KWS (2015) for sugar beet and maize and Mammana (2014) for tomato.
Note: [1]Since 2005 part of Desprez. If SES van der Have and Desprez considered to be one company, the CR3 increases to 84% and the HHI to 2664. [2]The market share for tomato is based on the share of seed varieties owned and not sales.

Table A1.5 Mergers and acquisitions in the seed market

Company	Year	Company	Country	Product
Bayer Crop Science	2011	Hornbeck Seed Company	United States	Company supplies soybean, rice, and wheat varieties in the southern United States and has an in-house soybean breeding program and a proprietary soybean germplasm.
	2011	Raps GbR	Germany	Acquired the oilseed rape seed business of Raps GbR
	2012	Abbotts & Cobb Inc.	United States	acquired the watermelon and melon seed business
	2012	AgraQuest, Inc.,	United States	global supplier of innovative biological pest management solutions based on natural microorganisms
	2013	PROPHYTA Biologischer Pflanzenschutz GmbH	Germany	supplier of biological crop protection products
	2013	Wehrtec Tecnologia Agricola Ltda.	Brazil	Soybean seed production
	2013	Agricola Wehrmann Ltda.	Brazil	Soybean business of the company acquired
	2013	FN Semillas S.A.	Argentina	Start-up breeding, production and marketing of improved soybean seeds in Argentina
	2014	Biagro Group	Argentina	Acquired company specialized in biological seed treatment solutions
	2014	Granar s.a.	Paraguay	Acquisition of the seeds business of Granar s.a., specialized in soybeans for tropical regions
	2014	E. I. DuPont de Nemours and Company	United States	Provides access to the growing forestry and range & pasture business segments in North America
KWS AG	2011	Kenfeng KWS	China	Joint venture for maize seeds

	2012	KWS Potato B.V.	Netherlands	Completing full acquisition of 50:50 joint venture Van Rijn - KWS B.V. for seed potatoes
	2012	KWS BRASIL PESQUISA & SEMENTES LTDA	Brazil	Two seed companies SEMÍLIA und DELTA acquired for soybean and maize seed market
	2102	RIBER–KWS SEMENTES S.A.,	Brazil	Acquired majority share of the RIBER seed company, soybean and maize market
	2013	Genective	France	Joint venture between KWS and Vilmorin on transgenic maize research
	2014	KWS Momont	France	Complete acquisition of Momont (grain, osr, peas, maize, and fodder beets). A joint venture since 1999.
Monsanto	2010	Anasac	Chile	Acquired a corn and soybean processing plant from Anasac in Paine. Chile
	2011	Pannon Seeds	Hungary	Seed processing plant
	2011	Divergence, Inc.,	United States	Biotechnology Company
	2012	Beeologics	Israel	Start-up developing biological tools to provide targeted control of pests and diseases
	2012	Precision Planting, Inc.	United States	Planting technology developer
	2013	The Climate Corporation	United States	Weather data analysis
	2013	Dieckmann GmbH & CO. KG	Germany	Breeding of oilseed rape and rye seeds
	2013	Grass Roots Biotechnology	United States	Gene expression and other agriculture technologies
	2013	Rosetta Green Ltd	Israel	Identification and use of unique genes to guide key processes in major crops including corn, soybeans and cotton
	2013	Agradis, Inc.	United States	biological products
	2014	BioAgAllicance	United States	Alliance launched together with Novozyme to work on microbial

				solutions
Syngenta (dollar)	2010	Maribo	Denmark	Acquisition of the Maribo® sugar beet seeds business from Nordic Sugar
	2010	Monsanto	United States	Acquisition of Monsanto's global sunflower business completed
	2012	Devgen	Belgium	Developing hybrid Rice
	2012	Pasteuria Biosciences, Inc	United States	developing bacterial products to combat nematodes
	2012	Novozyme	Denmark	developing microbial-based biofungicides to combat fungal diseases
	2012	Sunfield Seeds	United States	Sunflower seeds production and processing
	2102	DuPont	United States	DuPont Professional Products insecticide business, professional turf, ornamentals and home pest control
	2013	MRI Seed Zambia Ltd and MRI Agro Zambia Ltd,	Zambia	developer, producer and distributor of white corn seed
	2014	Lantmännen	Sweden	Lantmännen's winter wheat and oilseed rape germplasm in Germany and Poland to support development of hybrid cereals world wide
	2014	Società Produttori Sementi (PSB),	Italy	Durum wheat breeding and pasta production
DOW	2010	Grand Valley Hybrids	United States	Seed company: corn, alfalfa, forage sorghums, sudan grasses
	2012	Barenbrug Holding B.V.	Netherlands	Specialized in grasses
	2012	Cal/West Seeds	US	Forage breeding and seed production
	2014	Cooperativa Central de Pesquisa Agrícola's	Brazil	expected to advance the development of soybean program and strengthen the position in the corn market segment

Dupont	2013	Pannar Seed Limited	South Africa	one of the largest field crop seed producers and suppliers in Africa
	2011	Danisco	Denmark	Research and development in biotechnology
	2013	Solae LLC	United States	Soy ingredient supply, DuPont required the remaining 28% share from Bunge
Vilmorin Annual Report 2013-14	2010	SuTarim	Turkey	Vegetable Seeds
	2010	Trinity Growers	UK	Vegetable Seeds
	2010	Mesa Maize	United States	Vegetable Seeds
	2010	Trio Research	United States	Field Seeds
	2010	Sementes Guerra	Brazil	Maize assets included in Limagrain Guerra do Brasil
	2010	Brasmilho	Brazil	Maize and sorghum seeds, 100% acquisition completed in 2012
	2010	Atash Seeds	India	Bought additional 38.74% share
	2010	Trigen Seeds	United States	Wheat research program bought
	2010	Arcadia Biosciences	United States	Field Seeds
	2010	BSF Ag Research	United States	Field seeds
	2010	Genesis Seed Research	United States	Field seeds
	2010	Clovis Matton	Belgium	Field seeds
	2011	VCC Japan	Japan	
	2012	Boreal Plant Breeding	Finland	Partnership, breeding of field seeds for Northern Europe
	2012	Genetica Agricola	Brazil	Field seeds
	2012	Campbell Soup Group	United States	Tomato and pepper breeding and sales business
	2012	Century Seeds	India	Vegetable seeds
	2012	Eurodur	France	Field seeds
	2013	Link Seed	South Africa	Maize seeds
	2013	Bisco Bio Sciences	India	Corn, sorghum, millet, and rice

	2013	Geneseed	Brazil	Field seeds
	2013	KSP	Brazil	Field seeds
	2013	CCGL	Brazil	Field seeds
	2013	Shamrock	US and Mexico	Vegetable seeds
	2013	Eureka Seeds	United States	Field seeds
	2014	Seed Co	Zimbabwe	Field seeds
	2014	Seed Asia	Thailand	Field seeds
	2014	Greenland	Poland	Garden Products
DLF	2012	Jensen Seeds A/S	Denmark	Vegetable seeds
	2013	Pickseed	Canada	Production and distribution of turf and forage seeds
	2014	Jenks Seed Connection	United States	Grass seeds
Winfields	2010	Ester	United States	Wholesale distributor of agriculture, range and pasture, and specialty crop protection
	2010	Agriliance de Mexico	Mexico	Distributor of agriculture seeds and crop protection
	2011	Global Seed Genetics, S.A.	Mexico	Development of proprietary conventional tropical corn seeds
	2011	La Crosse Forage and Turf Seed	United States	Partnership, forage and turf seed
	2013	Matrix Turf Solution	United States	Golf course turf and landscape maintenance
	2013	GeoSys	France	Provision of geographic information systems
	2015	Precision Turf & Chemical	United States	Agronomic and specialty products for golf courses, parks, recreation departments, and commercial property

ANNEX 2: FEED STUDY

The Netherlands

In The Netherlands, 72 companies produced 13.6 million metric tons of compound feed in 2013. Of these companies three produce 60% of the total compound feed production, 18 medium-sized firms ranging from 0.06 to 0.50 Mt produced 30% and 50 small businesses produced 10% (ForFarmers 2012).

Table A2.1: Major compound feed producers with headquarters in The Netherlands

Company	Volume (Mt.)
ForFarmers	6.39
Agrifirm	4.11
De Heus Animal Nutrition	4.10 ('12)
AgruniekRijnvallei	0.60
Boerenbond Deurne	0.54
Total	15.05*

Source: Data from Rabobank International (2015) and company reports
Note: * The total production volume of the companies with headquarters in The Netherlands is produced in several countries.

ForFarmers

ForFarmers is the largest player with EU production of 6.39 Mt which amounts to 4.1% of total EU-27 compound feed. More than 3.64 Mt are produced in The Netherlands, Germany, and Belgium. Another more than 2.28 Mt are produced in the UK. ForFarmers acquired some important players within the last year. In their company report, ForFarmers write: "In 2012, ForFarmers has acquired the Hendrix nutrition business in The Netherlands, Belgium, and Germany from Nutreco and the BOCM Pauls business in the UK. These two acquisitions add €1.3 billion to the group's turnover, which therefore amounts to €6.5 billion on a pro-forma basis." (ForFarmers 2012).

Table A2.2: Sales and turnover of ForFarmers

	2009	2010	2011	2012	2012*	2013
Compound feed sales (Mt)	2.22	2.38	2.48	4.89	6.25	6.39
Total animal feed sales (Mt)	2.70	2.85	3.05	6.62	8.62	8.55
Turnover (billion euros)	1.95	4.16	5.22	6.62	2.56	2.62

Source: ForFarmers (2012)
Note: * The 2012 pro forma figures include the ForFarmers results for the full year, as if the 2012 transactions (acquisition of Hendrix and BOCM PAULS and sale of Cefetra[42] and Probroed[43]) had happened on 1 January 2012. This means that the results of the Hendix and BOCM PAULS acquisitions are included over the whole of 2012 and that the results of the entities sold during the year (Cefetra and Probroed) have been eliminated over the whole of 2012.

[42] Cafetra is an international trading company supplying raw material to the feed, food and fuel industries.
[43] Probroed is a supplier of day-old chicks for broiler farms.

Almost 40% (€1 billion) of the total turnover was generated in The Netherlands, €727 billion in the UK, €577 billion in Germany, €237 billion in Belgium and €31 billion in other countries. Assuming the same percentage of turnover being produced in compound feed volume yields c. 2.05 Mt of compound feed being produced in The Netherlands. This would be a market share by volume of c. 15%.

Market share, according to the European Commission (2012) on…
… Single feed ("animal feed products which are made up of only one basic feed ingredient" (European Commission 2012), e.g., scraps of soya, sugar beet, or grain.)
The Netherlands:

- 5-10% at EU level
- 30-35% for The Netherlands
- 5-10% for Germany
- 15-20% for Belgium.

… Compound feed

- 5-10% on the average market share in Benelux, parts of northern France, and Northern half of Germany.
- 20-25% in The Netherlands
- 5-10% in Belgium
- 5-10% in Germany.

Cooperative Agrifirm

Agrifirm is a cooperative of 17,500 Dutch farmers producing different kinds of animal feed, raw materials, minerals, and vitamins. It was founded in June 2010 following the merger of cooperative Agrifirm in Meppel and Cehave Landbouwbelang in Veghel with its headquarter now in Apeldoorn and is active in ten countries in Europe and China. In 2013, it generated a turnover of €2.5 billion and sales from The Netherlands totaled €1.5 billion. The company annually produces 4.135 Mt of compound feed of which about three quarters in The Netherlands (=3.101 Mt). The Nuscience group is the international premix and specialties division of Agrifirm, which has successfully expanded into emerging markets like China and the Ukraine. Agrifirm generated net sales of €2.5 billion in 2013. According to the merger case of ForFarmers and Hendrix, the EC's stated market share of Agrifirm in The Netherlands is 20-25% (European Commission, 2012).

De Heus Feed

In 2013, group revenues of De Heus Feed accounted to €2.2bn. In 2012, De Heus Feed produced 4.10 Mt of compound feed worldwide in more than 35 countries. The company's headquarters are in Ede, The Netherlands and 1.7 Mt of feed is produced at eight production facilities in The Netherlands. According to the merger case of ForFarmers and Hendrix, the EC's stated market share of Agrifirm in The Netherlands is 10-15% (European Commission, 2012).

AgruniekRijnvallei

AgruniekRijnvallei is the merger of two cooperatives: Agruniek and Rijnvallei. The new cooperative started its operations in January 2012. Agruniek and Rijnvallei combined

reported compound feed volumes of about 0.60 Mt in 2011 and total sales of close to €300m (ForFarmers, 2012).

Cooperative Boerenbond Deurne

Boerenbond Deurne reported volumes of 1.1m tons in 2011, including the trading activities. The company has three production locations and reported 2011 sales of about €250m. In addition, the company has a storage and transshipment facility. The company employs over 180 employees and its headquarters are located in Deurne.

Germany

In 2013, 313 German manufacturers produced c. 24 Mt of compound feed. The majority of the compound feed producers are in the Northern provinces that represent about 58% of the total production.

Table A2.3: Major compound feed producers with headquarters in Germany

Company	Volume (Mt)
Agravis	3.60 ('12)
BayWA	2.54
Cremer/Deuka	2.40
Bröring	1.50
HaGe Kiel (DLG)	1.063
Total	11.1*

Source: Data from Rabobank International (2015) and company reports.
Note: * The total production volume of the companies with headquarters in Germany is produced in several countries.

Agravis Raiffeisen

Agravis, with its headquarters in Münster, Germany, is one of the largest EU compound feed producers, particularly for special feedstuff products and animal health. In 2013, Agravis had a total turnover was €7,5bn and a compound feed production of 3.6Mt. Agravis is Germany's leading manufacturer in the field of pig compound feed, with a production of 1.50 Mt and a market share of 15% (Agravis, 2014).

BayWA group

The BayWA group is an international trading and service company, with a focus on several sectors including agriculture, energy and construction. Total feed sales amounted to €16bn. Feedstuff production was 2.54 Mt.

ForFarmer

Turnover in Germany: €577m (31% of the cumulated turnover of The Netherlands, Germany, and Belgium. ForFarmer produces 3.64 Mt in these three countries. Assuming the same share of production per country as the turnover, its production in Germany is estimated to be 0.63 Mt.

Deutsche Tiernahrung Cremer GmbH & Co. KG/PRODUCTION
In 2013, turnover of Deutsche Tiernahrung Cremer GmbH & Co. KG/PRODUCTION was €0.2bn to €0.53bn and is a subsidiary of Cremer. The twelve plants produce 2.4 Mt of compound feed annually which is sold in Germany and other European countries. The headquarters are located in Düsseldorf.

Bröring
Bröring is a German feed producer operating six plants in the North Western part of Germany. The company sells about 0.20 Mt of compound feed on an annual basis and has an annual turnover of c. €450m (Broering GmbH & Co. KG, 2015).

MEGA Tierernährung
Mega Tierernährung, part of the PHW Group, produces 1.2 Mt of compound feed and 164 employees working for MEGA, which focuses exclusively on compound feed for poultry and has five production manufacturing locations in Germany (ForFarmers, 2012).

United Kingdom
In 2013, about 344 manufacturers produced c. 16 Mt compound feed in the UK. The Top 5 producers of the UK have an estimated combined market share of c. 50%.

Table A2.4: Major compound feed producers with headquarters in the UK

Company	Volume (Mt)
Ab Agri (ABF)	4.70 ('10)
ForFarmers	2.00
Mole Valley Farmers	0.65
Wynnstay Group	0.30
IAWS Agri	NA
Total	7.65*

Source: Data from Rabobank International (2015) and company reports.
Note: * The total production volume of the companies with headquarters in Germany is produced in several countries.

AB Agri
AB Agri is part of Associated British Foods (ABF) and generated sales of €1,55bn in 2012. AB Agri manufactures premix, starter feeds and animal feeds, which are sold in more than 65 countries. The company is also active in crop inputs. Since AB Agri's estimated amount produced in the UK is 1.3-1.4 Mt, ForFarmers (BOCM Pauls) is actually the largest feed producer in the UK (ForFarmers, 2012).

NWF Agriculture
NWF Agriculture supplies and manufactures ruminant compound feeds from Central Scotland and the UK. In Wardle, the company operates the largest specialist ruminant feed mill in the UK. Apart from compound mills they also operate four blending sheds. The company manufactures 0.356 Mt of compound feed per year. (ForFarmers, 2012)

Mole Valley Farmers

Mole Valley Farmers supplies more than 0.35 Mt per year. In 2005, the company acquired the compound feed producer Pye Bibby (ForFarmers, 2012).

Belgium

In 2013, Belgium produce c. 6.78 Mt compound feed, roughly half of what is produced in The Netherlands. Its turnover is about €2.5 billion, with more than 90% of the Belgium production being located in Flanders.

Table A2.5: Major compound feed producers with headquarters in Belgium

Company	Volume (Mt)
Aveve/Dumoulin	1.33 ('07)
VandenAvvene Oigern	0.55
Cehave van den Berghe	0.47 ('10)
Versele Lage	NA
Total	2.345*

Source: Data from Rabobank International (2015) and company reports.
Note: * The total production volume of the companies with headquarters in Germany is produced in several countries.

Aveve

Aveve-Dumouline—the result of a merger of Aveve and Dumouline in 2007—is the leading player in Belgium. Aveve (sales of €1.3 billion in 2012) being a large supplier for the agriculture and horticulture, as well as the production and supply of animal nutrition in Flanders and bordering areas. Aveve is not active in premix but does supply biochemical specialties like enzymes and natural antimicrobial oils to a diverse customer base. Dumoulin is mainly active in feed for ruminants, pigs, horses, poultry, sheep and rabbits. The feed business has annual sales volume of 0.80 Mt and it claims a market share of 15% in Belgium. The company operates two production plants in Belgium. (Rabobank International 2015)

Vanden Avenne

Vanden Avenne produces 0.515 Mt of compound feed per year generating revenues of €250m. The company produces compound feed for pigs, poultry, and cattle. Its headquarters are in Ooigem and it has two production facilities both located in Belgium. ForFarmers is comparable in size to Vanden Avvene and Cehave, and produces 0.45- 0.55 Mt of compound feed (ForFarmers 2012)

Versele Nutrition

Versele Nutrition has its headquarter in Deinze and realizes revenues of €430 million annually. The group distributes feed in Belgium, the southern part of the Netherlands and the northern part of France. In 1999, the firm took over the compound feed productions of group Dossche.

France, Italy, and Poland

Table shows the major compound feed manufacturers for France, Italy, and Poland.

Table A2.6: Major compound feed producers in France, Italy, and Poland

Country	Companies
France	Sofial (3.50Mt.), Invivo (2.40Mt.), Cooperl (1.45Mt.), Terrena (1.40Mt.), Le Gouessant (1.01Mt.), Axereal (0.56Mt.), Nealia (Vivescia) (0.34Mt.).
Italy	Veronesi (2.5Mt.), Skretting (Nutreco), Cargill s.r.l., Martini Zootecnica
Poland	Wipasz (1.0Mt.), Provimi (Cargill), Cargill Polska, Dossche, Hima (de Heus)

Source: Data from Rabobank International (2015).

Spain

The Spanish and Portuguese compound feed market is very fragmented, as it has more than 800 producers. However, the Top 5 producers share 32% of the market. Nutreco, through its 100% subsidiary Nanta, is with a production of 2.73 Mt the leading player with a market share of c. 13%. Second largest producer is Vall companys, with 1.7 Mt (7% market share), followed by Guissona with 1.1 Mt (5% market share), Coren and Nuter, both with 0.9 Mt (4% market share).

Animal nutrition and compound feed equivalent measure

Additionally to the European firms, Cargill started to play an important role as it acquired several European firms. In 2001, its acquisition of Agribrands International has increased Cargill's market share in Spain and Portugal to c. 15% (European Commission, 2001). During that time period, Cargill was already the leading European producer of oilseed meal, an upstream market for animal feed, where it had an EU-wide market share of over 25% (ibid.).

the Dutch firm Provimi in 2011. Provimi produced 3.20 Mt of compound feed and had a turnover of €1.45 billion in 2009. An even bigger role plays Provimi in the animal nutrition business. Using the complete feed equivalent (CFE) measure – a measure that states the total amount of compound feed that could theoretically be produced with ingredients like premix, concentrate, etc. - , Provimi's market share is estimated to be about 10%, surpassed by DSM with a market share of 20%, Nutreco, with about 12%, and surpasses Invivo, which has a market share of about 6-8% (Rabobank International 2015).

Computation of the maximum Herfindahl-Hirschman Index (HHI_{max})

Given is the total compound feed production volume x in Mt as well as the production volume x_k of the K greatest firms, k = 1,…, K. Each firm has a market share $s_k = x_k/x$. The Herfindahl-Hirschman Index (HHI) can be computed as the sum of the HHI_k of the largest K firms and the HHI_r of the remaining firms, r = K + 1, …, N

$$HHI = HHI_k + HHI_r = \sum_{k=1}^{K} s_k^2 + \sum_{r=K+1}^{N} s_r^2$$

However, the production volume of the remaining N – K firms is unknown.[44] For a worst case scenario, a maximum HHI can be computed. This scenario refers to a situation of

[44] In total, firms are indexed by 1,…, K, K+1,…, N.

maximum market power, given the production volume of the first K firms, $X_k = \sum_{k=1}^{K} x_k$. To compute HHI_{max}, the unknown HHI_r must be adjusted such that it will be maximized under the conditions of the K leading firms. This can be done by assuming that the remaining volume is produced by a number of $\left\lfloor \frac{x}{\min\{x_k\}} \right\rfloor$ firms that have the same market share, $\min\{s_k\}^2$, as the smallest of the K firms. Finally, a single firm is assumed to produces the "leftover" $X_L \equiv X - X_K - \left\lfloor \frac{x}{\min\{x_k\}} \right\rfloor \min\{x_k\} \leq \min\{x_k\}$ and all other $N - K - \left\lfloor \frac{x}{\min\{x_k\}} \right\rfloor$ number of firms are assumed to produce zero output[45]

$$HHI_{max} = \sum_{k=1}^{K} s_k^2 + \left\lfloor \frac{x}{\min\{x_k\}} \right\rfloor \min\{s_k\}^2 + \left(\frac{X_L}{X}\right) + 0 \,.$$

[45] Note: total production $X = X_k + \left\lfloor \frac{x}{\min\{x_k\}} \right\rfloor \min\{x_k\} + X_L$. The first part of the sum is the production of the K firms, while the other two parts amount to the production of the remaining firms, N – K.

ANNEX 3: ENERGY STUDY

Figure A3.1: Development of the time trend coefficient for the energy cost share in the period 1989–2009

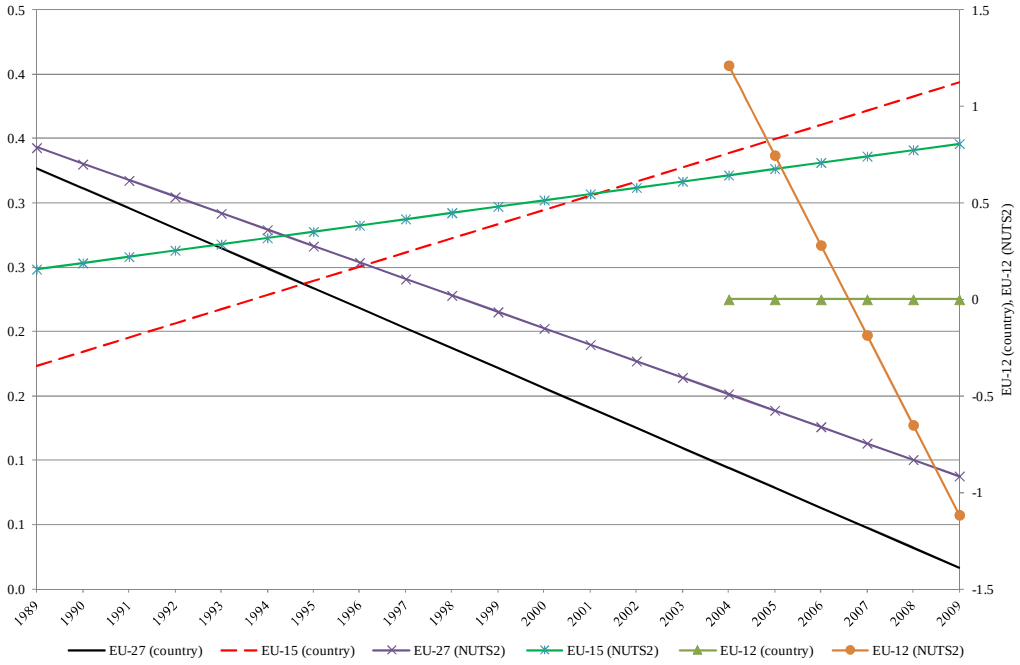
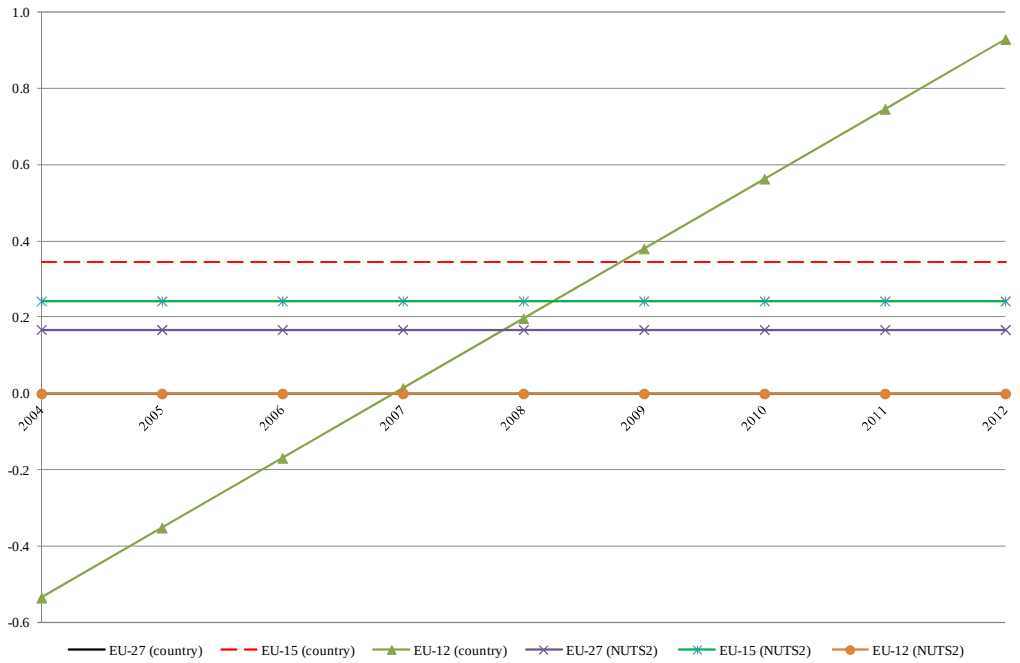


Figure A3.2: Development of the time trend coefficient for the energy cost share in the period 2004–2012



ANNEX 4: FERTILIZER STUDY

Graphical representation of estimated trend coefficients

Figure A4.1: Graphical representation of estimated time trends assessing the changes of fertilizer cost shares over time: FADN Data 1998-2009

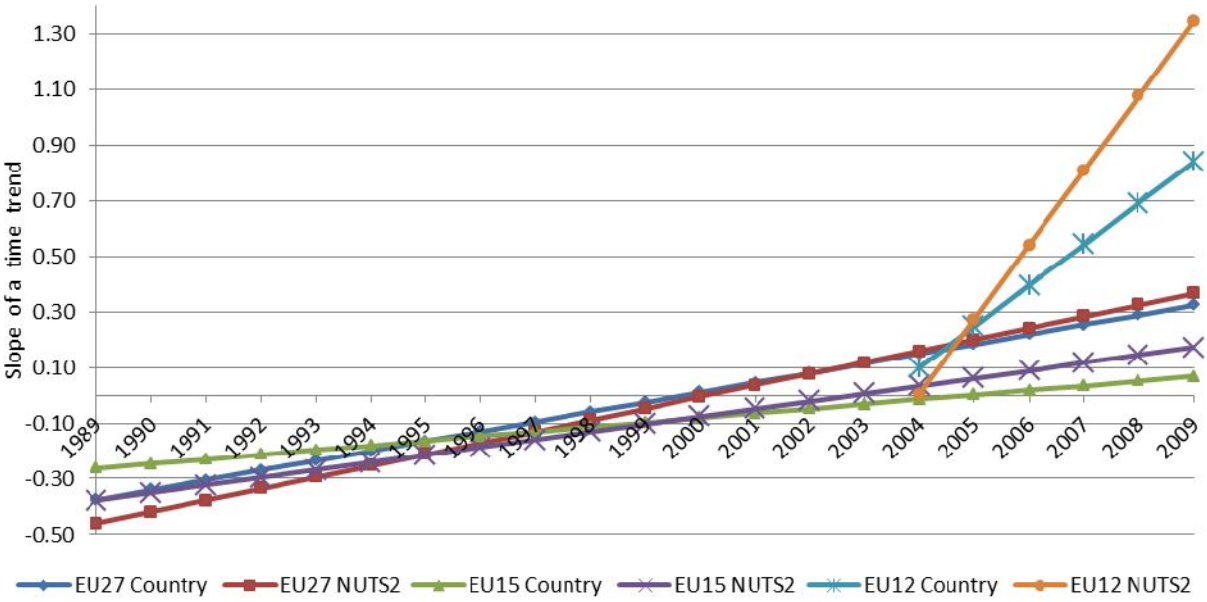


Figure A4.2: Graphical representation of estimated time trends assessing the changes of fertilizer cost shares over time: FADN Data 2004-2012

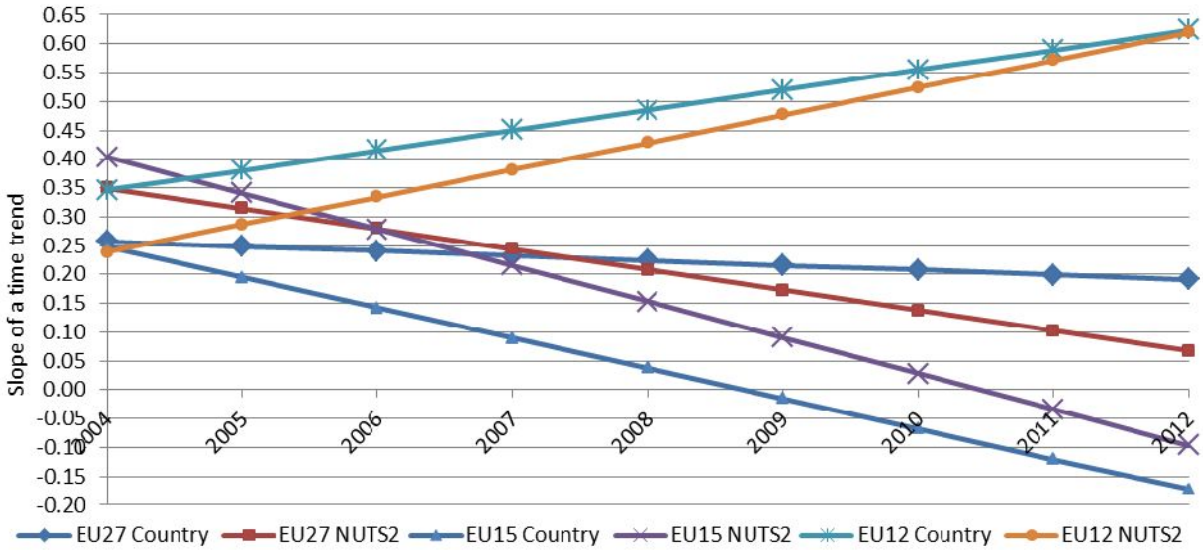


Table A4.1 Selected relevant mergers and acquisitions for the EU fertilizer industry

Acquiring company	Year	Acquired company
Yara International ASA	1978 - 1990	NSM (Netherlands), Supra (Sweden), Fisons (the UK), Ruhr Sticstoff (Germany), Windmill (The Netherlands), Cofaz (France)
	2007	GrowHow Ltd
Borealis Group	2012	PEC-Rhin SA (France)
	2013	Rosier SA (Belgium), GPN SA (France)
Eurochem	2012	BASF SA - fertilizer Business units (Germany)
	2012	K+S Nitrogen - fertilizer BU of K+S Group (Germany)
Anwil	2006	Spolana SA (the Czech Republic)
Israel Chemicals Ltd	2002	Cleveland Potash Ltd (United Kingdom)
Ameropa Holding AG	2012	Azomures (Romania)

ANNEX 5: PLANT PROTECTION AGENTS STUDY

Figure A.5.1 – Graphical representation of estimated time trends assessing the changes of plant protection agents' cost shares over time: FADN Data 1989-2008

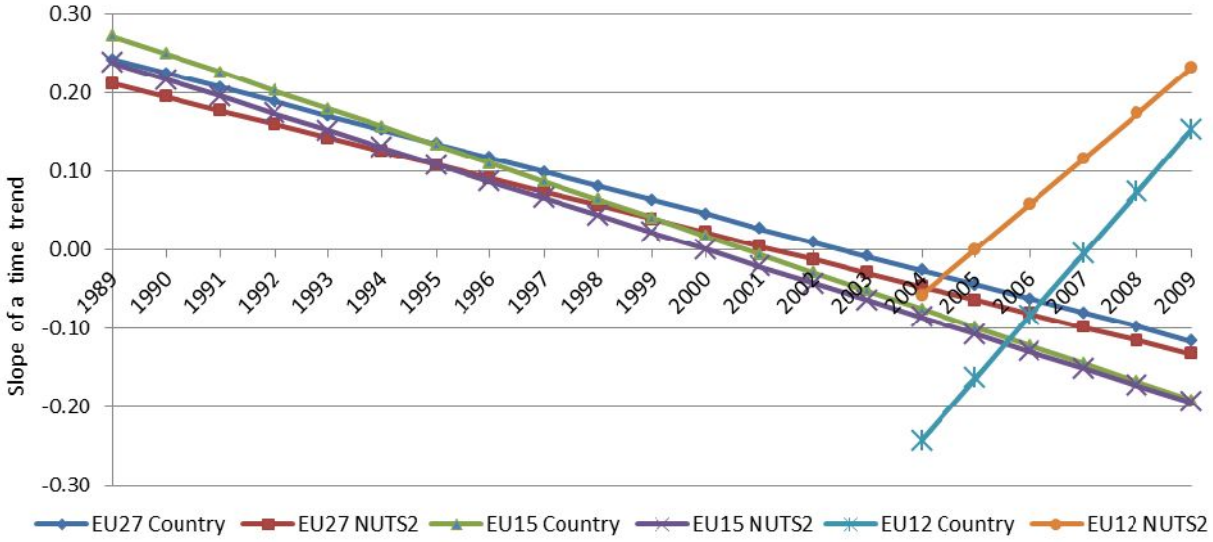


Figure A.5.2 – Graphical representation of estimated time trends assessing the changes of plant protection agents' cost shares over time: FADN Data 2004-2012

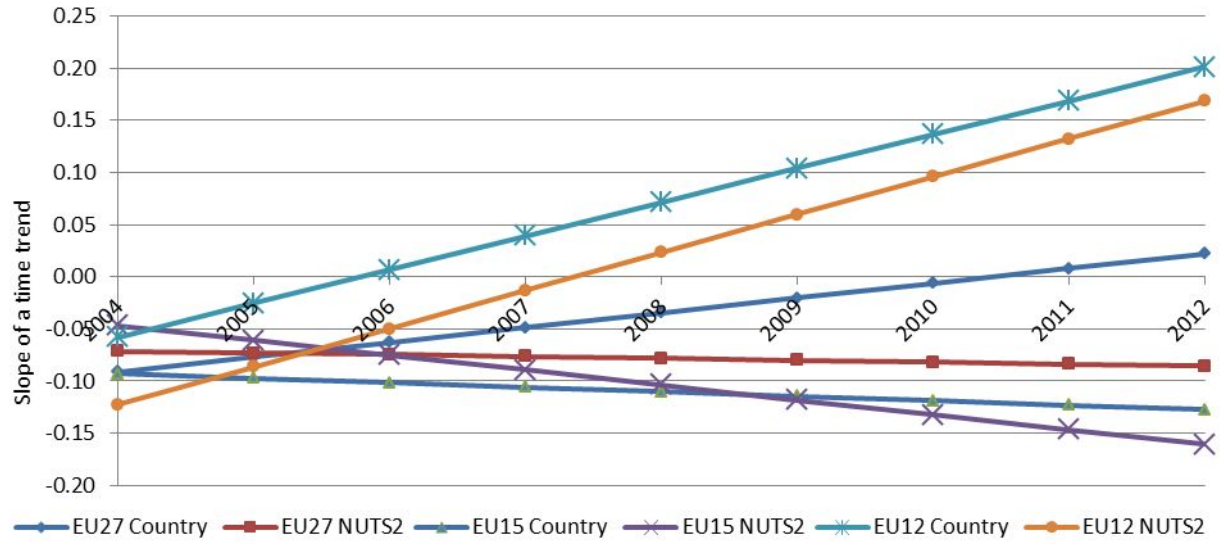


Table A5.1: Definition of the Market segments used to derive plant protection agents sale

Company	Measured Segment	Activities included
BASF	Agricultural Products	BASF's plant protection agents division supplies agricultural products and chemicals. The company produces fungicides, herbicides and insecticides including F500 (pyraclostrobin), epoxiconazole, pendimethalin, boscalid, fipronil, seed treatment products, and imidazolinones for use in the Clearfield Production System.
Dow	Health and Agricultural Science	Agricultural Chemicals, Seeds, Traits and Oils
DuPont	Crop Protection	Herbicides, Fungicides, Insecticides
Adama	CPP	Crop Protection Products (herbicides, fungicides, other pesticides)
Monsanto	Roundup and other glyphosite-based herbicides	Nonselective agricultural, industrial, ornamental and turf applications for weed control excluding all lawn-and-garden herbicides
Syngenta	Crop Protection	Herbicides, Fungicides, Insecticides & Others excluding Professional Products and Seed Care

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