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Results for the French national FADN

Dominique Desbois, Jean-Pierre Butault, Nathalie Delame, Guillaume Zardet

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FACEPA

Farm Accountancy Cost Estimation and Policy Analysis of European Agriculture

Implementation, validation and results of the cost of production model using national FADN data bases

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Edited by Frank Offermann (vTI)

with contributions by

A. Berner, W. Kleinhanss, F. Offermann (vTI)

M. Dolman, W. van Everdingen, D. Verhoog (WUR-LEI)

L. Cesaro, S. Marongiu, A. Zanoli, F. Arfini, M. Donati (INEA)

D. Desbois, J.-P. Butault, N. Delame, G. Zardet (INRA)

D. Nikolov, R. Popov, M. Anastasova-Chopeva, B. Ivanov, S. Bahta (IAE, vTI)

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Executive Summary

Within the FACEPA project, considerable resources have been allocated to implement and validate the 'general cost of production model' (GECOM). The outcome of the related work is published in three connected reports: Two reports describing the implementation, validation and the results from the GECOM on the basis of national farm accountancy data networks (FADN) and the EU FADN, respectively, and a report providing an overall synthesis and conclusions for future research and for the design of a related software tool.

This report presents the results of implementing and testing the GECOM on the basis of German, Italian, Dutch, French and Bulgarian national FADN. Depending on the extent of analysis which additionally has been carried out for these countries on the basis of the EU FADN, the respective country chapters either provide a full overview of results and validation, or concentrate on specific issues, e.g. differences between cost estimates based on national vs. EU FADN.

The estimations based on the **German** FADN focus on the so-called production costs (I), which includes all costs with the exception of costs for labour, land and capital. For this formulation, the resulting income indicator is very close to the definition of farm net value added in the EU FADN. An extended model then included costs for labour, land and capital, i.e. accounting costs (e.g. rents, wages) as well as imputed costs for family owned factors. The analyses focus on the impact of farm characteristics on production costs, differences between results based on the national versus the EU FADN, the exploratory application of a cross-entropy estimator, and the validation of the estimated production costs.

Following a short overview on the average production costs for the three main products (wheat, milk, pig) during the period 1996 to 2008, production costs are differentiated by farm characteristics like region, land quality, part- and full-time farmers, legal forms, education of the farm manager, and between specialised and non-specialised farms. For wheat, there are large differences in production costs (I) between regions, with a maximum of 149 €/t in Baden-Württemberg and minimum of 107 €/t in Niedersachsen, while for pigs the differences are much smaller and for milk almost no differences can be observed. Land quality shows no significant impact on estimated production costs for wheat and milk. While part-time farmers have higher production costs than full-time farmers for wheat in all years, this might also be related to scale effects. For pigs and milk, the production costs were only slightly higher for part-time farms. For wheat no clear ranking regarding the production costs of different legal forms could be discerned, while for pigs, in most years the highest production costs were estimated for private partnerships. The same can be seen for milk production, where private partnerships also have mostly the highest production costs followed by individual farms and the lowest production costs can be found for legal entities. A negative correlation between the level of production costs and the education level of the farm manager was detected, which might however also be due to size effects. Surprisingly, for all three products the production costs of specialised farms are mostly higher than those for the average of all farms and for non-specialised farms. The estimations for wheat and milk show a clear digression of production costs with farm size due to reduced costs for overheads and depreciation. An interesting aspect is also that the

impact of the outlier elimination routine on results is negligible for this differentiation: this indicates that an adequate delimitation of samples by technology may be important for ensuring the robustness of the estimations.

To account for the increasing specialization in the area of beef and pig production with respect to the processing steps and output produced, a specific analysis focuses on the differentiation between bull fattening farms and specialized suckler cow farms and on the differentiation between pig fattening and piglet production, respectively. The results show that specialized bull fattening farms have higher cost and return levels than the estimates for all beef producing farms. The cost development of specialized suckler cow farms coincides with that of the bull fattening farms. After decoupling the profitability of suckler cow production is to a large part depending on Pillar-2 payments. Costs for specialized pig fattening farms are generally between 1000 and 1200 €/LU. Specialized piglet farms have a higher cost level but also higher market returns, and on average achieve a slightly higher income.

A comparison between the results using the EU FADN and the German FADN highlights significant differences. Three possible causes for these differences are identified: systematic structural differences in the two samples, different weighting factors, and differences in the data or aggregation of accounts to variables. The differences in samples and weights seem to explain only few of the observed differences in the cost estimates, while the impact of the data differences on estimated costs is rather large for some products.

A generalized cross entropy estimator as an alternative to SUR estimation is tested for a sample of farms in the region of Schleswig-Holstein. The cross entropy estimation avoids the occurrence of negative coefficients, and allows to include a-priori information on the probable level of individual cost coefficients. Exploratory tests have been made using different model design differing in the set of support points as well as in the set of the prior information. Results highlight that indicators for model selection as well as the choice of prior probabilities need to be made carefully, as they can have huge influence on the results. The benefit of the cross entropy estimator are largest for small sample sizes for which the SUR results are often less robust or implausible.

Last but not least the estimated costs are validated. For this purpose, costs from other sources are presented and compared to the estimated cost figures. A complete validation often proved to be impossible, due to a multitude of differences in definitions of cost categories and treatment of imputed costs. However, the comparisons which could be made for wheat and milk show a high similarity, for total costs as well as for single cost categories, of the FACEPA estimates to those of other studies. During a national workshop with experts, the general trend of the estimated production costs for wheat, pigs and milk over time was deemed plausible, however many suggestions were made with regard to the definition and presentation of those costs.

The next chapter presents and discusses the results obtained by applying the general cost of production model to the **Italian** FADN. The main aim of this application is to compare these results to those estimated on the basis of the EU FADN, as the two databases differ with respect to he number of farms included, the detail of cost variables included, and the weights used. The comparison covers production costs of soft wheat, durum wheat, maize and cow milk during the 2004-2007 period.

For soft wheat, the total cost estimations based on the national FADN are higher in two of the four years, and many of the differences in individual cost coefficients are statistically significant. Especially the values obtained for subsidies are very different, which may be due to a different aggregation in the two datasets. The results for durum wheat are very similar with the exception of 2005, for which the values based on the national FADN are higher and seem much more plausible. Also for maize, the results are very similar with the exception of 2007, for which again the values based on the national FADN are higher and seem to better reflect the increase in fertiliser and plant protection costs. On average, for the period analysed, total milk production costs as well as individual cost coefficients are the same for both databases; however, for single years many differences occur and are statistically significant.

The following chapter applies the general cost of production model to adjusted **Dutch** FADN data. The analysis focuses on comparing the data as well as cost estimation of the national FADN to that of EU FADN for the three main products (milk, pig and wheat), using a systematic stepwise comparison to isolate the effect of different farm numbers, different data and different weights.

For both milk and pigs, the effects of differences in the samples as well as of differences in data on cost estimations are small, while differences in the weighting scheme leads to higher differences in some aggregated cost categories. For total production costs however, differences are small. For wheat, differences between the different model specifications are quite large, both for single costs aggregates as well as for total production costs. Generally, the estimated costs for wheat fluctuate strongly over the years, show some negative coefficients, and seem too high to be plausible. A detailed comparison of the data in the two databases confirms the results for the cost estimations, indicating that the different weights are the main cause for the observed dissimilarities. For pigs, the analysis highlights that for a calculation of per ton production costs for the output pig, it is advisable to use the liveweight prices included in the national data base, as these are systematically lower than those reported in the Eurostat database.

The next chapter is based on the **French** FADN, which includes almost the same number of farms for France as the EU FADN, but uses different weighting factors. First, the impact of outlier elimination on production cost estimates is analysed. Over the 1995-2007 period, the trimming process eliminates approximately 10 % the sample farms. While the R-square of the regression equations generally improve slightly, variability of estimates increases for many inputs. For wheat, differences in estimated cost coefficients are not statistically significant, and total costs estimates are similar with and without outlier elimination.

The analyses then focuses on a comparison of the GECOM output for EU FADN to the results of a very similar national estimation model (*Coutprod*) as well as to results from technical surveys. Generally, the level of costs of wheat and corn estimated with the GECOM and *Coutprod* models are very similar, though for some inputs less variable over time in the GECOM model. Especially for fertilizer and depreciation costs, the two model estimates are highly correlated. For pigs, the differences between the two model estimates are a bit larger even when accounting for the different treatment of home-grown seeds and feed in the two models.

For crop products, model estimates could be compared to survey data for the period 2002-2007. For wheat, the level of estimated seed costs are slightly higher than the survey

figures, while fertilizer costs are very close to the average level of the survey results over the 2004 to 2007 period. Crop protection costs estimates appear to be systematically higher than the average survey figures, however, the general trend of the survey figures seems to be well apprehended by the common trend of the GECOM and *Coutprod* estimates. Survey fuel and energy costs are consistent with the model estimates. The estimated depreciation costs follow the same trend as the depreciation figures from the surveys, though the levels are not directly comparable due to different rules for the calculation of depreciation rates. The costs of land for common wheat estimated by the models are higher than the figures given by the surveys. Moreover, for the land costs, the cross-time variability of the model estimates appears to be somewhat contradictory with the smooth trends of the survey data, and it is concluded that smoothing the estimates with a moving average on a three-year basis can be a reasonable practice. Total cost estimates for wheat over the 2002-2007 period of time appear to be a bit higher than the results of the technical surveys. For corn, estimated seeds and crop protection costs are a bit lower than reported by the surveys, while energy and fertilizer costs seem to be significantly higher; however, this validation is impeded by unexplainable large variations in the survey figures for fertilizer costs.

For fattening pigs, estimated costs are compared to survey results for the period 1995 to 2007. The level of estimated feeding costs, which represents the most important cost item, is very similar to that reported by the surveys, and closely follows the same trend over time. For total variable costs, there is a very close similarity between model estimates and survey results for production costs per ton using externally calculated carcass prices, while results on costs per livestock unit are less correlated. For overheads and fixed costs, the results depend strongly on the model specification and are closest to the survey results for the GECOM model without explicit estimation of home-grown feed costs.

For cow milk, estimated costs are also compared to survey results for the period 1995 to 2005. Moreover, a complementary comparison over the 1995-2003 period has been made with a previous study, based on EU FADN. The sum of estimated feeding costs, one of the major cost items, is very close to those reported both by the surveys and the study, and nearly follows the same trend over the periods referenced. However, a slight but noticeable difference has been found in the allocation of costs between the purchased feed and the fodder production cost, the model estimates being higher than the survey results for the purchased feed and vice versa for the fodder inputs. For total variable costs, the operation costs issued from the surveys are close from the model estimates, and follow the same trend over the 1995-2001 period with an attenuation of the downward trend observed in 2002-2005, compared with model estimates. For overheads and fixed costs, the estimates depend on the model specification. The model estimates without explicit estimation of home-grown feed costs are closer to the survey results than the ones of the standard GECOM model. The two model specifications are practically equivalent for the depreciation cost estimates, and are significantly higher than the survey results. However, for land costs, the standard GECOM model estimates are significantly lower than the survey results and do not follow the survey trend over the 1995-2000 period.

The final chapter is based on the **Bulgarian** FADN for the years 2005 to 2007. For wheat, estimated production costs reflect the increase in input prices during the period analyzed, as well as the poor harvest in 2007. For milk, data issues could not be fully resolved and seem to be partly responsible for rather large fluctuations of estimated production costs. Estimated cost in milk production are significantly higher than results from a survey of

dairy farms. The model results for pig production indicate a marked rise of production costs from 2005 to 2007, mostly due to an increase of feeding costs.

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Abbreviations and Acronyms

FAM	FranceAgriMer
FGC	Farm Grown Consumption
GECOM	General cost of production model
GPCA	Generalized Principal Component Analysis
GTE	Technico-Economic Management Survey
IE	Institut de l'Elevage
IFIP	French technical institute for the pig
IPPAP	Indice des Prix des Produits Agricoles à la Production
LU	Livestock Unit
NSI	Bulgarian National Statistic Institute
MAF	Bulgarian Ministry of Agriculture and Food
ONIGC	Office national interprofessionnel des grandes cultures'
SSP	French Office for Agricultural Statistics
UAA	Utilisable agricultural area

Input categories

FEEDPC:	Feed purchased
FEEDHC:	Feed homegrown
VETCOS:	Veterinary costs and other livestock specific costs
SEED:	Seeds (purchased and home grown)
FERTIL:	Fertilizer
CRPROT:	Crop protection
MOTFUE:	Motor fuel and lubricants
OENERG:	Electricity and heating fuels
CONWOR:	Contract work
BUILUK:	Upkeep buildings
MACHUK:	Upkeep machinery
OTHSIC:	Other costs (car expenses, other costs crops, forestry specific costs, water, insurance, other farming over heads and insurance of farm buildings)
LANDCO:	Land rent and taxes on land and buildings
INTERE:	Interest paid on all loans
DEPREC:	Depreciation
TAXES:	Taxes
SUBSID:	Subsidies
NETVAL:	Net value added

Italian cost aggregates

SFC:	Seed, Fertilizers, Crop protection (SEED + FERTIL + CRPROT)
MO:	Motor fuel and lubricants, electricity and heating fuels (MOTFUE+OENERG)
CW:	Contract work (CONWORK)
BM:	Building and Machinery (BUILUK + MACHUK)
OC:	Other costs (OTHSIC)
LI:	Land costs and interests (LANDCO + INTERE)
DT:	Depreciation and taxes (DEPREC + TAXES)
S:	Subsidies (SUBSID)
NV:	Net value added (NETVAL)
SE:	Seeds (SEED)
FE:	Fertilizer (FERTIL)
CR:	Crop protection (CRPROT)

German region codes

BB	Brandenburg
BW	Baden-Württemberg
BY	Bayern
HE	Hessen
MV	Mecklenburg-Vorpommern
NI	Niedersachsen
NW	Nordrhein-Westfalen
RS	Rheinland-Pfalz + Saarland
RP	Rheinland-Pfalz
ST	Sachsen-Anhalt
SH	Schleswig-Holstein
SN	Sachsen
TH	Thüringen

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1 Introduction

Within the FACEPA project, considerable resources have been allocated to implement and validate the 'general cost of production model' (GECOM; Surry et al., forthcoming). The outcome of the related work is published in three connected reports: Two reports describing the implementation, validation and the results from the GECOM on the basis of national farm accountancy data networks (FADN) and the EU FADN, respectively, and a report providing an overall synthesis and conclusions for future research and for the software tool developed in work package 4.

This report presents the results of implementing and testing the GECOM on the basis of German, Italian, Dutch and French national FADN. Depending on the extent of analysis which additionally has been carried out for these countries on the basis of the EU FADN, the respective country chapters either provide a full overview of results and validation, or concentrate on specific issues, e.g. differences between cost estimates based on national vs. EU FADN.

All country applications used the same methodological approach. To estimate the cost-allocation coefficients from farm accounting data a set of linear equations is considered where the derived demand from farm *f* for each input *i* is represented as a function of several outputs *k*. The output of the various products is denoted $y_k\,(k = 1,.....,K)$ and the $x_i\,(i = 1,.....,I)$ represent the non-allocated costs of the production factors. Assuming I inputs used by F farms to produce K outputs the set of equations can be written as

(1) $$x_{if} = \sum_{k=1}^{K} \beta_{ik}\, y_{kf} + u_{if}\ ,$$

where

x_{if} is the total cost of input *i* paid by farm *f* (including subsidies and net value added),

y_{kf} is the total value of output *k* produced by farm *f*,

β_{ik} is the unknown technical production coefficient, which is defined as the average (for all farms) expenditure on input i required to produce one unit of output value *k*,

u_{if} is the error term specific to each input and farm.

On each farm *f*, the observed costs in input *i* differ from the theoretical costs by a random term u_{jf} of zero expectation and is independent from one farm to the next.

In order to achieve the accounting consistency of the model, a constraint ensures that the sum of output values equals the sum of input costs plus net value added the model is estimated subject to:

(2) $$\sum_{k=1}^{K} \beta_{ik} = 1$$

This equation ensures that the production coefficients add up to one.

The subsidies enter the model as an independent variable with negative values. Thus, it is possible to derive the average amount of subsidies associated with the production of one unit of output value k. The net value added is composed of the sum of output value plus subsidies minus input costs. Using the aforementioned nomenclature this relation can be written as:

(3) Net value added $_f$ = $\sum_{k=1}^{K} y_{kf} - \sum_{i=1}^{I-1} x_{if}$

For the FACEPA project, the production cost analysis includes up to 18 aggregated input categories, including subsidies (defined as negative input) and net value added, as well as 31 output categories. The model was estimated using SAS based on the so-called seemingly unrelated regression (SUR) procedure. A complete description of the GECOM model, the econometric specifications and estimation procedures is given in Surry et al., (forthcoming).

2 Results for German national FADN

Authors: Anja Berner, Werner Kleinhanss, Frank Offermann

von Thünen Institute (vTI), Braunschweig

This chapter presents and discusses the results obtained by applying the general cost of production model to the German national database. After a brief description of the data and the results for the three main products, this study focuses on the differentiated analysis of the impact of farm characteristics, like type, size or location on production costs. In addition, possibilities for adjusting the model specification to improve the estimation of production costs in pig and beef production are analyzed. The next part of this chapter then compares the results to those obtained by using the EU-FADN, and examines the causes for observed differences. Then the outcomes of an exploratory application of a generalized cross entropy estimator as an alternative to SUR estimation are discussed. Last but not least the estimated costs are validated. For this purpose, costs from other sources are presented and compared to the estimated cost figures. Furthermore, the experiences and recommendations from the national workshop with experts are reported.

2.1 Data

In most Member States, the European FADN was not started from scratch; several Member States were already conducting agricultural surveys based on farm accounts. Germany for example had a system since 1965. Thus, European FADN is derived from national surveys, carried out by the Member States of the European Union. Most countries use their own rules to manage the national FADN and then create a specific file to complete the European FADN. Although the FADN datasets at the Member State and EU level are to a certain extent harmonized, differences occur. For example, FADN data for input and output categories tend to be more aggregated at the EU than at the Member State level (Delame and Butault, 2010). While in most Member States the national sample equals almost the sample for the Commission, (Delame and Butault, 2010) Germany has a greater national sample than is included in the EU-FADN (see Table 2-1).[1]

Table 2-1: Sample size of German and EU-FADN

	2005	2006	2007
EU			
	7,046	7,529	7,660
Germany			
	12,169	11,720	11,508
Germany* (> 16 ESU)			
	10,420	9,778	9,955

Source: Own illustration based on EU-FADN DG-Agri L-3 and German national FADN.[2]

[1] It should be noted that in Germany, many farm accounts refer to a farming year and not a calendar year, e.g. the data from EU FADN 2005 usually refers to accounts for the farming year 2005/06. In some national publications based on the German FADN, the same farming year may be labelled 2006. To avoid confusion, we use the year classification of EU FADN for all data bases in this study.

[2] German national FADN = BMELV-Testbetriebe.

The availability of a more detailed data base, different weights as well as a larger sample size motivate the application of the GECOM to the German national FADN.

The German dataset works with four-digit numbers for the corresponding row and a two-digit number for the column which can be found in a code catalogue. To apply the general cost of production model, the EU codes for the estimation have to be translated into German codes. As stated before, the EU cost categories are more aggregated as the national cost categories, so that one EU code can compose several German codes.

The structure of the model is the same as for the GECOM model. Included are 15-18 input variables as well as 31 output categories. Subsidies include all coupled subsidies as well as all 2nd pillar payments, but exclude the decoupled Single Farm Payment. Generally, the model was formulated to estimate the so-called *production costs (I)*, i.e. including all costs with the exception of costs for labour, land and capital. For this formulation, the resulting income indicator is very close to the definition of farm net value added in the EU FADN. An extended model then included costs for labour, land and capital, i.e. accounting costs (e.g. rents, wages) as well as imputed costs for family owned factors:

- **Land costs**: all costs for rented land.
- **Labour costs**: costs for external employees (no family labour).
- **Interest**: Interest payments on borrowed capital
- **Own land**: Imputed costs for own land (valued at regional rental prices).
- **Family labour**: Imputed costs for own labour
- **Own capital**: Imputed interest for own capital (at 4.5 % interest rate)

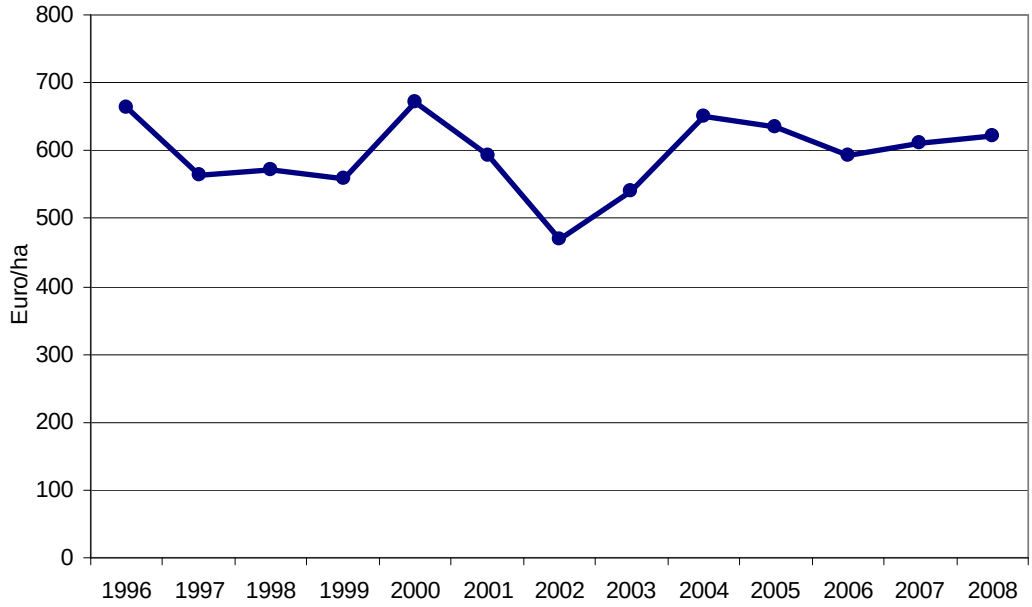
For some of the graphs, costs were aggregated using the following definitions:

- **Specific cost**: costs for feed, veterinary and other livestock-specific costs, seed, fertilizer and crop protection.
- **Non-Specific cost**: All other costs, except depreciation (motor fuel, other energy costs, contract work, building, machinery, other costs and taxes)
- **Production cost (I)**: All costs described under specific and non-specific cost, including depreciation.

2.2 National average production costs

This chapter will provide a brief overview of the application of the general cost of production model to the total German national FADN sample, and the related results concerning the development of the production costs of wheat, pigs and milk. In Figure 2-1 the production costs per hectare of wheat from 1996 to 2008 are illustrated.

Figure 2-1: Production costs (I) of wheat 1996-2008, national average

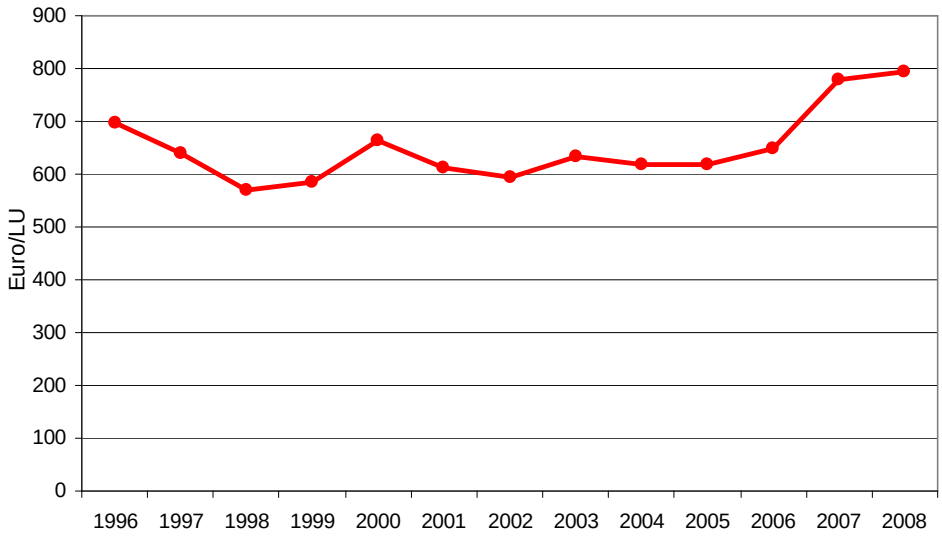


Source: German national FADN.

Production costs of wheat vary in a range of 470 to 670 Euro per hectare, with a minimum in 2002. After the decrease in 2002 the costs rise again until 2004 to almost its maximum value, after that the costs are more or less constant with a value just slightly higher than 600 Euro per hectare. The increase over time of specific costs is compensated by the decrease of non-specific costs and depreciation.

Production costs of pigs have almost continuously risen since 1998, to a value of more than 800 Euro/LU (Figure 2-2). The strong rise of production cost observed in the last two years reflects the increase of feed prices during that period.

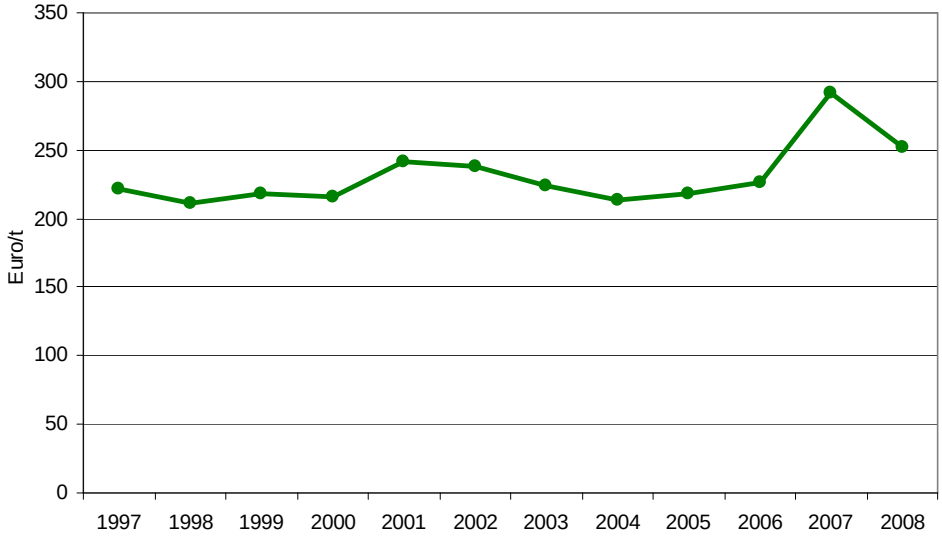
Figure 2-2: Production costs (I) of pigs, 1996-2008, national average



Source: German national FADN.

The production costs of milk had been almost constant until 2006 and have varied only in a range of 210 to 240 Euro per ton. In 2007, the costs rose to a maximum of 290 Euro per ton due to higher costs for concentrates. In 2008 (i.e. accounting year 2008/09 for most farms in Germany), the costs decreased again to a value of 250 Euro per ton.

Figure 2-3: Production costs (I) of milk, 1996-2008, national average



Source: German national FADN.

2.3 Differentiating production costs by farm characteristics

2.3.1 Regional differentiation of estimates

The regions in Germany differ, often significantly, with respect to climate, soils and production and farm structures, and a-priori we expect corresponding regional variations in production costs. In the following, the cost of production model is estimated for all German Laender (excluding the city states) for the year 2005 for the three chosen agricultural products (wheat, pig, milk).

Table 2-2 shows the estimates for wheat for 2005.[3] Many of the coefficients are not statistically significant at 95% significance level. The results also show negative coefficients (including statistically significant coefficients) for some regions. In general the coefficients vary strongly between the different regions, also when excluding the non-significant ones. For 'fertilizer' for example the coefficients vary between 0.13 (NI) and 0.31 (MV).

[3] For the abbreviations see the general abbreviation and acronym section.

Table 2-2: Estimated cost share coefficients for wheat for different German regions, 2005

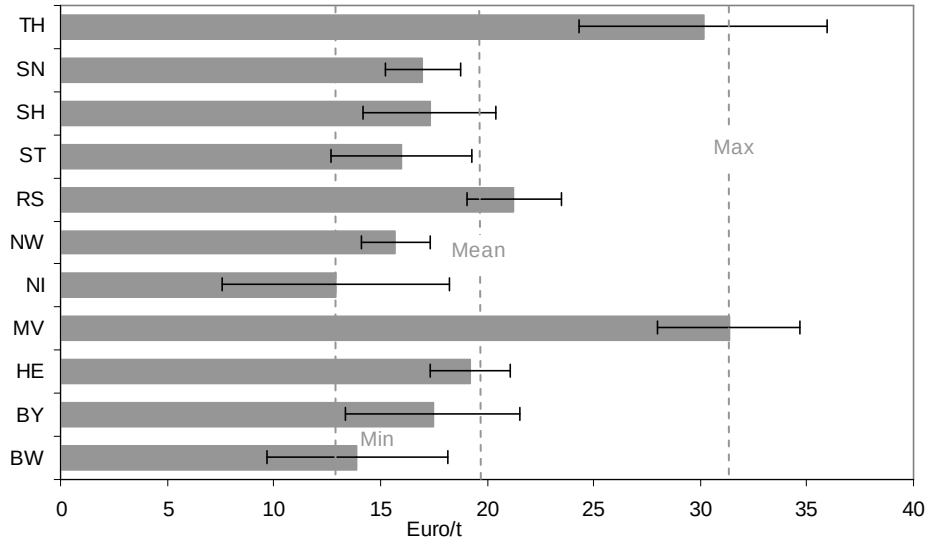
	BW	RS	BY	HE	NI	NW	SH	TH	ST	SN	BB	MV
N	674	510	978	452	693	630	387	274	392	361	208	262
Ø output (€/ha)	689	602	698	644	730	781	802	614	578	547	518	683
Seeds	0.07 *	0.00 *	0.10	0.07 *	0.04	0.08 *	0.07	0.06	0.10	0.05 *	0.10	0.06
Fertilizer	0.14	0.21	0.18	0.19	0.13	0.16	0.18	0.30	0.16	0.18	0.26	0.31
Crop protection	0.20	0.13	0.17	0.23	0.16	0.19	0.22	0.21	0.16	0.15	0.18	0.22
Motor fuel	0.11	0.17	0.16	0.08	0.10	0.08	0.12	0.21	0.11	0.10	0.15	0.11
Other energy	0.03 *	0.01 *	0.05	-0.01 *	0.02 *	0.04 *	0.02 *	0.04	-0.04	0.01 *	0.01 *	0.00 *
Contract work	0.09	0.08	0.08	0.01 *	0.03	0.20	0.02 *	0.05 *	0.16	0.14	0.02 *	0.13
Building	-0.01 *	0.03 *	0.00 *	0.02 *	0.01 *	0.04 *	0.00 *	-0.02 *	-0.01 *	0.05 *	-0.03 *	0.03
Machinery	0.12	0.10	0.14	0.05	0.06	0.05	0.07	0.11	-0.05	0.04 *	-0.03 *	0.11
Other costs	0.10 *	0.19	0.04 *	0.14	0.06	0.04 *	0.04 *	-0.07 *	0.42	0.07 *	0.22	0.13
Depreciation	0.24	0.09	0.33	0.25	0.20	0.17	0.14	0.27	0.15	0.17	0.24	0.19
Taxes	0.01 *	0.02 *	0.02	0.00 *	0.03	0.02	0.02	0.00 *	0.01	0.00 *	0.01 *	0.04

* = Not statistically significant at 95 % level.

Source: German national FADN 2005 and own calculations.

In Figure 2-4 the fertilizer costs for the different regions are shown. this time per ton of wheat, to account for differences in yields. Included is also the confidence interval (± 2σ) and the mean as well as minimum and maximum. It can be seen that NI has the lowest fertilizer costs with approximately 12.90 Euro/t and the highest are the fertilizer costs in MV with 31.33 Euro/t. The mean is around 19.83 Euro/t.

Figure 2-4: Fertilizer costs per ton of wheat for different German regions, 2005



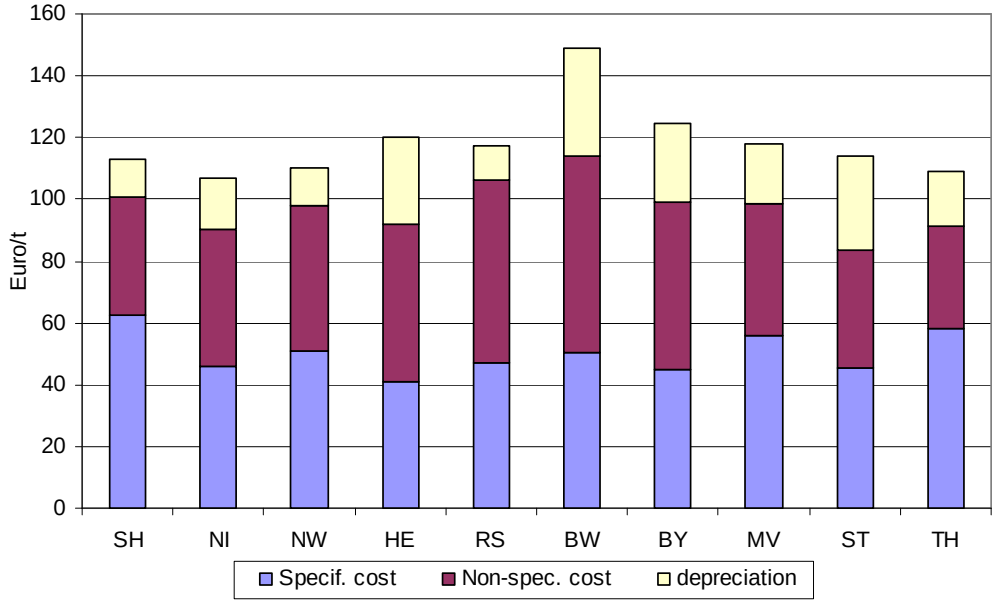
Source: German national FADN 2005 and own calculations.

The average (2007-2009) production costs (excluding land cost and interest) per ton of wheat for different German regions are shown in Figure 2-5, differentiated into specific costs, non-specific costs and depreciation.[4] It can be seen that the production costs vary between different regions. Very high production costs over the whole period shown can be found for BW with a mean over the years of 149 €/t, whereas the lowest average costs can

[4] For the description of these cost categories see page 6.

be found in NI with 107 €/t.[5] The highest value for specific costs can be found for SH, whereas BW shows again the highest costs for non-specific costs and depreciation.

Figure 2-5: Production costs (I) per ton of wheat in different German regions (Ø 2007-2009)



Source: German national FADN and own calculations.

Table 2-3 shows the estimated coefficients for pigs for 2005. In general a high share of coefficients is statistically significant. Overall the variation of regional estimates is lower than for wheat. The highest variation is observed for 'purchased feedstuff' and 'homegrown feedstuff'.

Table 2-3: Estimated cost share coefficients for pigs in different German regions, 2005

	BW	RS	BY	HE	NI	NW	SH	TH	ST	SN	BB	MV
N	451	174	889	371	752	633	221	119	75	136	69	40
Ø herd size (LU)	67	64	49	46	138	140	177	365	166	151	432	385
Purchased feed	0.32	0.27	0.28	0.28	0.38	0.33	0.31	0.34	0.35	0.44	0.31	0.46
Home-grown feed	0.11	0.16	0.14	0.18	0.07	0.11	0.06	0.05	0.04	0.05	-0.02	0.01 *
Veterinary costs	0.06	0.08	0.07	0.06	0.08	0.06	0.17	0.10	0.08	0.10	0.11	0.13
Seeds	0.00 *	0.02	0.00 *	0.01 *	0.00 *	0.01 *	0.00 *	0.01 *	0.01	-0.01 *	0.01	0.00 *
Fertilizer	-0.01	-0.02	-0.01	-0.01	0.00	0.00	-0.01	-0.02	-0.01	0.00 *	0.02	0.00 *
Crop protection	0.01	0.01	0.00	0.01	0.01	0.00	0.00	0.00 *	0.00 *	0.00 *	0.02	-0.01 *
Motor fuel	0.02	0.00 *	0.01	0.00 *	0.01	0.01	0.01	0.00 *	0.01 *	-0.01 *	0.02	0.02
Other energy	0.04	0.04	0.04	0.05	0.06	0.05	0.05	0.08	0.05	0.05	0.04	0.07
Contract work	0.03	0.04	0.02	0.01	0.03	0.03	0.02	0.04	-0.01 *	0.05	0.01 *	-0.01 *
Building	0.01	0.02	0.01	0.02	0.01	0.01	0.02	0.01 *	0.01	0.04	0.04	0.01
Machinery	0.03	0.02	0.02	0.01	0.02	0.03	0.03	0.00 *	0.00 *	0.01 *	0.04	0.03
Other costs	0.05	0.03	0.05	0.02 *	0.03	0.04	0.05	0.03 *	0.02 *	0.04 *	0.05	0.04
Depreciation	0.09	0.07	0.08	0.09	0.07	0.07	0.05	0.08	0.10	0.06	0.10	0.08
Taxes	0.00	0.00 *	0.00 *	0.00 *	0.00	0.00	0.00	0.01	0.00	0.00 *	0.00	0.00 *

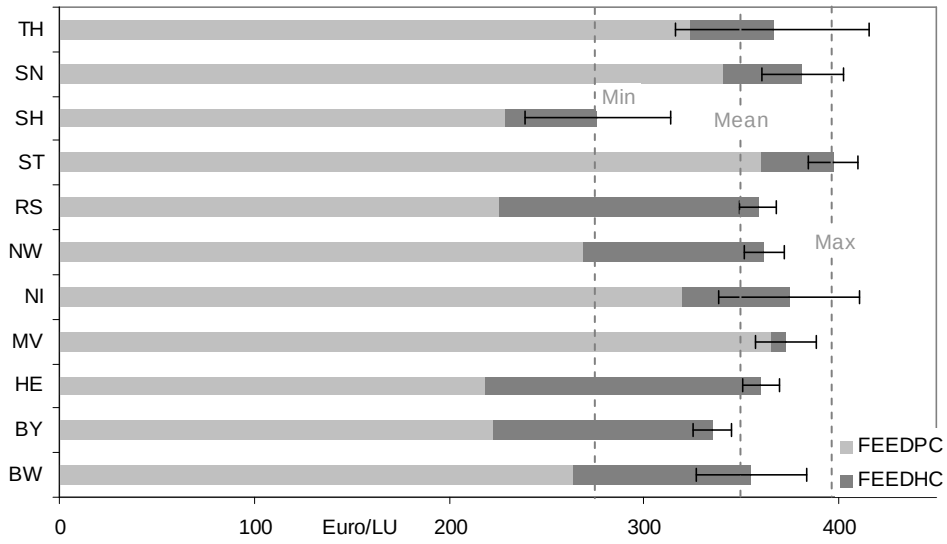
* = Not statistically significant at 95 % level.

Source: German national FADN 2005 and own calculations.

[5] Note that results for BB and SN are excluded here, due to a high amount of negative values.

Although the costs for purchased and homegrown feedstuff are different between the regions, the sum of both is approximately the same in all regions (Figure 2-6). The lowest total value can be found in SH (276 Euro/LU) and the highest in ST with 397 Euro/LU, while the mean is around 350 Euro/LU.

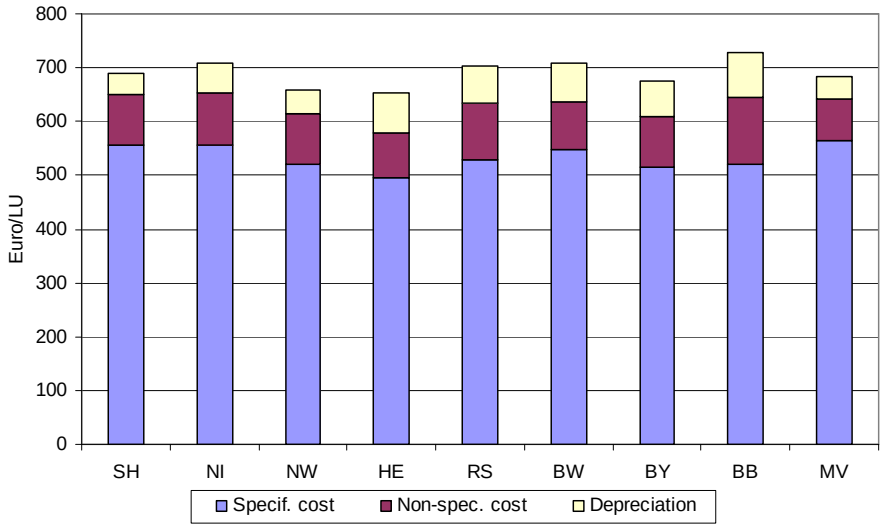
Figure 2-6: Purchased and homegrown feedstuff costs per livestock unit pig, 2005



Source: German national FADN 2005 and own calculations.

The two year (2007, 2009) average production costs per livestock unit pig are presented in Figure 2-7. The results for TH, SN and ST seem questionable, due to implausible high value for 'other costs' in TH and feed costs in ST and SN (which might be due to the sample size – 136 in SN, 75 in ST) and are therefore excluded in the graph. Otherwise the highest average production costs for all years can be found in BB with 727 €/LU, whereas the lowest average costs can be found in HE with 655 €/LU. But in general there is no big difference in amount and structure of the production costs between the different regions.

Figure 2-7: Production costs (I) per livestock unit pig in different German regions (Ø 2007, 2009)[6]



Source: German national FADN and own calculations.

[6] The year 2008 is excluded here, as it shows many implausible negative values.

The estimates for milk for 2005 show significant results for many cost items (Table 2-4). Here the variation across the different regions is also relatively low. It is again the highest for ‘homegrown feedstuff’ followed by ‘other costs’ and ‘subsidies’. The smallest difference can be found for ‘taxes’ and ‘other energy costs’.

Table 2-4: Estimated cost share coefficients for milk by German regions, 2005

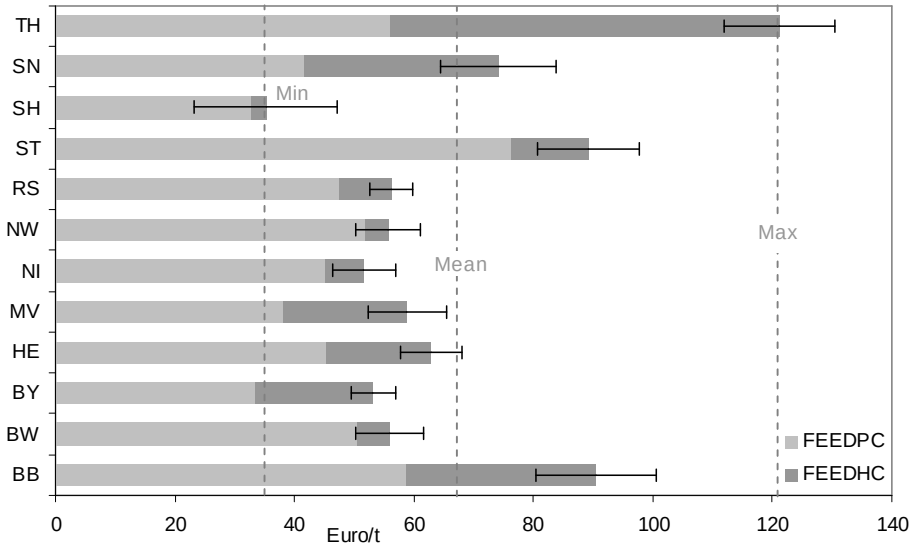
	BW	RS	BY	HE	NI	NW	SH	TH	ST	SN	BB	MV
N	556	350	1526	293	694	516	383	172	294	182	131	143
Ø yield (kg milk/cow)	5586	6100	5835	6291	7128	6683	7279	7166	7118	7202	7031	7467
Purchased feed	0.17	0.16	0.11	0.16	0.16	0.18	0.12	0.20	0.27	0.14	0.21	0.14
Home-grown feed	0.02	0.03	0.07	0.06	0.02	0.01	0.01 *	0.23	0.05	0.11	0.11	0.07
Veterinary costs	0.08	0.09	0.07	0.10	0.08	0.09	0.16	0.10	0.08	0.09	0.10	0.15
Seeds	0.01 *	0.01	0.01	0.01 *	0.01	0.01	0.02	0.01	0.03	0.02 *	0.01	0.02
Fertilizer	0.01	0.02	0.02	0.02	0.03	0.02	0.02	0.01	0.04	0.02	0.03	0.03
Crop protection	0.00 *	0.01	0.00 *	0.00	0.01	0.00	0.01	0.02	0.02	0.01	0.01	0.00 *
Motor fuel	0.05	0.04	0.04	0.05	0.04	0.04	0.03	0.06	0.06	0.05	0.05	0.04
Other energy	0.03	0.02	0.03	0.03	0.03	0.03	0.02	0.04	0.03	0.03	0.03	0.02
Contract work	0.05	0.04	0.04	0.04	0.06	0.06	0.08	-0.01 *	0.03	0.03	-0.02 *	0.05
Building	0.00 *	0.01	0.01	0.01	0.01	0.01	0.02	0.05	0.01	0.00 *	0.02	0.01
Machinery	0.06	0.04	0.04	0.04	0.05	0.04	0.05	0.06	0.07	0.04	0.01	0.03
Other costs	0.07	0.07	0.09	0.06	0.06	0.07	0.07	-0.08	0.00 *	0.05	0.04	0.05
Depreciation	0.20	0.19	0.24	0.19	0.16	0.15	0.15	0.17	0.10	0.17	0.11	0.11
Taxes	0.01	0.00 *	0.01	0.00 *	0.00	0.00	0.01	0.01	0.01	0.00 *	0.00 *	0.00 *

* = Not statistically significant at 95 % level.

Source: German national FADN 2005 and own calculations.

Figure 2-8 shows the production costs per ton of milk in 2005 for purchased and homegrown feedstuff, which vary significantly between regions. The lowest are the production costs in SH with approximately 35 Euro/t, while the highest costs can be found in TH with 121 Euro/t. The mean is around 67 Euro/t, whereas the median is at 57.5 Euro/t.

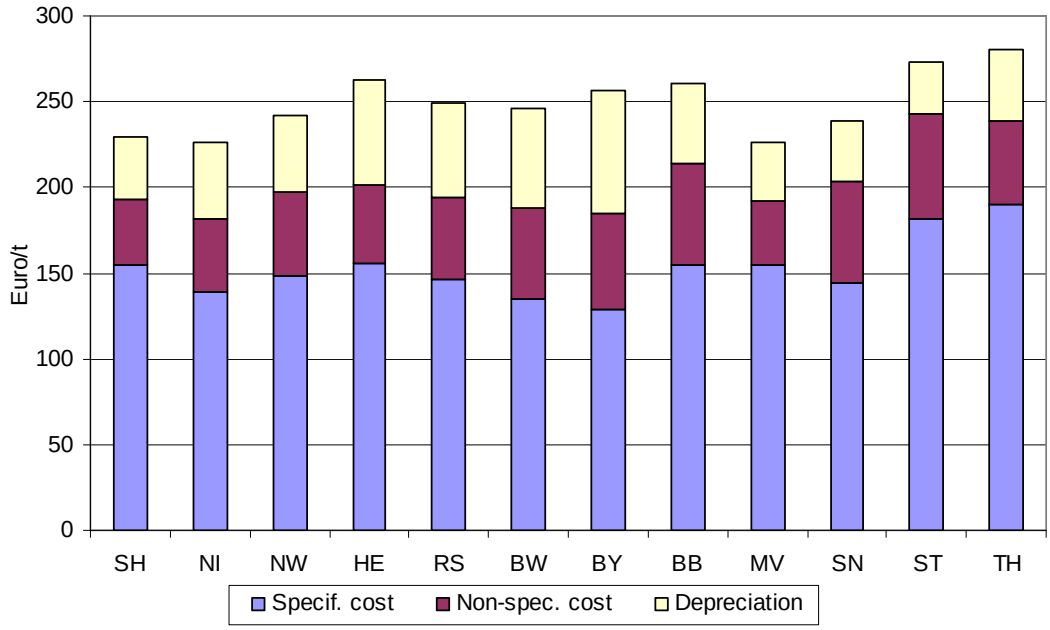
Figure 2-8: Purchased and homegrown feedstuff costs per ton of milk, 2005



Source: German national FADN 2005 and own calculations.

In Figure 2-9 the average production costs per ton milk are illustrated. The highest mean production costs over all years can be found for TH with 280 €/t[7] and the lowest can be found in NI with 226 €/t. TH also shows the highest value for specific costs, whereas ST has the highest value for non-specific costs as well as BY for depreciation. Generally, the level as well as the regional differences in production costs seem plausible, at least for the old Laender. The estimates for the new Laender were sometimes less robust, possibly due to smaller sample sizes, and are surprisingly high, which might partly be due to accounting rules (e.g., the accounting period differs between legal and family farms) and data problems (e.g., single farm accounts may not properly reflect true costs due to the often rather complex legal structures of multi-farm holdings in one enterprise).

Figure 2-9: Production costs (I) per ton of milk in different German regions (Ø 2007-2009)



Source: German national FADN and own calculations.

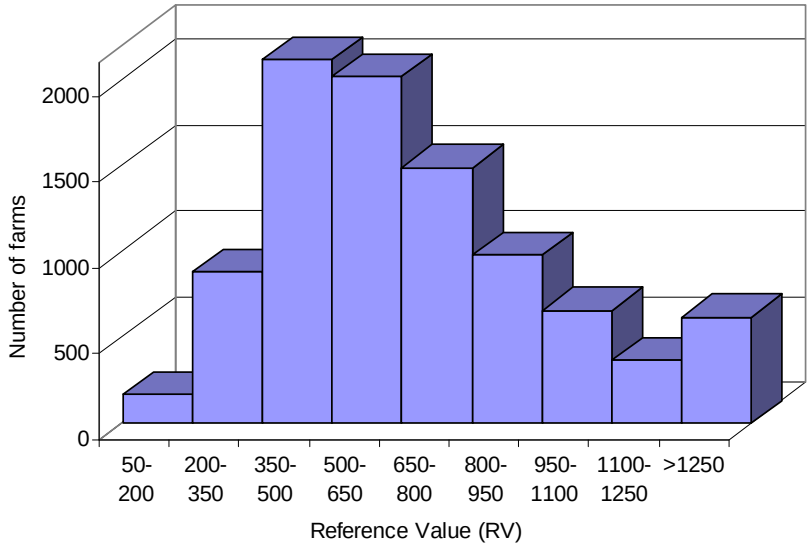
2.3.2 Differentiation by land quality

Land quality is expected to affect production costs per physical output due to its impact on yields in crop production. A priori, it is expected that on good soils, wheat production costs per t are lower due to higher yields, and lower for milk due to higher fodder yields and thus lower feeding costs.[8] The Germany FADN provides the opportunity to cluster farms via a so-called 'reference value of land' (German: 'Vergleichswert') (in Euro/ha UAA), which assigns a value to every farm depending on the natural site conditions. For 2005, the value ranges between 50 and 2225 Euro/ha (Figure 2-10). Nine classes were generated, however, for the estimation the first class (50-200 Euro/ha) wasn't considered, as the sample size is

[7] For TH only the mean over 2007 and 2009 is calculate, as most cost figures in 2008 are negative and non-significant.
[8] Pig production costs were not analysed, as there's no connection between soil quality and pig production.

too small. The general cost of production model is applied to these different samples based on the reference value (RV).

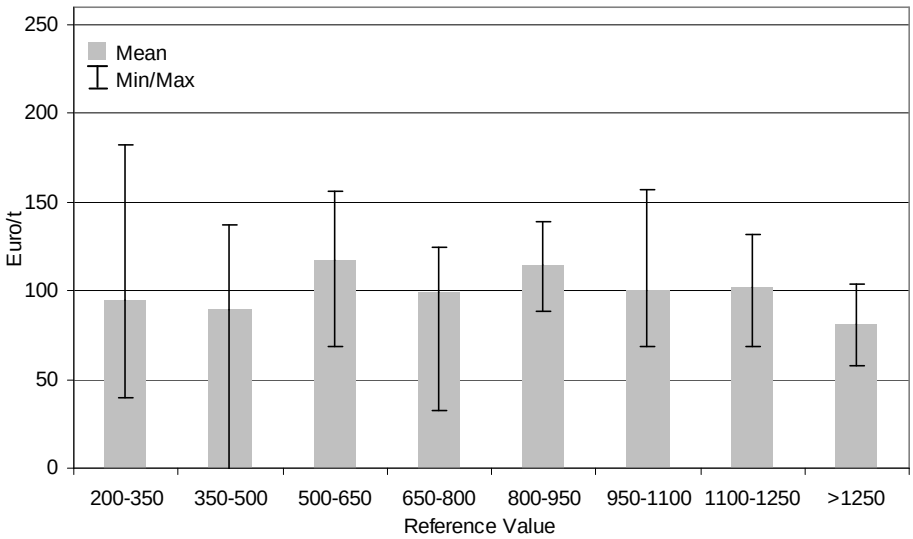
Figure 2-10: Size range of the reference value of German farms, 2005



Source: German national FADN 2005 and own calculations.

Figure 2-11 shows the mean of the production costs per ton of wheat for different size classes of the reference value for the years 1996-2008. Additional the minimum and the maximum values are shown to illustrate the variation of the values over time.

Figure 2-11: Production costs (I) per ton of wheat by land quality (Ø 1996-2008)



2005	200-350	350-500	500-650	650-800	800-950	950-1100	1100-1250	>1250
N	266	859	1208	1090	788	609	346	564
Ø yield (€/ha)	735.1	653.8	648.3	670.7	747.8	747.0	735.1	769.7

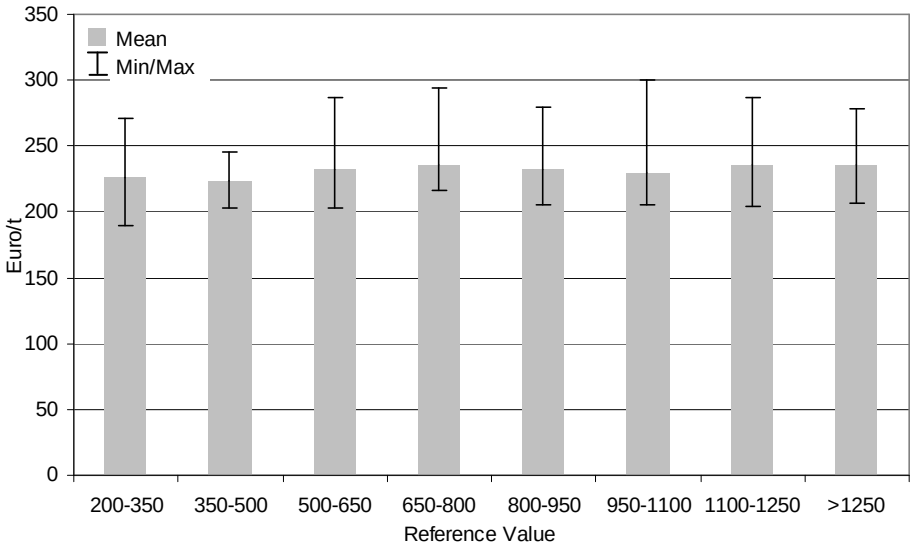
Source: German national FADN and own calculations.

The mean varies between 80 and 117 Euro/t, where the highest value can be found for farms with an RV of 800-950 Euro/ha followed by farms with an RV of 500-650 Euro/ha.

Surprisingly, farms with an RV of less then 500 Euro/ha have on average lower production costs then farms between 500-650 and 800-950 Euro/ha. But as the variation of the values over time is very high, the results are robust, probably due to small sample sizes.

In Figure 2-12 the mean production costs per ton of milk for different reference value classes for the years 1997-2008 are illustrated. Again, the minimum and the maximum values are shown.

Figure 2-12: Production costs (I) per ton of milk by land quality (Ø 1997-2008)



2005	200-350	350-500	500-650	650-800	800-950	950-1100	1100-1250	>1250
N	645	1500	1267	815	429	247	110	250
Ø yield (kg milk/cow)	6090	6080	6335	6437	6714	6354	6389	6220

Source: German national FADN and own calculations.

It can clearly be seen that the production costs for milk are rather homogenous; they vary between 223 and 236 Euro/t. For milk also the difference between the minimum and the maximum value is much smaller than it is for wheat.

2.3.3 Differentiation between part- and full-time farmers

For individual farms and private partnerships there is the possibility to cluster farms depending on their type of business (full- and part-time). Here, full-time businesses are defined as those greater than 16 ESU and with at least one AWU. The German dataset for 2005 consists of mainly full-time farms (90%); only 10% are part-time farms.

Table 2-5 shows the production cost estimates for full-time farms in 2005. Also, the statistical significant differences between full- and part-time farms in 2005 are illustrated. It can be seen that 27% of those coefficients shown, are significantly different at 1% significance level. About 35% are significantly different at 5% level.

Table 2-5: Estimated cost share coefficients for full-time farms, 2005

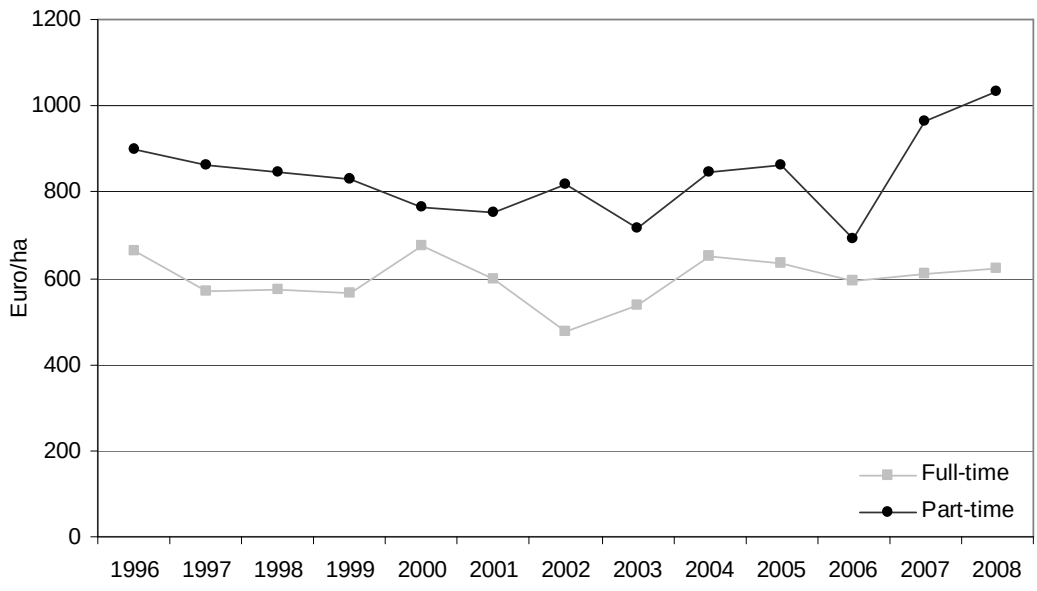
	Wheat	Barley	Potato	Sugar-beet	Rape seed	Cattle	Pig	Milk
Purchased feed						0.194 ***	0.343 *	0.183 ***
Home-grown feed						0.035 ***	0.072 ***	0.079 ***
Veterinary cost						0.065	0.094 ***	0.105 ***
Seeds	0.069	0.082	0.163	0.054	0.045	0.019	0.003	0.013
Fertilizer	0.176	0.201 ***	0.064 ***	0.054	0.259 **	0.048 ***	-0.001	0.021
Crop protection	0.207 ***	0.184 ***	0.081 ***	0.046	0.155	0.014 **	0.009	0.012 **
Motor fuel	0.113 **	0.178 ***	0.067	0.046	0.121	0.098 *	0.013 *	0.058 ***
Other costs	0.011 **	0.023 *	0.009 **	0.006	0.015	0.025 ***	0.055	0.030
Contract work	0.052 ***	-0.042	0.032	0.107	0.048 *	0.061 **	0.017 **	0.018 ***
Building	0.008	0.044	0.000	0.015	-0.013 *	0.027 ***	0.017	0.018
Machinery	0.044 ***	0.141	0.065	0.028	0.042	0.079 *	0.026 **	0.052 *
Other costs	0.008 ***	0.241	0.011	-0.018 ***	0.086 **	0.090 ***	0.024 *	0.024 ***
Depreciation	0.191	0.248 ***	0.090	0.071	0.019	0.213 *	0.090 **	0.134
Taxes	0.020	-0.008 ***	0.004	0.010	0.026 ***	0.018	0.004	0.006
Subsidies	-0.014 *	-0.086 *			0.035	-0.168		-0.050
Net Value	0.115 *	-0.206 ***	0.414	0.581 *	0.160	0.181 ***	0.234	0.296

Statistical significance of the difference of the coefficients between full- and part-time farms.
*** = 1 % sign. level, ** = 5 % sign. level, * 10 % = sign. level.

Source: German national FADN 2005 and own calculations.

For the three chosen products the estimated production costs are illustrated in more detail. Figure 2-13 shows the production costs per hectare of wheat for full- and part-time farms. It can be seen that for all years part-time farms have higher production costs than full-time farms, mainly due to higher non-specific costs. These differences might be due to scale effects in production, as full-time farms cultivate on average 139 ha UAA (in 2005) and part-time farms only 27 ha.

Figure 2-13: Production cost (I) per hectare of wheat for full- and part-time farms, 1996-2008



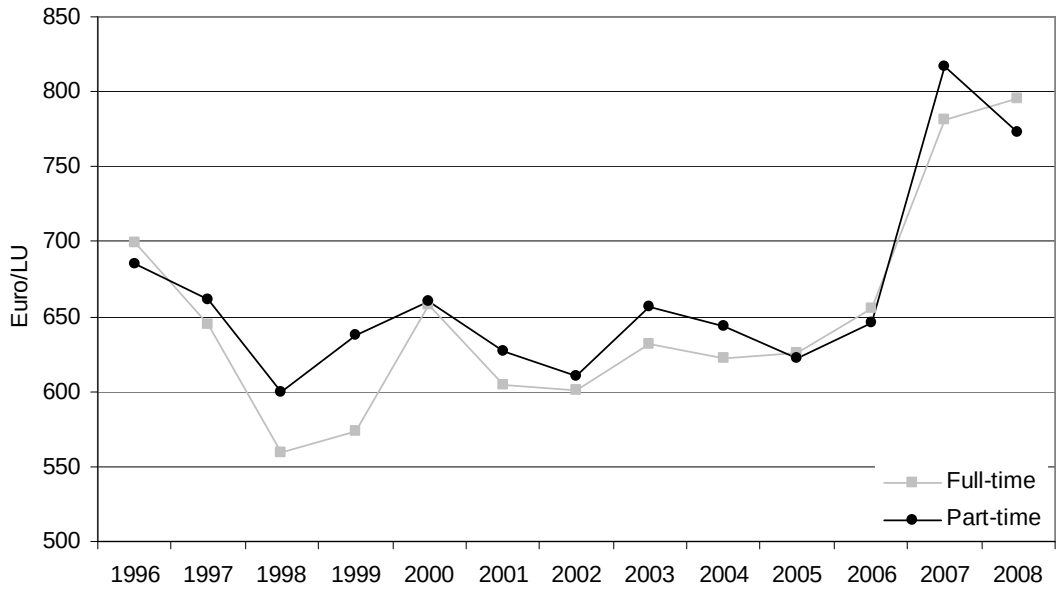
2005	Full-time	Part-time
N	5208	613
Ø yield (€/ha)	708.9	669.1

Source: German national FADN and own calculations.

Part-time farms show in the first years until 2001, a downward trend in the production costs, whereas in the last two years there is a rise in these costs, reflecting increased prices for fertilisers and energy. The production costs (I) for full-time farms are more volatile over the years, but no clear trend can be seen; they vary in a range of 470-675 Euro/ha.

In Figure 2-14 the production costs (I) per livestock unit of pig for full- and part-time farms are illustrated. The production costs for part-time farms are slightly higher in 8 of the 12 years shown, and for some years (e.g. 2000, 2005, 2006) the costs are almost equal.

Figure 2-14: Production cost (I) per livestock unit of pig for full- and part-time farms, 1996-2008

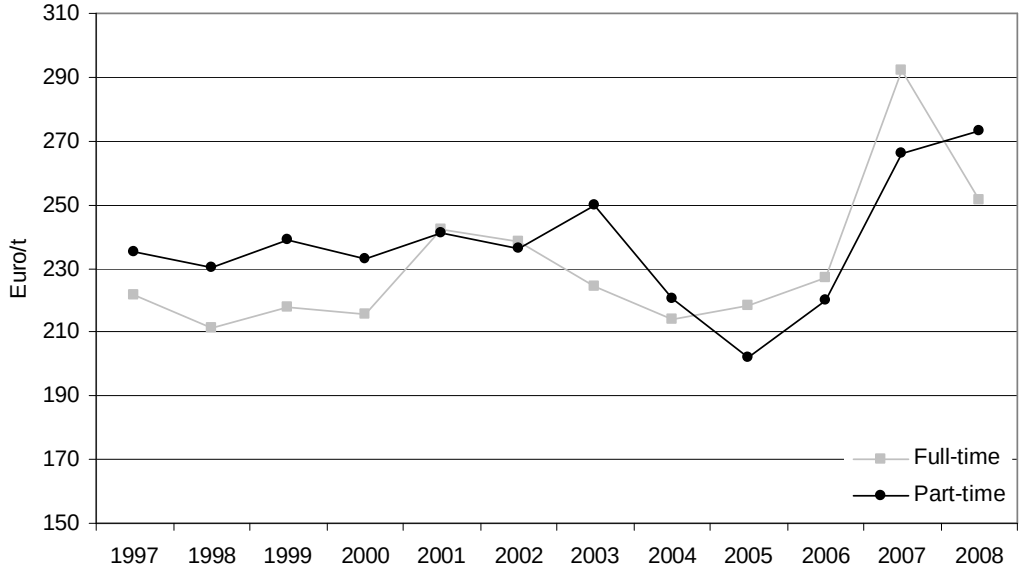


2005	Full-time	Part-time
N	3558	372
Ø herd size (LU)	121.65	23.47

Source: German national FADN and own calculations.

Figure 2-15 shows the production costs per ton of milk. The production costs for part-time farms are in the beginning higher then those of full-time farms, but during 2005 to 2007 it is the other way around. Generally, non-specific costs and depreciation per ton are slightly higher in part time farms. The production costs of full-time farms are more or less constant (with only a slight raise in 2001) until 2006, where they rise to a peak in 2007, before they fell again in 2008. The production costs of part-time farms are also more or less constant until 2003, where they start decreasing until 2005, before they rise again for the last couple of years, with a maximum in 2008. However, it should be noted that the sample size for milk production of part-time farms is relatively small (174 farms in 2005).

Figure 2-15: Production costs (I) per ton of milk for full- and part-time farms, 1996-2008



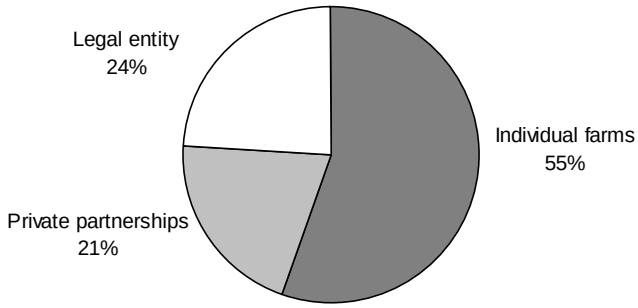
2005	Full-time	Part-time
N	5069	174
Ø yield (kg milk/cow)	6377	5235

Source: German national FADN and own calculations.

4.3.4 Legal form

Farms are operating under different legal forms. In Germany there are three different main types: individual farms, private partnerships (as the German GbR, OHG, KG) and legal entities (e.V., GmbH, e.G., AG). While in the old Laender individual farms still dominate farming, in the new Laender the structures are much more diverse. Figure 2-16 shows the distribution of these three types of legal forms of FADN (full-time) farms for the new Laender of Germany in 2005. A priori, no clear hypotheses on the impact of legal form on production cost exists: While individual farms may benefit from better incentive structures and lower transaction costs, private partnerships and legal farms may be more professional and more oriented to profit-maximization.

Figure 2-16: Legal form of full-time farms in 2005 for new Laender of Germany



Source: Own illustration based on German national FADN.

The general cost of production model is applied to these different types of farms. The results for the three chosen products are shown in Table 2-6. The coefficients with a star are statistically significant at 95% significance level.

While for milk most coefficients are statistically significant at 95% level, pig and wheat show several non-significant coefficients, especially for legal companies.

Table 2-6: Estimated cost share coefficients for different legal forms, 2005

Input		Wheat	Pig	Milk
FEEDPC	individual enterprise		0.310 *	0.158 *
	private partnership		0.298 *	0.172 *
	legal entity		0.358 *	0.200 *
FEEDHC	individual enterprise		0.058 *	0.103 *
	private partnership		0.047 *	0.053 *
	legal entity		0.027 *	0.094 *
VETCOS	individual enterprise		0.104 *	0.107 *
	private partnership		0.130 *	0.133 *
	legal entity		0.118 *	0.104 *
SEED	individual enterprise	0.073 *	0.016 *	0.014 *
	private partnership	0.133 *	0.014 *	0.025 *
	legal entity	0.060 *	0.005	0.018 *
FERTIL	individual enterprise	0.166 *	-0.002	0.026 *
	private partnership	0.191 *	0.007	0.011 *
	legal entity	0.206 *	0.007	0.020 *
CRPROT	individual enterprise	0.156 *	0.015 *	0.008 *
	private partnership	0.196 *	0.012 *	0.008 *
	legal entity	0.224 *	0.012 *	0.015 *
MOTFUE	individual enterprise	0.146 *	0.011 *	0.039 *
	private partnership	0.076 *	0.005	0.057 *
	legal entity	0.123 *	0.021 *	0.058 *
OENERG	individual enterprise	0.008	0.029 *	0.028 *
	private partnership	-0.006	0.062 *	0.032 *
	legal entity	0.007	0.059 *	0.032 *
CONWOR	individual enterprise	0.087 *	0.038 *	0.053 *
	private partnership	0.077 *	0.015	0.064 *
	legal entity	0.035	-0.002	-0.007
BUILUK	individual enterprise	0.023 *	0.019 *	0.006 *
	private partnership	0.038 *	0.005 *	0.013 *
	legal entity	0.010	0.024 *	0.024 *
MACHUK	individual enterprise	0.085 *	0.025 *	0.040 *
	private partnership	-0.005	0.010 *	0.043 *
	legal entity	0.024	0.033 *	0.052 *
OTHSIC	individual enterprise	0.027	0.057 *	0.035 *
	private partnership	0.093 *	0.088 *	0.072 *
	legal entity	0.086	0.005	0.005
DEPREC	individual enterprise	0.174 *	0.069 *	0.109 *
	private partnership	0.194 *	0.092 *	0.141 *
	legal entity	0.206 *	0.111 *	0.118 *
TAXES	individual enterprise	0.018 *	0.009 *	0.003 *
	private partnership	0.009 *	0.001	0.005 *
	legal entity	0.026 *	0.005 *	0.008 *

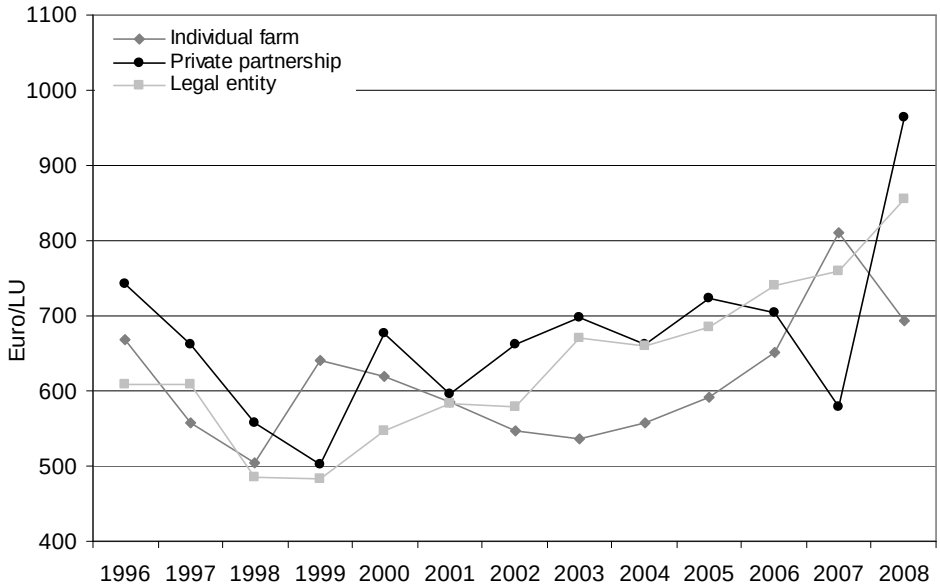
* = Statistical significance at 95 % level.

Source: German national FADN 2005 and own calculations.

In general, the production costs vary between the different legal forms. For wheat no clear ranking regarding the production costs of different legal forms can be generated.

Concerning pig production, the production costs are for most years the highest for private partnerships (Figure 2-17).

Figure 2-17: Production costs (I) of pigs for different types of legal forms, 1996-2008

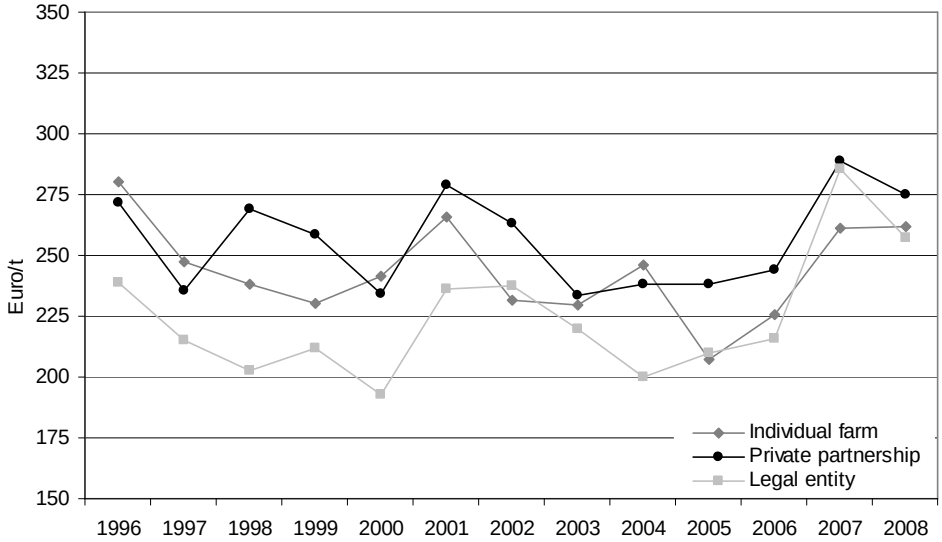


2005	Individual farm	Private partnership	Legal entity
N	3484	281	342
Ø herd size (LU)	90	144	716

Source: German national FADN and own calculations.

The same can be seen for milk production, where private partnerships also have mostly the highest production costs followed by individual farms and the lowest production costs can be found for legal entities (except for 2007), where the production costs are on average ca. 50 Euro lower than for private partnerships (Figure 2-18). These results might be due to scale effects, as the average number (in 2005) of dairy cows is 426 cows in legal companies but only 144 dairy cows in private companies and just 63 dairy cows in individual farms.

Figure 2-18: Production costs (I) of milk for different legal forms, 1996-2008



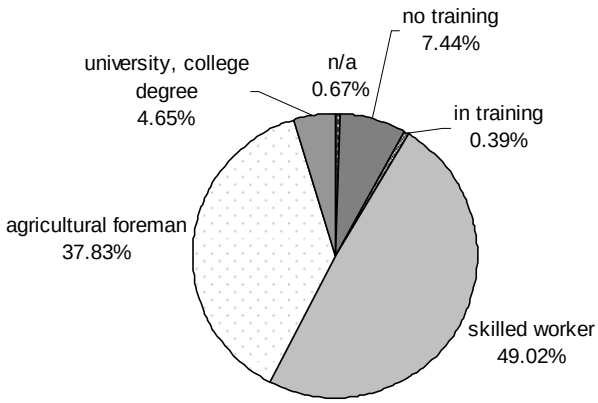
2005	Individual farm	Private partnership	Legal entity
N	4370	531	165
Ø yield (kg milk/cow)	6174	6856	7864

Source: German national FADN and own calculations.

2.3.5 Education of farm managers

Education is expected to increase the efficiency of farm management and production, and reduce production costs. The German FADN allows to analyse whether there is a connection between education level and the costs of production. An overview of the education of the farm manager of individual farms and private partnerships is shown in Figure 2-19 for 2005.

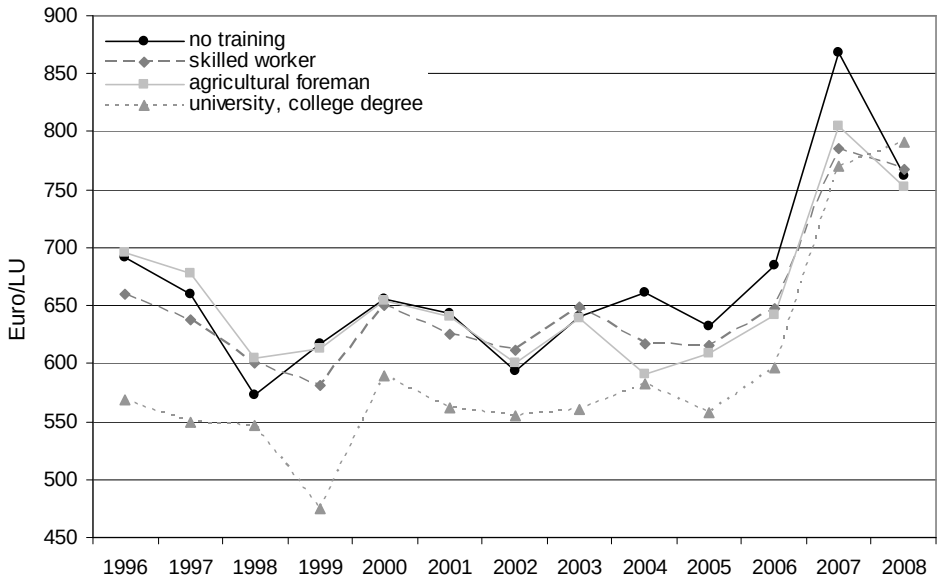
Figure 2-19: Education of farm managers in 2005



Source: Own illustration based on German national FADN.

While for wheat and milk no influence of the education on the cost of production can be detected, some interesting results can be identified for the production cost of pigs (Figure 2-20).

Figure 2-20: Production cost (I) for pigs subject to the education of the farm manager, 1996-2008



2005	no training	skilled worker	agricultural foreman	university, college degree
N	382	1899	1314	130
Ø herd size (LU)	59	79	126	151

Source: German national FADN and own calculations.

It can be seen that for all years (except 2008), the production costs of pigs held by farmers with a university or college degree are lower than those of other farmers. Although the sample size for those farms is relatively small (130 farms), most of the estimated coefficients are statistically significant (at 95% significance level) (not shown). However, this result has to be revised, as there is a high correlation between the education of the farm manager and the size of the farms, so that this results might result might be due to size effects.

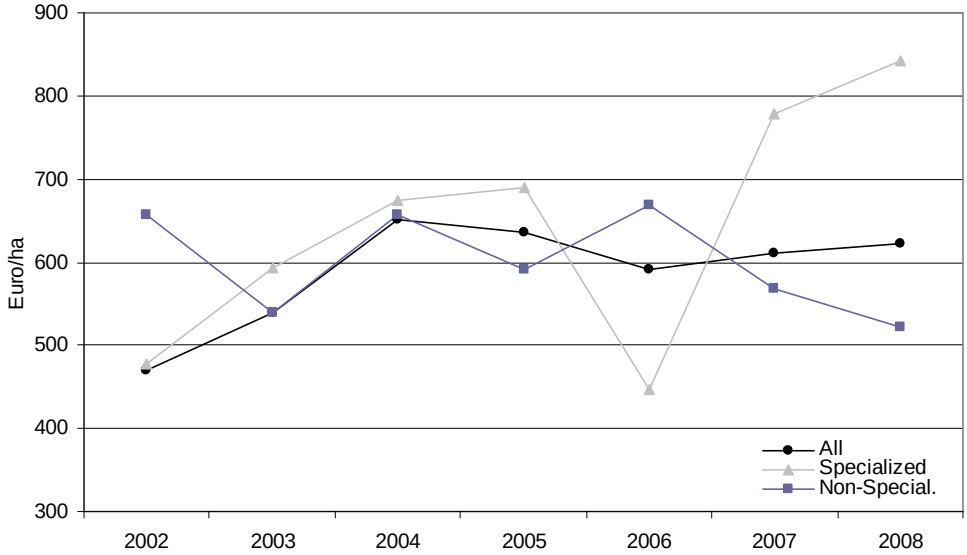
2.3.6 Specialized farms

For the years 2002-2008 a comparison of the production costs (I) between specialized farms (for crop, pig and milk), non-specialized (all but the specialized farms) and all farms is made.[9] While specialisation is expected to lower production costs due to economies of scale and efficiency effects, the loss of economies of scope may increase costs. Against the background of the increasing tendency of specialisation of farming in Germany and the decreasing number of mixed farms, we expect a priori that overall, the cost-decreasing effect of specialisation prevails.

In Figure 2-21 the production costs per hectare of wheat for specialized crop and root crop farms are compared to the production costs of wheat for non-specialized and all farms.

[9] Starting in 2002 farm specialization was defined according to EU FADN classification.

Figure 2-21: Production costs (I) of wheat for specialized, non-specialized and all farms, 2002-2008



2005	Specialized	Non-specialized	All
N	1653	4168	5821
Ø yield (€/ha)	680.4	707.3	698.4

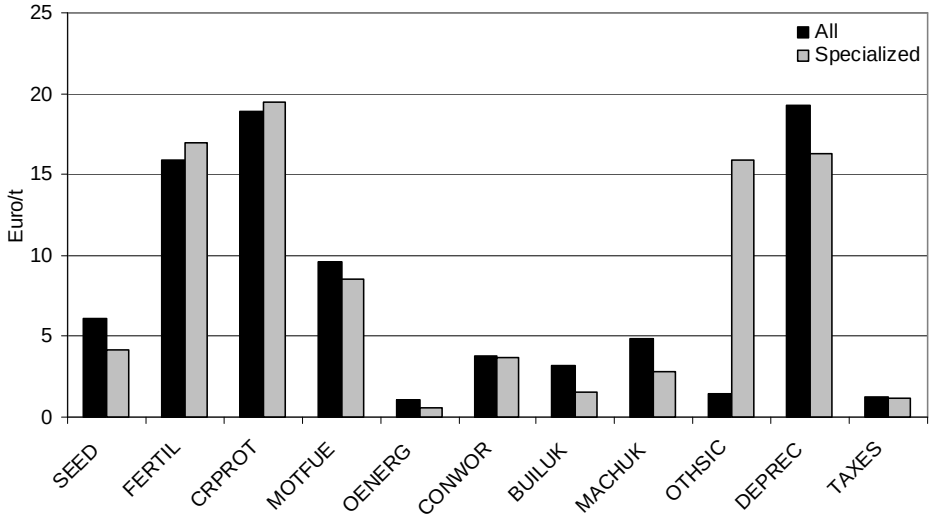
Source: German national FADN and own calculations.

It can be seen that, except for the year 2006 [10], the production costs per hectare of wheat for specialized farms are higher than those of non-specialized and all farms. Furthermore, for the last two years the difference is even higher than in the beginning. These discrepancies are mainly due to variations in fertilizer and crop protection costs, as well as 'other costs' (car expenses, water costs, building and insurance costs etc.)

In Figure 2-22 the average costs per *ton* of wheat for the years 2002-2008 are shown for different input categories. The biggest difference can be found for depreciation, machinery and seed costs, each of which are approximately 2-3 Euro/t higher on all farms. However, specialized farms show much higher values for 'other costs', which are 14.5 Euro/t higher than for all farms. It seems that the model attributes a (too?) high share of non-specific / overhead costs to the main products of a farm.

[10] The reason can't be fully explained and might be due to data inconsistencies.

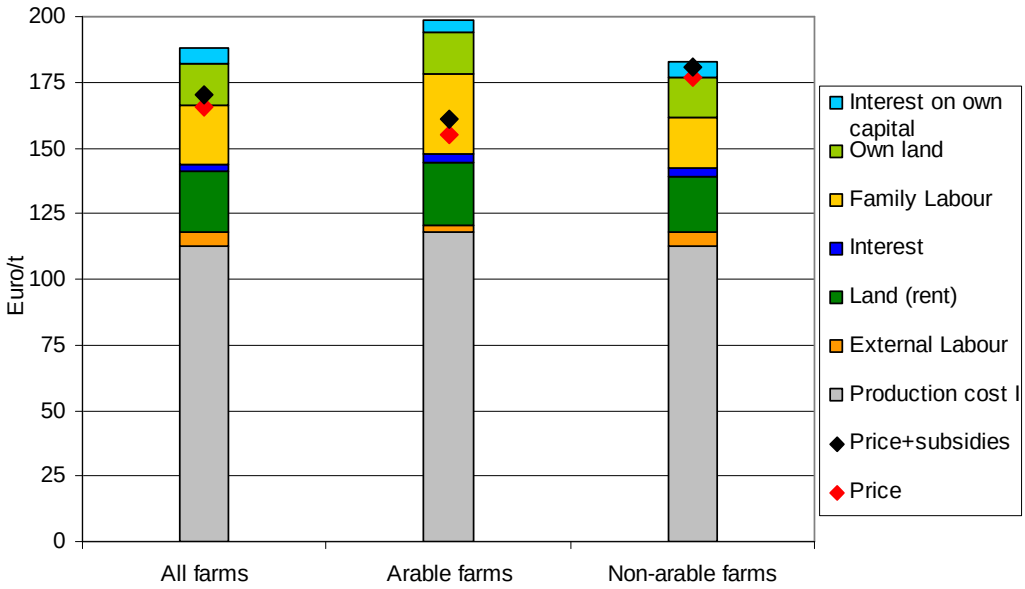
Figure 2-22: Input costs for wheat in specialized and in all farms (Ø 2002-2008)



Source: German national FADN and own calculations.

In Figure 2-23 the average production costs, including interest, land and labour costs as well as opportunity costs for land, labour and interest in the Old Laender states of German for all, arable farms and non-arable farms are shown. It can be seen that the costs per ton are higher for specialized farms, while they are the lowest for non-specialized farms. The cost structure for all three types is rather similar. Included are also the sales price as well as the price plus subsidies, where both are not high enough for all three farm types to cover all costs, but at least high enough to cover all costs but the opportunity costs.

Figure 2-23: Full production costs of wheat in the Old Laender (Ø 2007-2009)

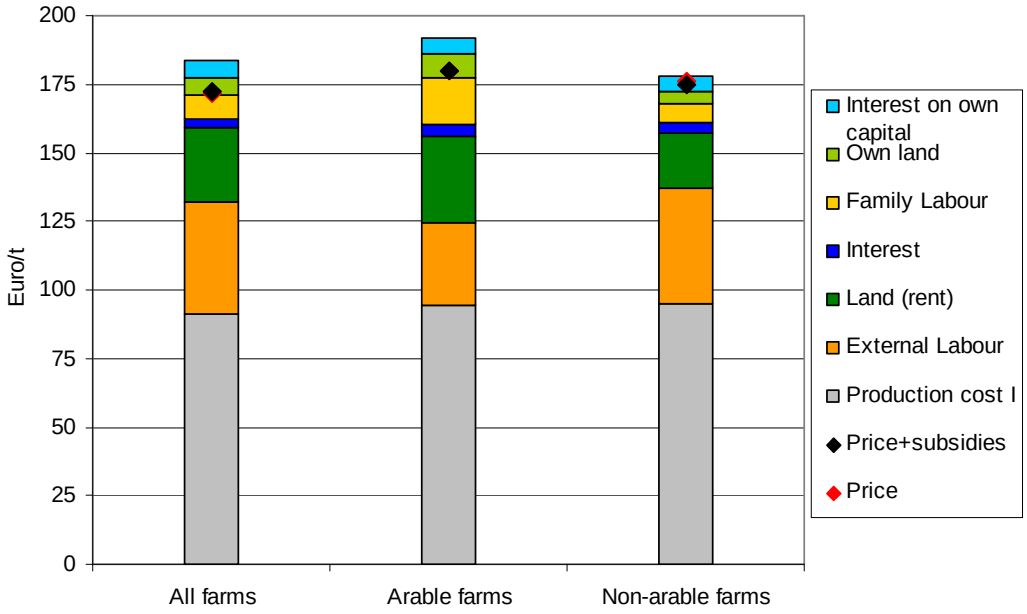


Source: German national FADN and own calculations.

The same picture (Figure 2-24) can be drawn for the New Laender states of Germany. In general, arable farms show slightly higher costs that the other two farm types. Concerning the cost components, in the New Laender states, the hired labour costs are higher that in the Old Laender states, whereas for the own labour costs it is the other way around. In general the average cost level for all three farm types is similar to the one in the Old Laender states.

Here the price (plus subsidies) is almost high enough to cover all costs including opportunity costs.

Figure 2-24: Full production costs of wheat in the New Laender (Ø 2007-2009)

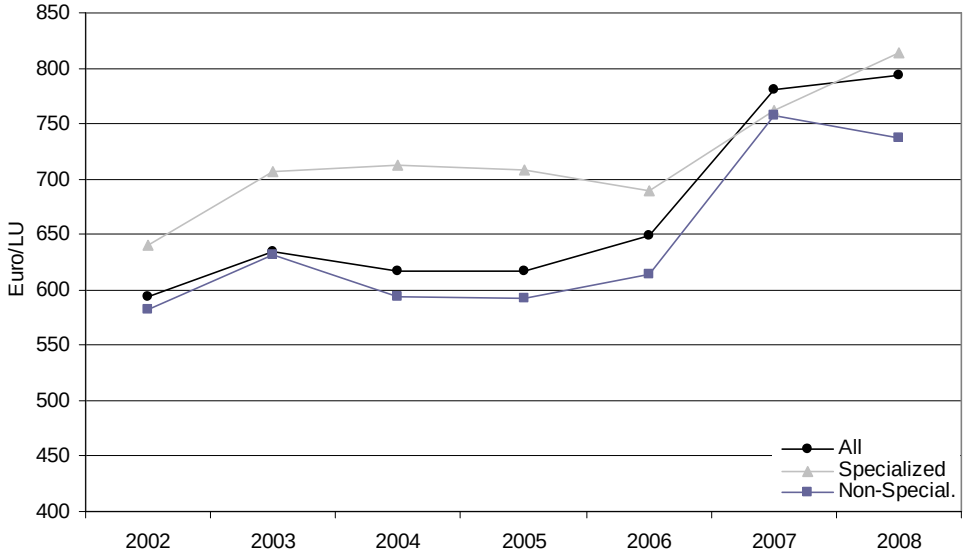


Source: German national FADN and own calculations.

In Figure 2-25 the production costs per livestock unit of pig for specialized pig fattening and breeding farms, non-specialized and all farms are illustrated.[11] It can be seen that the production costs for specialized farms are higher, except for 2007, than those of all farms. The biggest difference can be found for 2004 and 2005, while the costs are rather similar in the last two years. This convergence may partly be due to the higher importance of specific costs for total production costs during the last years. But as the monetary output per livestock unit of pig is also higher for specialized farms, those farms still have a higher net value added in all years than all farms. The development of the costs is quite similar for all farms and non-specialized farms, but all farms have a slightly higher cost level than non-specialized farms.

[11] A more detailed analysis of the issue of costs in pig production can be found in chapter 4.4.2.

Figure 2-25: Production costs (I) of pig for specialized, non-specialized and all farms, 2002-2008

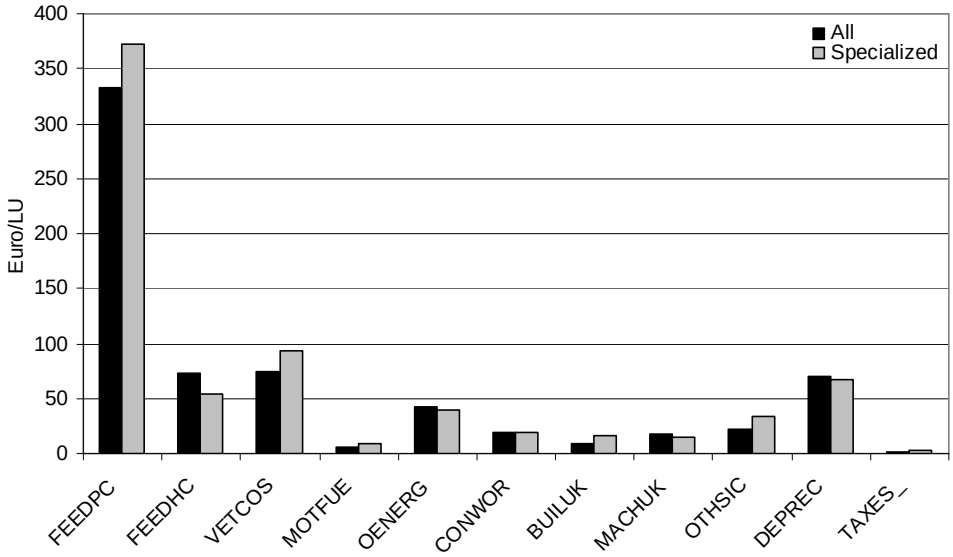


2005	Specialized	Non-specialized	All
N	578	3352	3930
Ø herd size (LU)	215.58	86.29	100.51

Source: German national FADN and own calculations.

Figure 2-26 shows the average input costs for the years 2002-2008 per livestock unit of pig of specialized and all farms. It can be seen that by far the highest share of the production costs is taken by purchased fodder costs for specialized as well as for all farms. Here can also be found the biggest difference (of 39 Euro/LU) between specialized and all farms, followed by veterinary costs with a difference of 18.6 Euro/LU. Higher production costs for all farms (than for specialized farms) can be found for home-grown fodder costs with a difference of 19 Euro/LU.

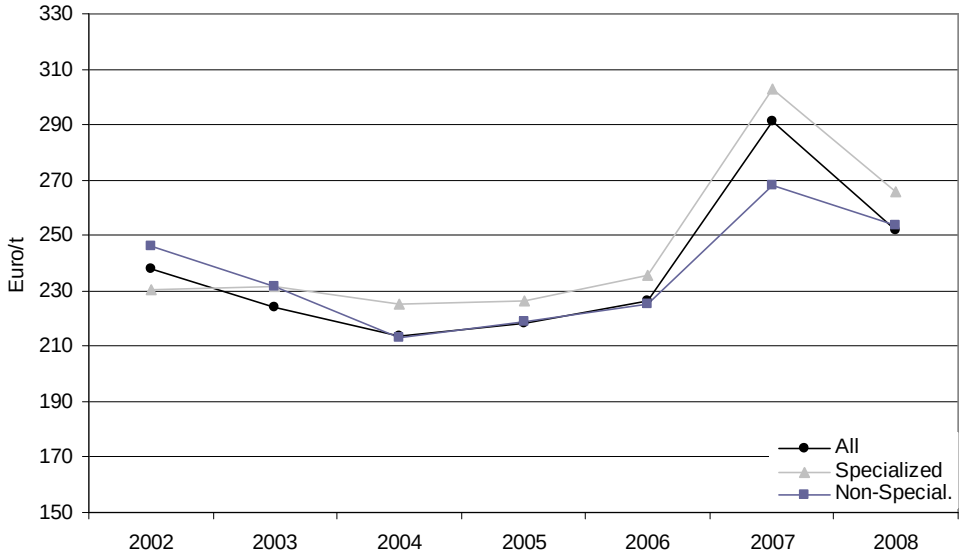
Figure 2-26: Input costs for pig in specialized and in all farms (Ø 2002-2008)



Source: German national FADN and own calculations.

The production costs per ton of milk for specialized, non-specialized and all farms are illustrated in Figure 2-27. Here, the production costs per ton of milk for all three farm types are rather similar, with slightly higher costs for specialized farms for all years except 2002 and 2003.

Figure 2-27: Production costs (I) of milk for specialized, non-specialized and all farms, 2002-2008

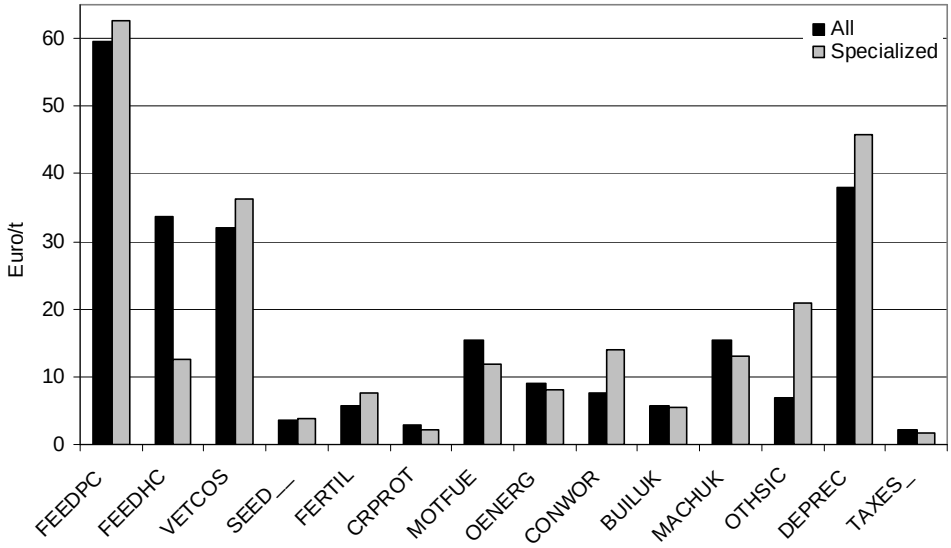


2005	Specialized	Non-specialized	All
N	3558	1685	5243
Ø yield (kg milk/cow)	6300	6053	6239

Source: German national FADN and own calculations.

The average costs by input category for milk production are illustrated in Figure 2-28 for specialized dairy farms and for all farms. It is obvious that the purchased fodder costs take again the largest share for both types of farms and the biggest difference can be found also for home-grown fodderwith higher costs of 21.3 Euro/t for all farms. However specialized farms show higher costs for ‘other costs’ (14 Euro/t).

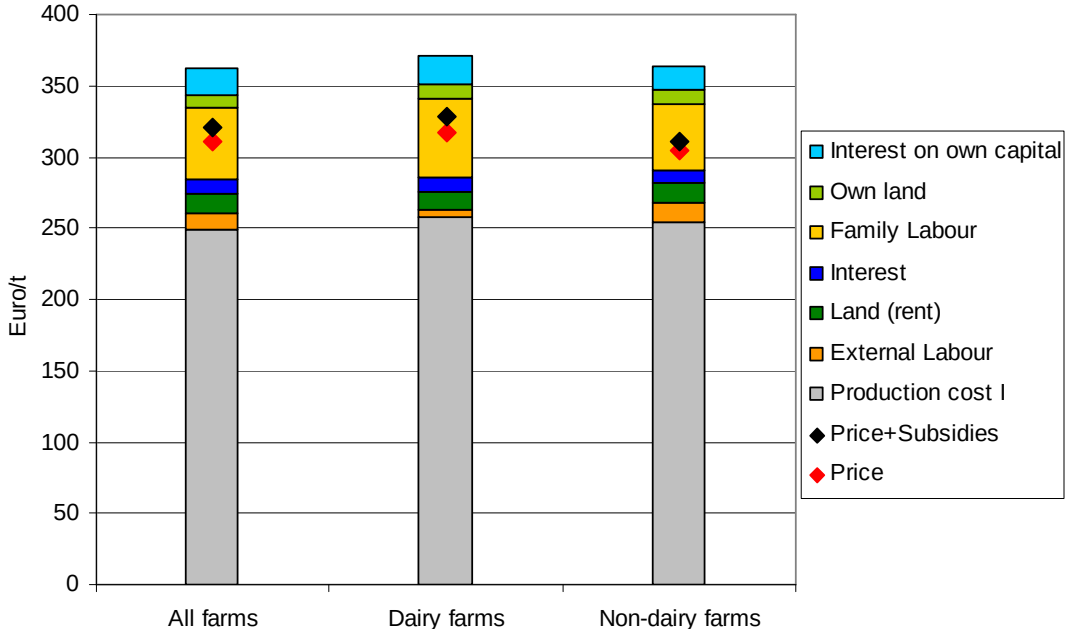
Figure 2-28: Input costs for milk in specialized dairy farms and in all farms (Ø 2002-2008)



Source: German national FADN and own calculations.

In Figure 2-29 the production costs of milk, including interest, land costs and labour costs as well as opportunity costs for land and labour for all, specialized dairy farms and non-specialized farms in the Old Laender states of German are shown. It can be seen that specialized farms in the Old Laender states have similar production costs than all farms and non-specialized farms. The prices (plus subsidies[12]) cover most of the costs, although not the opportunity costs.

Figure 2-29: Full production costs of milk in the Old Laender (Ø 2007-2009)

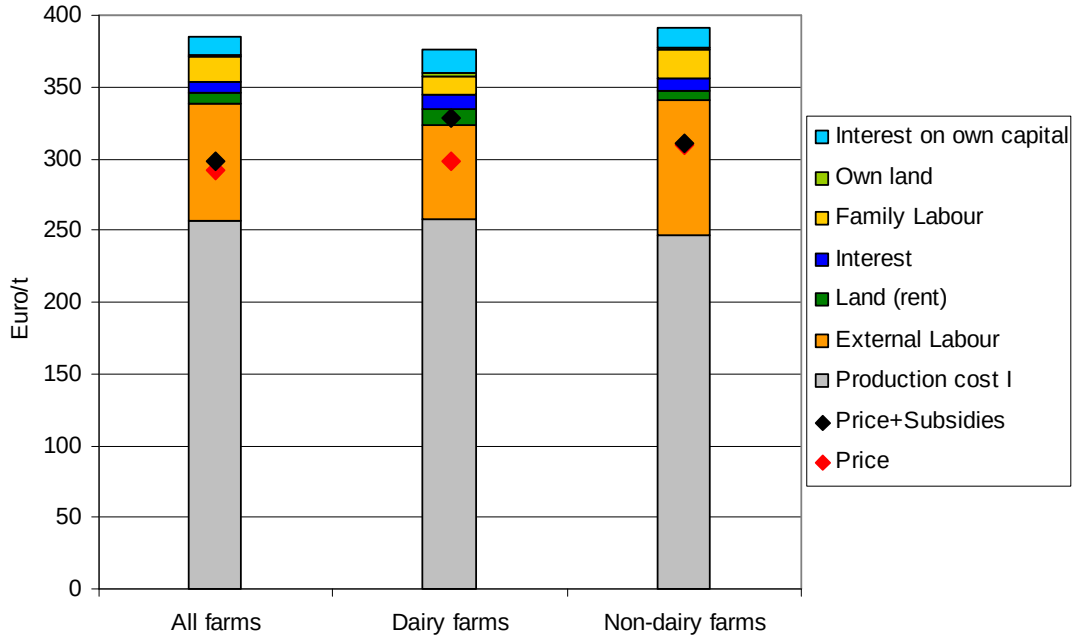


Source: German national FADN and own calculations.

[12] Subsidies include coupled but no decoupled payments.

Figure 2-30 shows the same cost structure than Figure 2-29, except that this picture is drawn for the New Laender states. It becomes obvious here that non-dairy farms and all farms have slightly higher production costs than specialized farms. It can also be seen quite clearly that the costs for hired labour are much higher in the New Laender states. The prices (plus subsidies) are a bit lower than in the Old Laender states and again doesn't cover all cost (including opportunity costs).

Figure 2-30: Full production costs of milk in the New Laender (Ø 2007-2009)

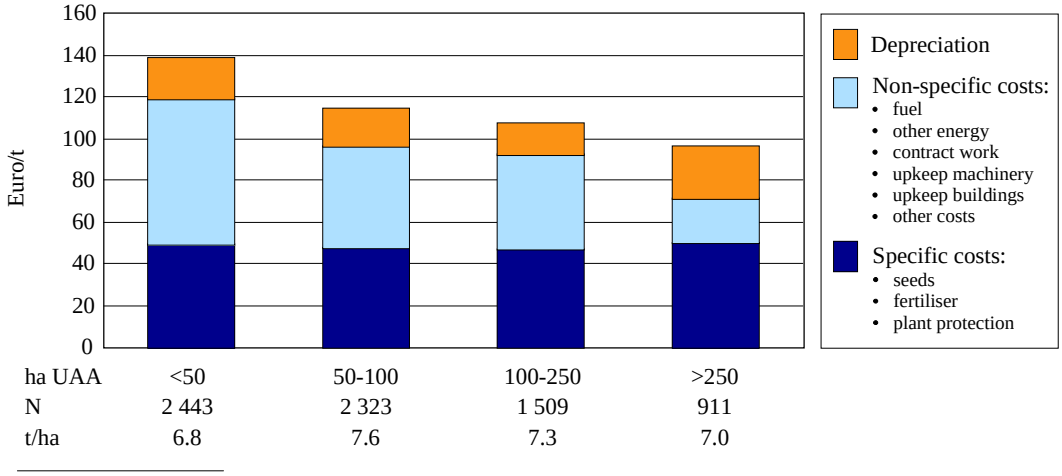


Source: German national FADN and own calculations.

2.3.7 Production costs by farm size

Economies of scale has been one of the main driving factor of structural change in agriculture, and the estimation results confirm that the size of the farm area also plays an important role in the level of the production costs (I). Farms with an UAA smaller than 50 ha have the highest level of wheat production costs (I), which continuously decrease with farm size (Figure 2-31). While the level of specific costs per t of wheat is not affected by farm size, there is a clear digression of non-specific costs. Depreciation is reduced with size up to 250 ha; for very large farms, depreciation increases again as these farms can fully utilise own machinery and reduce the amount of contract work. An interesting aspect is also that the impact of the outlier elimination routine (compare deliverable 3.2) on results is negligible for this differentiation: this indicates that an adequate delimitation of samples by technology may be important for ensuring the robustness of the estimations.

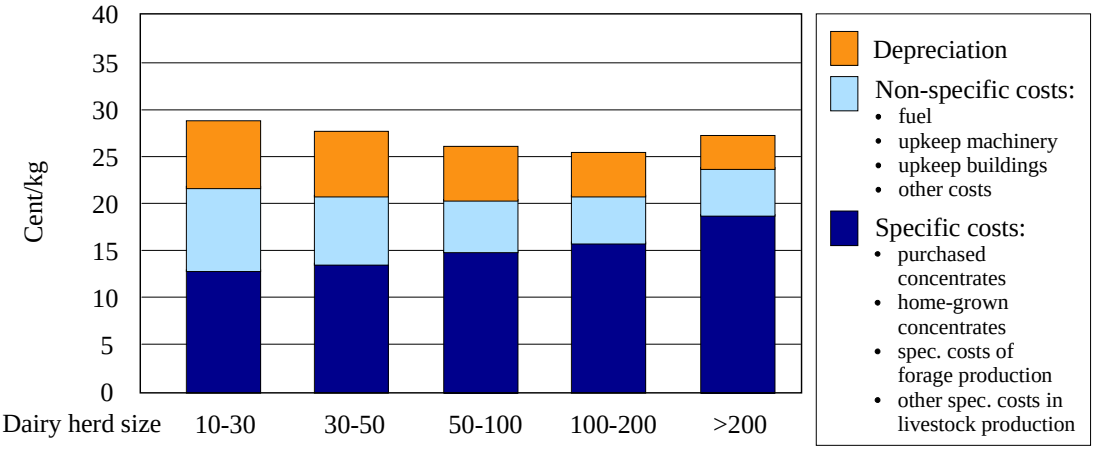
Figure 2-31: Production costs (I) for wheat by size of farm area (Ø 2006-2008)



Source: German national FADN and own calculations.

For milk, scale effects were taken into account by differentiating by dairy herd size (Figure 2-32). Here, the production costs (I) also decrease with increasing herd size, except for farms with more than 200 cows, where the production costs (I) rise again slightly.

Figure 2-32: Production costs (I) for milk by size of dairy herd (Ø 2006-2008)



Source: German national FADN and own calculations.

2.4 Further differentiating costs for beef and pig production

In the standard model of GECOM, livestock output is often aggregated with regard to final products (e.g., cattle; pig). However, in the area of livestock production, farms become more and more specialized with respect to the processing steps and the output produced, e.g. piglet production vs. pig fattening, breeding of beef calves (suckler cows) vs. bull fattening. In the following it is shown how - by means of suitable model specifications and selection of samples - costs can be estimated for the different branches of business.

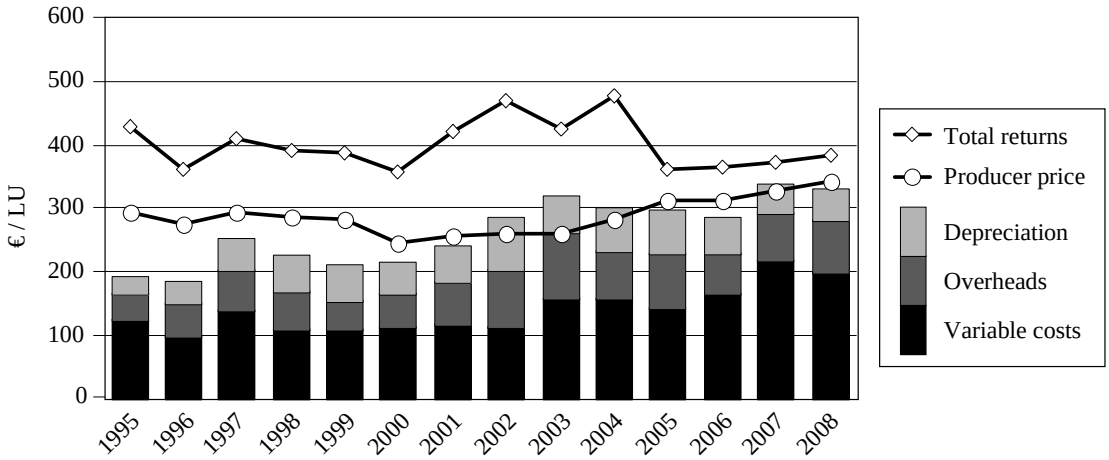
2.4.1 Production costs of beef

Beef production in Germany is composed by about 40% of cow's meat and bull's meat, respectively. However, typical for the German beef sector is specialized bull fattening and beef-calves production by suckler cows. This subchapter will first present the results obtained for beef production costs when using the GECOM model for the total sample. Then, results are differentiated for specialized farms in the beef sector, which are selected as following:

- Bull fattening farms: male bovine animals > 1 year, at least 50 animals/farm
- Suckler cows: > 20 suckler cows/farm

Figure 2-33 shows the development of costs, direct payments, market returns as well as market returns plus coupled direct payments since 1995/96 for the total German farm sample. Between 1995 and 1996 the cost level was about 200 €/LU. This rose to 260 €/LU in 1997 and after a slight recession they rose until 2003 to 300 €/LU. The increase in 2007 is due to the increase of feed costs. Costs were covered by the market returns until 1999, where the BSE crisis and the CAP reform lead to comparatively lower prices between 2000 and 2004, so that costs weren't covered any longer. In the following years costs and returns were almost balanced. A significant part of income in beef production results from coupled payments, which amounted to about 100 €/LU until 2000, then rose under the Agenda 2000 Reform to 200 €/LU. In line with the decoupling of subsidies, they decreased to about 40 €/LU, an amount which results exclusively from less favored area and agri-environmental payments. Including these payments the net value added reaches levels of 100 to 200 €/LU in the years up to 2004, and only 50 €/LU after decoupling.

Figure 2-33: Production costs (I) of beef



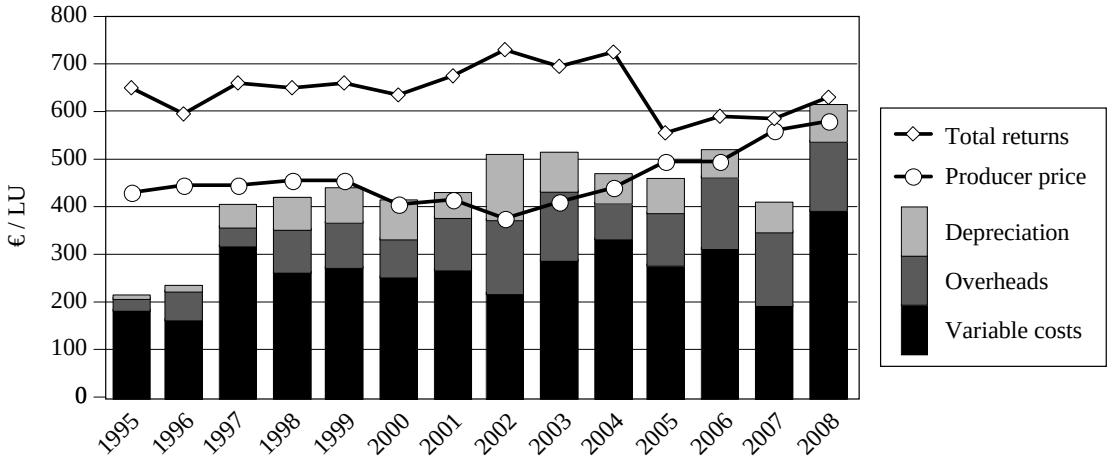
Source: German national FADN and own calculations.

The results shown in Figure 2-33 are referring to the overall beef production in Germany, composed by about 40% of cow's meat and bull's meat, respectively. However, typical for the German beef sector is specialized bull fattening and beef-calves production by suckler cows.

a) Production costs of specialized bull fattening farms

The results for specialized bull fattening farms are shown in Figure 2-34. In contrast to the results of total beef production, a higher cost and return level was achieved. The very low cost level in 1995 and 1996 can't be explained; it might be influenced by cost allocation in the data. In 1997 the costs amounted to about 420 €/LU. Because of the strong increase of the feed and energy costs the production costs have risen till 2008 to 600 €/LU. The costs were covered by market returns only until 1998 and in 2005 and 2007. Only when including coupled payments, a net value added of about 200 €/LU can be achieved until 2004. Since the decoupling of direct payments, the net value added is only 50 €/LU with an exception in 2007 due to favourable price conditions.

Figure 2-34: Production costs (I) of beef in specialized bull fattening farms



Source: German national FADN and own calculations.

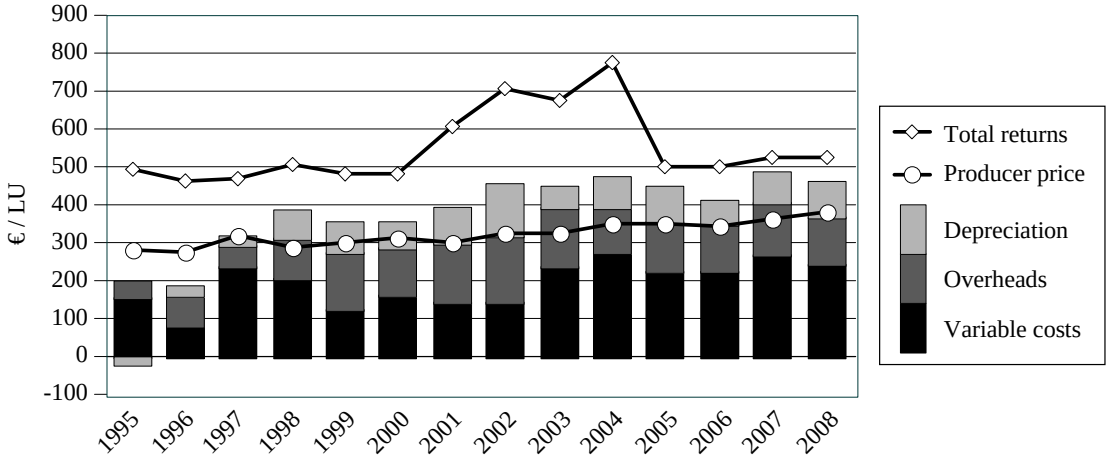
The profitability of beef production in specialized bull fattening farms has declined since decoupling and has become more dependent on the level of market prices.

b) Production costs of specialized suckler cow farms

The cost development of specialized suckler cow farms coincides with that of the bull fattening farms (Figure 2-35). Nevertheless, the cost level is approximately 50 €/LU lower. The costs are covered by market returns only in 1995 and 1996, while in succeeding years cost are not fully covered. Only due to direct payments and Pillar-2 payments, incomes of 100 to 250 €/LU can be achieved until 2004. The direct payments have strongly risen since the Agenda 2000 as well as the application of agri-environmental schemes. After decoupling the remaining Pillar-2 payments[13] are on a level of 150 €/LU, which is higher than the net value added, and the profitability of suckler cow production is to a large part depending on Pillar-2 payments.

[13] Pillar-2 payments are decoupled by definition, but effectively they are partially coupled to some activities, i.e. the Compensatory Allowances in Less Favored Areas. In the underlying model specification they are econometrically allocated to the different outputs.

Figure 2-35: Production costs (I) of beef in specialized suckler cow farms



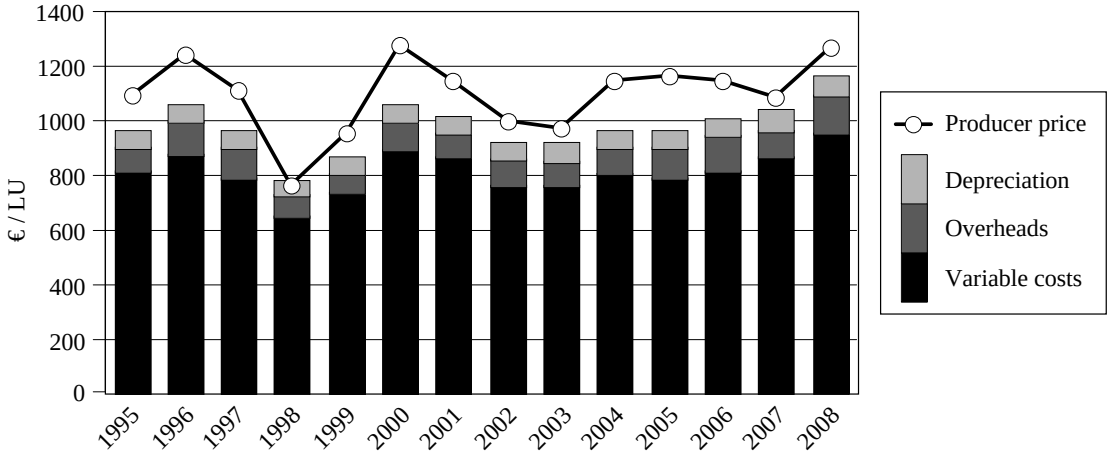
Source: German national FADN and own calculations.

2.4.2 Production costs in pig production

In Germany, there is an increasingly strong specialization of pig farms between piglet production and pig fattening. This subchapter will first present the results obtained for pig production costs when using the GECOM model for the total sample. Then, the results are differentiated for specialized piglet farms (share of LU sows > 75% LU total pigs) and specialized pig fattening farms (share of LU fattening pigs > 75% LU total pigs). The model is modified such that output is replaced by sales and livestock purchases are considered as input variable.

The costs and returns for aggregated pig production are shown in Figure 2-36 for the total sample. Returns and costs show relatively strong variation. In 1995, variable input costs are on a level of 800 €/LU then decline until 1998 to 650 €/LU. During the subsequent years the variable costs amount to 800-850 €/LU and in 2008 they increase further due to higher feed costs.

Figure 2-36: Production costs (I) of pigs



Source: German national FADN and own calculations.

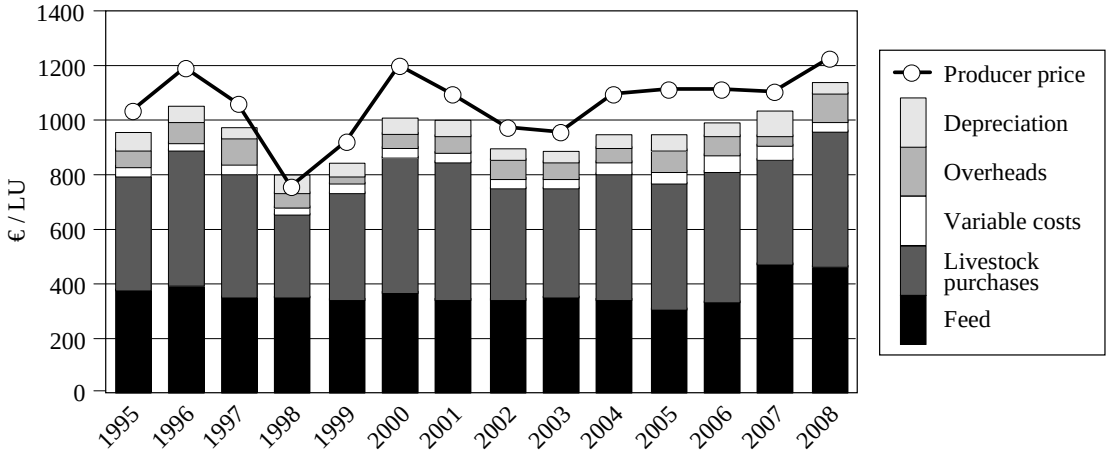
The other cost positions amount to approximately 200 €/LU with a slight increase in the underlying period. Therefore the whole costs vary between 800 €/LU in 1998 and 1200

€/LU in 2008, while they are about 1000 €/LU in the other years. The market returns covered the costs with an exception in 2000. In some years income rises up to 200 €/LU, while in other years it's scarcely positive.

a) pig fattening farms

Focusing the estimation on specialized pig fattening farms (as well as between feed costs and additional young animal purchases) a comparable picture to the previous one can be drawn (Figure 2-37). However, it becomes clear that the aggregated 'variable costs' consists to about 40% of feed costs. They decreased slightly until 2006 but went up significantly in 2007. Another reason is related to livestock purchases, which closely correlates with return values. Losses incurred in 1998, while during the other years slightly higher (50 €/LU) to high incomes (150 €/LU) are achieved.

Figure 2-37: Production costs(I) of pig fattening

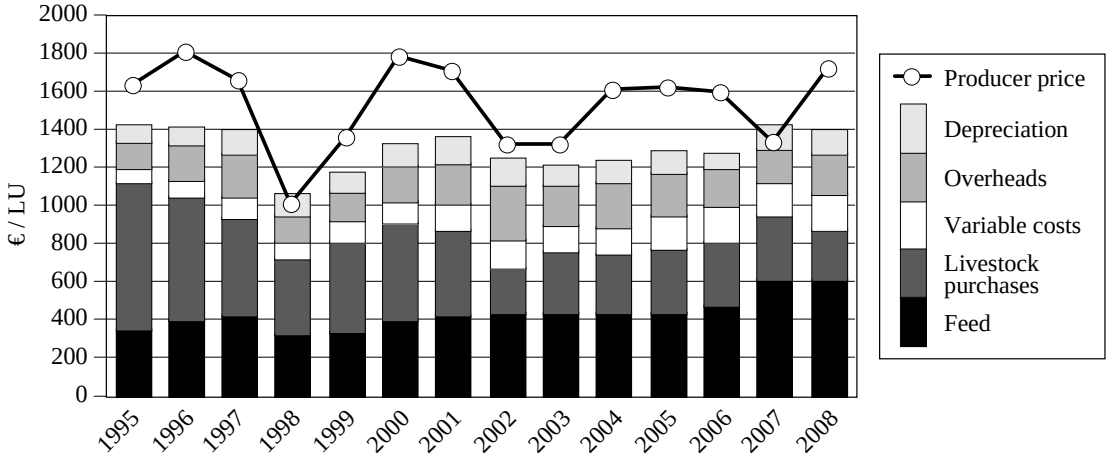


Source: German national FADN and own calculations.

b) Specialized piglet farms

Farms specialized in piglet production show much higher feed costs per LU than pig fattening farms, while costs for livestock purchases (i.e. mostly sow replacement) are lower and decreasing overtime (Figure 2-38). Livestock purchases are extremely high between 1995 and 1997, which can't be explained. Out of the remaining cost positions, depreciation shows a relatively high level. The whole costs amount to 1400 €/LU during the first three years. After a decline to 1050 €/LU in 1998 they range between 1250 and 1350 €/LU between 2000 and 2006. Due to increasing feed cost they further increase to 1400 €/LU in 2007.

Figure 2-38: Production costs (I) of piglet production



Source: German national FADN and own calculations.

Returns show higher variation than costs. In 1998 and 2007 losses incurred, in 2002 and 2003 income was slightly positive, while during times of high prices income of 200 to 300 €/LU have been achieved. Although the income situation is determined above all by the development of returns, it becomes clear by the example of 2007 that losses are determined by both, low piglet prices and high costs of feed and energy.

2.4.3 General conclusion with respect to differentiated estimation for livestock products

It has to be mentioned that for the estimation of pig production costs, subsidies were not considered in the underlying model specification. Alternative model specifications including subsidies for pigs show that the estimates for subsidies are close to zero. Therefore it can be concluded that the model describes the cost and income development realistically, as well as the effect of main changes of the CAP as the decoupling of direct payments.

2.5 Comparison of results from EU- and German FADN

2.5.1 Comparison of results for total samples

Table 2-7 shows the results obtained by applying the general cost of production model to the German FADN sample for the year 2005. Most of the input categories show an adjusted R^2 close to one. Comparing them to the results using EU-FADN (see Table 2-8), it can be seen that more input categories have a higher R^2 using the German-FADN. Overall, the results show slightly fewer negative values and fewer ‘implausible values’ greater than one, when using the German-FADN.

Table 2-7: Estimated costs share coefficients using German FADN 2005

Dependent variable	Adj. R^2	Wheat	Barley	Potato	Sugar-beet	Other crops	Cattle	Pig	Poultry	Milk
Purchased feed	0.90						0.19	0.34	0.65	0.18
Home-grown feed	0.36						0.04	0.07	-0.01 *	0.08
Veterinary cost	0.80						0.06	0.09	0.05	0.10
Seeds	0.78	0.07	0.08	0.16	0.05	0.11	0.02	0.00	0.00	0.01
Fertilizer	0.91	0.18	0.20	0.06	0.05	0.03	0.05	0.00 *	0.00	0.02
Crop protection	0.93	0.21	0.18	0.08	0.05	0.03	0.01	0.01	0.02	0.01
Motor fuel	0.93	0.11	0.18	0.07	0.05	0.04	0.10	0.01	0.00 *	0.06
Other cost	0.79	0.01	0.02	0.01	0.01	0.02	0.03	0.06	0.07	0.03
Contract work	0.54	0.05	-0.04 *	0.03	0.11	0.00	0.06	0.02	0.01	0.02
Building	0.39	0.01	0.04	0.00 *	0.02	0.00	0.03	0.02	0.00 *	0.02
Machinery	0.82	0.04	0.14	0.06	0.03	0.03	0.08	0.03	0.00 *	0.05
Other costs	0.87	0.01	0.25	0.01	-0.02 *	0.13	0.09	0.02	0.17	0.03
Depreciation	0.84	0.19	0.26	0.09	0.07	0.06	0.22	0.09	0.06	0.13
Taxes	0.52	0.02	-0.01 *	0.00	0.01	0.01	0.02	0.00	0.01	0.01

* = Negative Values.

Source: Own calculations based on German national FADN.

Statistical tests are applied to determine if the appearing differences between the estimated coefficients are statistically significant. As can be seen from Table 2-8, many significant differences exist between the estimated coefficients using EU-FADN and the German-FADN. While wheat and potatoes show few significant differences in the cost coefficients, for milk, barley and other crops almost all coefficients are significantly different. For the products shown in Table 2-8 almost half the coefficients (48%) are significantly different at 1% significance level and 59% at 5% significance level.

There are three possible causes for these large differences:

- systematic structural differences in the two samples: the national sample includes also small farms with an economic size smaller then 16 Economic Size Units (ESU), which are excluded from the EU-FADN.
- the weighting factors used in the two samples differ (compare Hansen et al., 2009)
- the data / aggregation of accounts to variables in the estimation model differs

The contribution of these factors to the differences in results will be analyzed in the next paragraphs.

Table 2-8: Estimated costs share coefficients using EU-FADN 2005

Dependent variable	Adj. R^2	Wheat	Barley	Potato	Sugar-beet	Other crops	Cattle	Pig	Poultry	Milk
Purchased feed	0.91						0.22 *	0.35 *	0.61 *	0.19 *
Home-grown feed	0.50						0.02	0.08 **	0.02 *	0.10 *
Veterinary cost	0.42						0.07	0.07 *	0.02 *	0.05 *
Seeds	0.82	-0.09 *	0.38 *	0.13 *	0.08	0.57 *	0.20 *	0.00	-0.01	0.05 *
Fertilizer	0.91	0.20 *	0.10 *	0.06	0.05	0.02 *	0.05	0.00 **	0.00	0.01 *
Crop protection	0.93	0.23 *	0.11 *	0.08	0.03 *	0.02 *	0.00 *	0.01 *	0.01	0.01
Motor fuel	0.94	0.11	0.19	0.06	0.03 **	0.03	0.07 *	0.01 **	0.01	0.05
Other cost	0.83	0.01	0.07 *	0.01	0.00	0.02	0.02	0.05	0.07	0.03 **
Contract work	0.59	0.03 **	-0.13 *	0.02	0.14 **	0.02 *	0.09 *	0.03 *	0.06	0.03 *
Building	0.41	0.01	0.05	0.00	0.00 *	0.00 ***	0.02 *	0.01 **	0.00	0.02 *
Machinery	0.82	0.05	0.19 *	0.07	0.02	0.02 *	0.07	0.02 *	0.01 **	0.05 *
Other costs	0.70	-0.01	0.83 *	0.04	0.01	0.19 *	0.12	0.07 *	0.34	0.13 *
Depreciation	0.89	0.18	0.30 ***	0.10	0.02 *	0.05 **	0.17 *	0.10 *	0.07	0.11 *
Taxes	0.52	0.02 **	-0.01	0.00	0.01	0.00 *	0.02	0.00	0.01	0.01

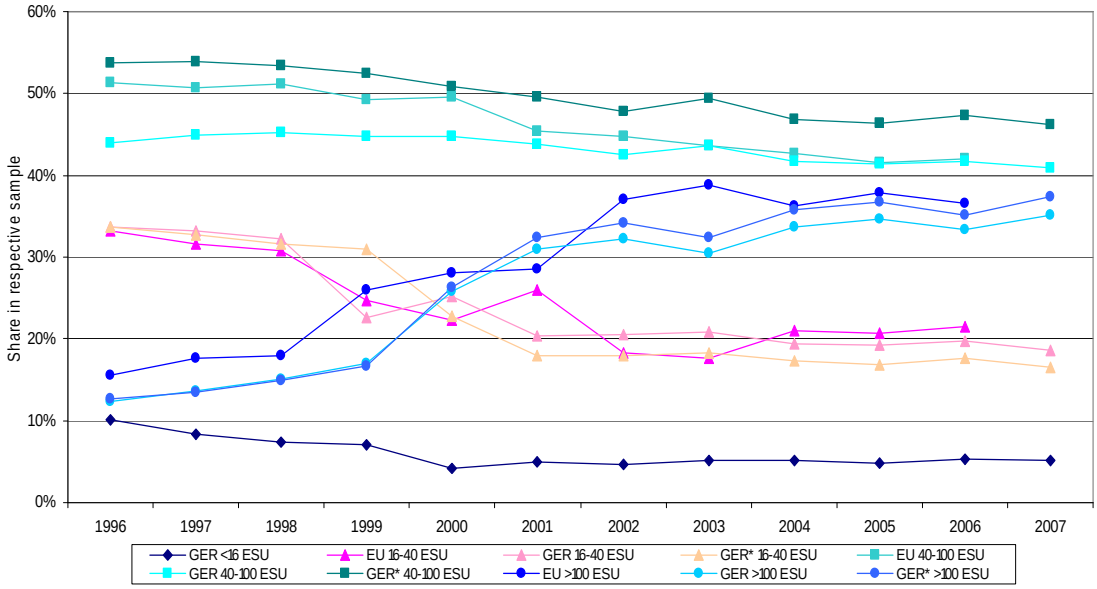
Statistical significance of the difference of the coefficients between EU and German-FADN.
*** = 1 % sign. level, ** = 5 % sign. level, * 10 % = sign. level.

Source: Own calculations based on EU-FADN DG Agri L-3.

2.5.2 Comparison of results accounting for differences in target population

To account for differences the target population, a subsample was generated from the German FADN which only includes farms greater than 16 ESU (denoted by GER* in the following). Figure 2-39 shows the economic size distribution in the EU and the national sample with all farms (GER) and farms greater than 16 ESU (GER*).

Figure 2-39: Economic size distribution in German and EU-FADN



Source: Own calculations based on EU-FADN DG-Agri L-3 and German national FADN.

It can be seen that the total composition of all three samples has changed significantly over the last years. While in the first years the proportion of farms with an ESU greater than 100 is relatively small, it increased over the last years to a proportion of almost 40%. For farms between 16 and 40 ESU it is the other way around: while the proportion in the first years

was higher than 30% it is at the moment below 20%. Comparing the composition of the samples shows that for farms between 40 and 100 ESU the EU sample is more similar to the German* national sample until 2001. After 2001, this proportion becomes more equal to that of the German sample with all farms. For farms greater than 100 ESU the proportion of the two national samples is almost equal until 2001; then the EU sample is more similar to the German* sample with one exception in 2002. Looking at farms between 16 and 40 ESU there is no clear similarity between the EU sample and either of the two national samples.

For 2005 (the year the comparisons in this subchapter focus on), the economic size distribution is, somewhat unexpectedly, more similar between the EU sample and the German sample rather than the German* sample. In-line with this, the amount of significant different coefficients increases when using the German* sample. Nevertheless, when using the German* sample, the estimates show fewer negative values compared to the 'original' German sample and no implausible values greater than one (Table 2-9).

Table 2-9: Estimated cost coefficients using German* FADN (farms > 16 ESU), 2005

Dependent variable	Adj. R^2	Wheat	Barley	Potato	Sugar-beet	Other crops	Cattle	Pig	Poultry	Milk
Purchased feed	0.90						0.18	0.34	0.63	0.18
Home-grown feed	0.36						0.02	0.07	0.01	0.07
Veterinary cost	0.75						0.05	0.09	0.05	0.10
Seeds	0.76	0.06	0.10	0.15	0.06	0.13	0.03	0.00	0.01	0.01
Fertilizer	0.90	0.16	0.21	0.06	0.06	0.03	0.04	0.00 *	0.00 *	0.03
Crop protection	0.91	0.19	0.17	0.07	0.06	0.02	0.01	0.01	0.02	0.01
Motor fuel	0.91	0.11	0.18	0.06	0.04	0.03	0.08	0.01	0.01	0.05
Other cost	0.76	0.01	0.02	0.01	0.01	0.02	0.03	0.05	0.07	0.03
Contract work	0.55	0.07	0.07	0.05	0.08	0.03	0.10	0.02	0.03	0.04
Building	0.35	0.00	0.01	0.00 *	0.03	0.00	0.03	0.02	0.00	0.01
Machinery	0.79	0.02	0.09	0.06	0.03	0.02	0.06	0.03	0.01	0.05
Other costs	0.82	0.16	0.19	-0.01 *	-0.03 *	0.14	0.13	0.02	0.02	0.03
Depreciation	0.84	0.21	0.34	0.10	0.04	0.05	0.18	0.08	0.05	0.15
Taxes	0.45	0.01	0.00	0.00	0.01	0.01	0.01	0.00	0.01	0.01

* = Not statistically significant at 95 % level.

Source: German national FADN 2005 and own calculations. Negative values are marked yellow.

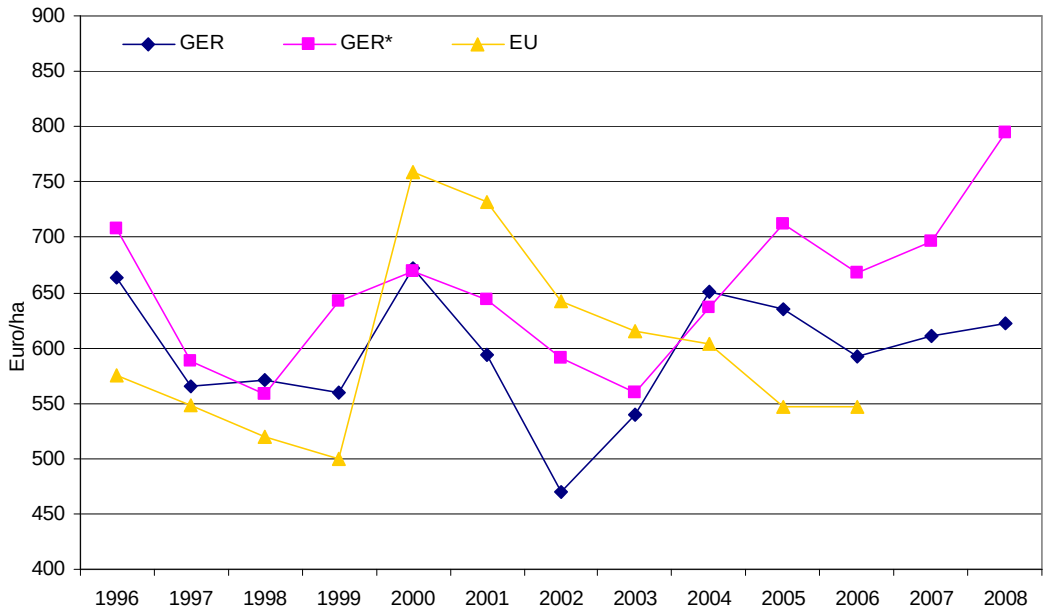
To give an overview of the results, time series of production costs for selected products have been estimated for the years 1996 till 2006 for the EU-FADN and until 2008 for the German national FADN. The results show the unit cost of production per hectare or livestock unit, and are illustrated for all farms of the German FADN, all farms greater than 16 ESU from the German* FADN and the EU-FADN. In addition the according correlation coefficients between the estimated production costs for the two German samples and the EU sample are calculated.

As can be seen from Figure 2-40, the production costs (I) per ha of wheat vary significantly over the years. The production costs based on the EU-FADN sample decrease until 1999 and then rise by more than 250 Euro/ha in 2000, before decreasing again in the following years. The German results show more or less the same development, whereas the decline is much higher in 2002 followed by a rise until 2004, then the production costs decrease again, too. The German* results show a rise in 1998, the same peek in 2000, and fall again until 2003, where they start to rise for the last years shown.

Overall no clear similarity between the EU sample and either of the two German samples can be identified. The correlation coefficient between the total production costs of the German and the EU dataset is, with 0.18, slightly higher than the correlation coefficient of the German* and the EU dataset (0.09).

It can be seen that for wheat the mean is more similar between the German and EU results, as well as the mean absolute deviation (MAD) which is also a bit lower for the German results (Table 2-10). When looking on the maximal difference from the two German samples to the EU sample, the biggest difference can also be found for the German sample with a difference of 173 Euro/t.

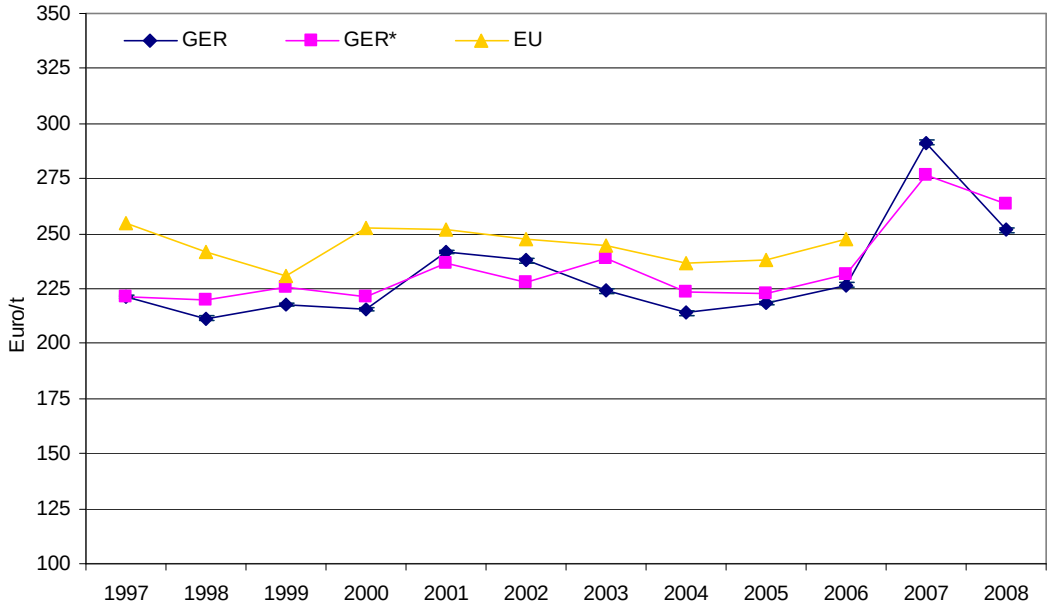
Figure 2-40: Comparison of estimated production costs per hectare of wheat between national and EU FADN



Source: EU-FADN DG-Agri L-3 and German national FADN and own calculations.

The unit costs of production per ton of milk are almost equal between samples for all years (Figure 2-41). Here, the results deriving from the German* sample show more similar results (mean; MAD) to the EU sample than the 'original' German results (Table 2-10), with a correlation coefficient of 0.45. When having a look on the development of the economic size of milk farms, it can be seen that over the last ten years the number of farms with a size between 16 and 40 ESU decreased while large scale farms with an ESU greater then 100 increased strongly, so that these two results have a greater resemblance. As shown in Figure 2-39, in the first years the similarity for farms between 16 and 40 ESU is higher between the German* and the EU-sample, while it changed in the later years. For farms greater then 100 ESU it is the other way around.

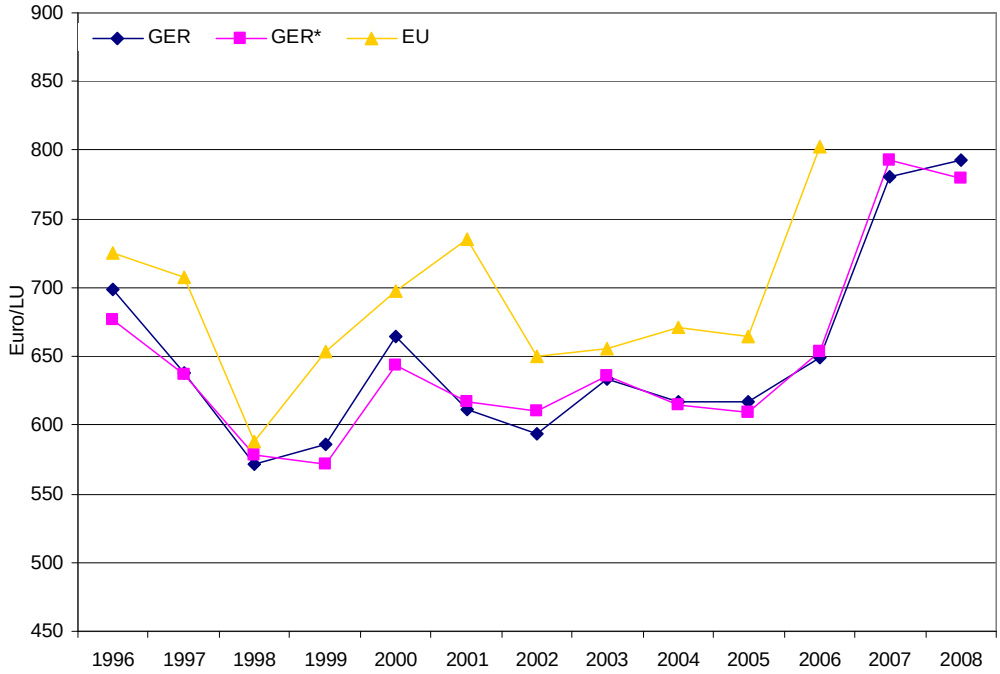
Figure 2-41: Comparison of estimated production costs per ton of milk between national and EU FADN



Source: EU-FADN DG-Agri L-3 and German national FADN and own calculations.

The results for the cost of production per livestock unit of pig are more or less similar for the two German samples, while the costs derived from the EU-FADN are, except for the year 1998, higher than the two results based on the German FADN (Figure 2-42). The correlation coefficient between the total production costs of both German and the EU dataset is between 0.65 and 0.71, while it is close to one (0.98) for the two German datasets.

Figure 2-42: Comparison of estimated production costs per livestock unit pig between national and EU FADN



Source: EU-FADN DG-Agri L-3 and German national FADN and own calculations.

For pigs the mean is almost identical for the two German results, while it is a bit higher for the EU sample (Table 2-10). Therefore the MAD for the two German samples is also almost identical, as well as the maximal difference to the EU sample.

The descriptive statistics of the results shown above are illustrated in Table 2-10. Here the mean, the mean absolute deviation from the EU-FADN value and the maximal difference to the EU-FADN values are shown.

Table 2-10: Descriptive statistics of the comparison of estimated production between national and EU FADN

Sample	German	German*	EU
Wheat		€/ha	
Mean	596	651	599
MAD	79	87	-
Max diff to EU	173	166	-
Milk		€/t	
Mean	231	234	245
MAD	22	18	-
Max diff to EU	37	33	-
Pig (€/LU)		€/LU	
Mean	650	648	687
MAD	61	64	-
Max diff to EU	153	149	-

Source: EU-FADN DG-Agri L-3 and German national FADN and own calculations.

2.5.4 Comparison taking into account differences in weighting factors

Differences in results may be due to the use of different aggregation factors in the two data bases (see, e.g., Hansen et al., 2009). To isolate this effect from possible influences of different sample delimitation and data differences, a subsample of farms identical to the farms included in the EU FADN was drawn from the German FADN for the year 2004, and production costs were then estimated and compared for this sample using the EU aggregation factor and the aggregation factor of the German FADN, respectively, as a weight in the estimation model.

The difference in estimated coefficients was tested for statistical significance using t-Values calculated as in the following:

$$t = (x_i - x_j) / \sqrt{(s_i^{\,2} - s_j^{\,2})}$$

where x_i and x_j are the coefficients of the two models and s_i and s_j are the respective standard deviations of the estimates of the two models. To be able to better judge if the identified differences are not only significant statistically but also relevant in size, the relative and absolute differences of production cost components estimated for the two models were calculated per ha (per kg) for wheat and milk.

In general, there are few significant differences among the production cost estimates for crop products and pigs. However, the number of differences is higher for milk production cost. Table 2-11 shows that 6 of the 14 estimated input costs for milk are significantly different from each other. However, absolute differences are small (Table 2-12), and production costs (I) for milk differ by only 0.2 cent / kg.

Table 2-11: Differences between production cost coefficients weighted with German national and with EU FADN aggregation factors

	Wheat	Barley	Potatoe	Rape seed	Cattle	Pig	Milk
Purchased feed							*
Home-grown feed							
Veterinary cost					*	*	
Seeds							
Fertilizer	*			*			
Crop protection	*			*			
Motor Fuel							*
Energy							
Contract work							*
Building					*		*
Machinary		*					
Other cost							*
Depreciation							*
Taxes							

* = Difference statistical significant at 5 % level.

Source: EU-FADN DG-Agri L-3 and German national FADN and own calculations.

Table 2-12: Difference between production cost coefficients of wheat and milk weighted with German national and with EU FADN aggregation factors

	Wheat				Milk			
	Weighted by aggregation factor		Rel. diff.	Abs. diff.	Weighted by aggregation factor		Rel. diff.	Abs. diff.
	EU FADN €/ha	DE FADN €/ha	%	€/ha	EU FADN cent/kg	DE FADN cent/kg	%	cent/kg
Purchased feed					5.3	5.6	6	
Home-grown feed					2.4	2.4	2	
Veterinary cost					3.4	3.3	-2	
Seeds	23	23	-1	0	0.3	0.3	-3	-0.01
Fertilizer	97	105	9	8	0.5	0.5	6	0.03
Crop protection	133	141	6	8	0.2	0.2	19	0.04
Motor Fuel	78	80	2	2	1.4	1.5	7	0.10
Energy	7	6	-8	-1	0.8	0.8	1	0.01
Contract work	52	58	12	6	0.8	0.7	-17	-0.14
Building	19	21	13	2	0.4	0.3	-24	-0.09
Machinary	28	24	-14	-4	1.3	1.3	-1	-0.02
Other cost	60	44	-27	-16	1.1	0.9	-20	-0.23
Depreciation	142	138	-3	-4	3.6	3.4	-5	-0.16
Taxes	6	6	-3	0	0.2	0.2	-3	-0.01
Total costs	645	646	0	2	21.6	21.3	-1	-0.20

Source: EU-FADN DG-Agri L-3 and German national FADN and own calculations.

2.5.4 Comparison taking into account differences in data / data aggregation

Detail and definition of variables in national and EU FADN is not always fully identical (Delame and Butault, 2010). To identify the contribution of these data discrepancies to the differences in model results, samples of identical farms in EU and German FADN were selected for the year 2004. Comparing the sum of unweighted costs between these samples highlights that while many cost items are identical, there are significant differences with respect to others (Table 2-13). Depreciation is lower in the German FADN because for the national FADN, depreciation is calculated at acquisition values compared to the use of replacement values for the EU FADN. The sum of the included subsidies is larger in the national FADN, mostly due to the different treatment of investment subsidies. Costs for homegrown feed and seed are lower in the national FADN, which may be due to methodological differences in the valuation of farm-produced inputs. There are large differences in the categories of ‘other costs for livestock production’ and ‘other costs’. Here, it appears that in the EU FADN some costs of the former category have been reallocated to the latter one in the process of the data plausibility checking for the EU FADN. In total, the costs covered by the estimation model based on EU vs. German FADN differ by 5 %.

Table 2-13: Comparison of total unweighted costs for a sample of identical farms in EU and German FADN, 2004

	EU FADN	DE FADN	Rel. diff.
	Mill. €		%
FeedPC	220	220	0%
FeedHC	77	69	-10%
Vet cost	57	83	45%
Seed	77	71	-8%
Fertilizer	84	84	0%
Crop protection	78	78	0%
Motor Fuel	95	95	0%
Energy	50	50	0%
Contract work	72	72	0%
Building	26	26	1%
Machinary	82	82	0%
Other costs	269	209	-22%
Depreciation	241	223	-7%
Taxes	14	14	-1%
Subsidies	-319	-372	17%
Total costs	1442	1376	-5%

Source: EU-FADN DG-Agri L-3 and German national FADN and own calculations.

The impact of the data differences on estimated costs is rather large for some products (Table 2-14). The are significant differences for the 'other costs' category, and the sum of costs per kg of milk is 16% higher when basing the estimation on the German FADN.

Table 2-14: Difference between production cost coefficients of wheat and milk for identical farms in the German and EU FADN, 2004, unweighted estimation

	Wheat				**Milk**			
	Unweighted		Rel. diff.	Abs. diff.	Unweighted		Rel. diff.	Abs. diff.
	EU FADN	DE FADN			EU FADN	DE FADN		
	€/ha	€/ha	%	€/ha	cent/kg	cent/kg	%	cent/kg
FeedPC					5.6	6.4	15%	0.8
FeedHC					2.8	3.2	14%	0.4
Vet cost					3.3	1.2	-63%	-2.1
Seed	23	24	4%	1	0.4	0.3	-29%	-0.1
Fertilizer	103	101	-2%	-2	0.4	0.3	-14%	0.0
Crop protection	138	134	-3%	-4	0.2	0.2	-25%	-0.1
Motor Fuel	82	79	-4%	-3	1.4	1.4	3%	0.0
Energy	9	6	-27%	-2	0.8	0.8	7%	0.1
Contract work	68	61	-11%	-7	0.7	0.7	-2%	0.0
Building	31	31	0%	0	0.3	0.3	-17%	-0.1
Machinary	12	17	38%	5	1.2	1.3	7%	0.1
Other costs	49	87	76%	38	0.8	4.8	478%	4.0
Depreciation	160	156	-3%	-4	3.0	3.3	8%	0.2
Taxes	6	6	-8%	0	0.2	0.2	19%	0.0
Prod. costs (I)	682	702	3%	20	21	24	16%	3
Subsidies	-289	-362	25%	-73	-3.8	-2.8	-28%	1.1
Net value added	367	427	17%	61	12.1	7.8	-36%	-4.3

Source: EU-FADN DG-Agri L-3 and German national FADN and own calculations.

2.6 Cross Entropy estimation

An alternative approach to the SUR estimation to recover activity-specific input allocations is presented by the Cross Entropy method. The motivation to use entropy methods results from the fact that with SUR estimation still many negative coefficients results, which are implausible and difficult to explain. By using Entropy methods those negative coefficients can be avoided. Also, for small sample sizes the SUR estimation techniques doesn't provide reliable estimates, which might be better estimated using entropy methods. Another advantage of especially the Cross Entropy approach is that prior information, e.g. in the form of expert information, can be incorporated directly. This chapter presents and discusses the results of first explorative applications of a Generalized Cross Entropy estimation of productions costs.

2.6.1 Method

As for the SUR method we assume:

$$x_{if} = \sum_{k=1}^{K} \beta_{ik}\, y_{kf} + \mu_{if} \tag{1}$$

where

x_{if} = are the total costs paid by farm *f* for input *i*

β_{ik} = are the unknown cost-allocation coefficients, defined as the average expenditure on input *i* required to produce one unit of output value *k*

y_{kf} = is the total value of output *k* produced by farm *f*

μ_{if} = is the residual, specific to each input *i* and farm *f*

This expression can be treated either as a single-equation or system-of-equations statistical model. If considering the later (as for SUR) an additional accounting restriction has to be included, this insures that the overall accounting balance between overall returns and costs is satisfied:

$$\sum_{i=1}^{I} \beta_{ik} = 1 \tag{2}$$

If incorporating this adding-up restriction, the system is singular and the inverse of the variance-covariance matrix doesn't exist. This problem can also be overcome with the SUR method, but the coefficients can still be negative.

This approach minimizes the entropy distance between the data and the prior information *q* and *r*. Out of all distributions of probabilities satisfying the constraints, the one closest to *q* should be selected. The general cross entropy measure can be formulated as following:

$$\underset{p,w}{Min}\ CE = \sum_{i=1}^{I}\sum_{k=1}^{K} p'_{ik} \ln\left(\frac{p_{ik}}{q_{ik}}\right) + \sum_{i=1}^{I}\sum_{f=1}^{F} w'_{if} \ln\left(\frac{w_{if}}{r_{if}}\right) \tag{3}$$

given the support vectors z, v as well as the probability vectors p and w, where

$$\beta_{ik} = \sum_{m=1}^{M} z_i^m p_{ik}^m \tag{4}$$

$$\mu_{if} = \sum_{n=1}^{N} v_i^n w_{if}^n \tag{5}$$

and due to the adding-up constraint:

$$\sum_{m=1}^{M} p_{ik}^m = 1 \tag{6}$$

$$\sum_{n=1}^{N} w_{if}^n = 1 \tag{7}$$

2.6.2 Data and model specification

The Cross Entropy approach is applied to a sample of 2005 German FADN data of 701 farms (T=701), i.e. all sample farms from one region (Schleswig-Holstein) in Germany. For this chapter, the production costs model comprises 16 input categories (including subsidies and net value added and excluding land cost and interest) and 31 output categories.

Different model specifications are applied with different designs for the support points for the cost-allocation coefficients. The different support sets differ regarding the width of the interval as well as the type of spacing of the support point within this interval. For each model 3 to 11 values (M=3,…,M=11) for the support vector z are chosen, as well as 3 values (N=3) for the error support vector v. These error support values are symmetrically defined around zero using the "three-sigma-rule" $[3\sigma_u;0;-3\sigma_u]$ (see Golan et al. (1996), p.88). For the error term an uninformative prior is used. Regarding the coefficients the set of the prior information varies.

For an overview of the different model designs for the coefficients see Table 2-15.[14] Design 1 has three support points symmetrically spaced between zero and one. Here an uninformative prior is used, which reduces the Cross Entropy approach to the Maximum Entropy approach. Designs 2-4 vary in the number of support points as well as range in which they are spaced. Design 5 and 6 both have 11 support points, where Design 5 is spaced left-skewed until 0.5 and Design 6 is symmetrically spaced between zero and one. A similar set for the support points was used in Léon et al. (1999) for a Maximum Entropy approach, where the non-symmetric left-skewed design was discovered as superior.

[14] The set of the support points for subsidies [-1; 0] and net value added [-1; 1] is different, but not reported in this table.

Table 2-15: Different model designs for cross entropy estimation

	Design 1	Design 2	Design 3	Design 4	Design 5	Design 6
Number of support points	3	3	5	6	11	11
Set of support points	[0; 0.5; 1]	[0; 0.5; 1]	[0; 0.1; 0.2; 0.3; 0.4]	[0; 0.1; 0.2; 0.3; 0.4; 0.5]	[0; 0.025; 0.05; 0.075; 0.1; 0.125; 0.15; 0.2; 0.3; 0.4; 0.5]	[0; 0.1; 0.2; 0.3; 0.4; 0.5; 0.6; 0.7; 0.8; 0.9; 1]
Prior infor-mation	Unifor-mativ	[0.7; 0.2; 0.1]	[0.4; 0.4; 0.1; 0.05; 0.05]	[0.05; 0.3; 0.3; 0.2; 0.1; 0.05]	[0.1; 0.2; 0.2; 0.2; 0.1; 0.08; 0.05; 0.04; 0.01; 0.01; 0.01]	[0.02; 0.4; 0.4; 0.06; 0.04; 0.03; 0.02; 0.01; 0.01; 0.005; 0.005]
Entropy Indicator	0.477	0.574	0.757	0.623	0.787	0.608

Source: Own illustration.

2.6.3 Results

Table 2-15 also shows a first part of the results by displaying the so-called Normalised Cross Entropy Indicator, which measures the performance of various support sets. The Entropy Indicator for the coefficients is defined as following:

$$S(\hat{p}) = \frac{-\hat{p}'\ln(\hat{p})}{-q'\ln(q)} \tag{8}$$

and measures the proportion of the total remaining uncertainty. This indicator varies in a range of [0; 1], where $S(\hat{p}) = 0$ implies no uncertainty and $S(\hat{p}) = 1$ implies $\hat{p} = q$, which means the unknown probability vectors equal the distribution of the prior information (q).

Similarly, the Entropy Indicator of the error term can be calculated as:

$$S(\hat{w}) = \frac{-\hat{w}'\ln(\hat{w})}{-r'\ln(r)} \tag{9}$$

The results for the Entropy Indicator of the error term aren't included in Table 2-15, as the results are almost similar for all Designs, which is not surprising, as the support values for w don't changed across the various model designs.

Regarding the Entropy Indicator for the coefficients, the highest value can be found for Design 5, with a left-skewed distribution of the support points, which is consistent with the a-priori belief that the estimates for the single cost coefficients are closer distributed around zero than around one.

In the following tables and graphs the estimated results for the three main products can be found for all designs, including the results using the SUR approach. Firstly, the results for wheat are presented in Table 2-16 and Figure 2-43.

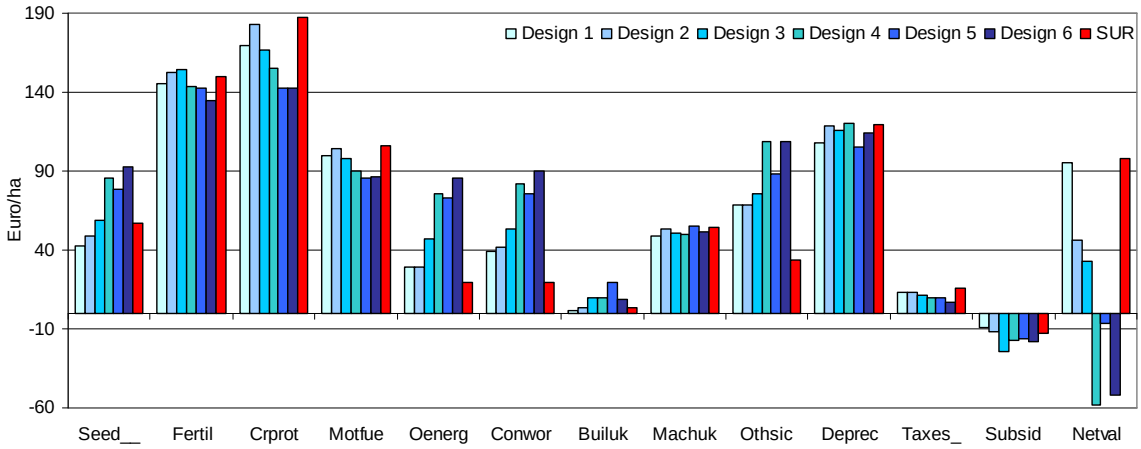
Table 2-16: Cost estimates for wheat per hectare using Cross Entropy and SUR, 2005

	Design 1	Design 2	Design 3	Design 4	Design 5	Design 6	SUR
Seed__	42.88	48.76	58.92	85.18	78.71	92.73	56.95
Fertil	144.99	152.79	154.71	143.92	142.95	134.66	150.21
Crprot	169.59	182.76	166.39	154.75	142.41	142.37	187.51
Motfue	100.21	104.60	98.19	90.24	85.16	86.69	105.98
Oenerg	29.13	29.54	47.12	75.33	72.90	85.82	19.67
Conwor	39.25	41.56	53.53	81.75	75.66	90.08	19.13
Builuk	1.89	3.00	9.98	9.22	19.50	8.57	3.77
Machuk	48.83	53.51	50.82	49.56	55.18	51.46	54.49
Othsic	68.54	69.02	76.16	108.95	87.86	108.80	34.17
Deprec	107.53	118.27	116.13	120.01	104.87	114.54	119.83
Taxes_	12.78	13.65	11.69	9.27	9.33	6.70	15.66
Subsid	-9.04	-11.51	-24.22	-17.38	-16.16	-18.41	-13.01
Netval	95.57	46.20	32.74	-58.64	-6.22	-51.85	97.80

Source: German national FADN 2005.

It can be seen that the results deriving from SUR estimation are most similar to the results of Design 2, which uses an uninformative prior, whereas Design 5 with the highest value for the Entropy Indicator achieves quite different results, especially regarding the net value added, which is then negative.

Figure 2-43: Entropy cost estimates for wheat, 2005



Source: German national FADN 2005.

Table 2-17 and Figure 2-44 show the results for pig also for all model designs compared to the SUR results.

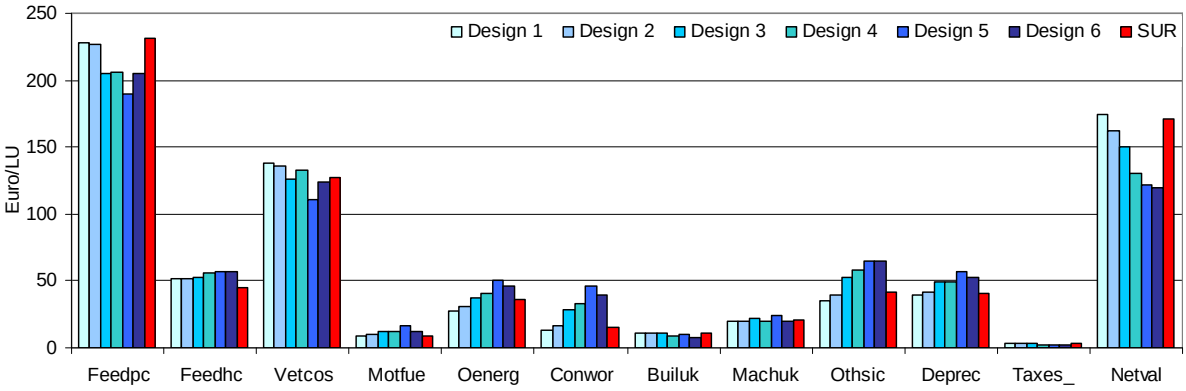
Table 2-17: Cost estimates for Pig using Cross Entropy and SUR, 2005

	Design 1	Design 2	Design 3	Design 4	Design 5	Design 6	SUR
Feedpc	228.46	227.23	205.51	206.44	190.20	205.41	230.86
Feedhc	51.96	51.75	52.30	55.49	56.67	57.46	44.50
Vetcos	137.70	135.76	126.41	132.88	111.07	123.65	127.34
Motfue	8.93	9.39	12.41	11.69	16.76	11.97	8.53
Oenerg	27.14	30.90	37.22	40.90	50.35	46.27	36.09
Conwor	12.98	16.49	28.92	33.35	46.06	39.74	15.62
Builuk	10.90	11.35	10.45	8.75	9.93	7.48	11.03
Machuk	19.45	20.16	22.00	20.25	23.71	19.58	20.96
Othsic	35.40	39.99	52.92	58.54	64.17	64.64	41.42
Deprec	39.46	41.74	49.31	48.94	57.56	52.44	40.06
Taxes_	3.11	3.16	2.91	2.49	2.43	2.06	3.29
Netval	174.88	162.47	150.01	130.65	121.45	119.66	170.69

Source: German national FADN 2005.

Again, it can be seen that the results from Design 1 are most similar to the results using SUR estimation, whereas for Design 5, the estimates are higher regarding 'Home-grown feed', 'Motorfuel', 'Other energy', 'Contract work', 'Other costs' and 'Depreciation' while for all other input categories the estimated costs are lower than the SUR results, which results in a much lower net value added for model Design 5 than for the SUR estimation.

Figure 2-44: Entropy cost estimates for pig, 2005



Source: German national FADN 2005.

Table 2-18 and Figure 2-43 show the cost estimates for milk production using different model specification for cross entropy estimation compared to the results of SUR estimation.

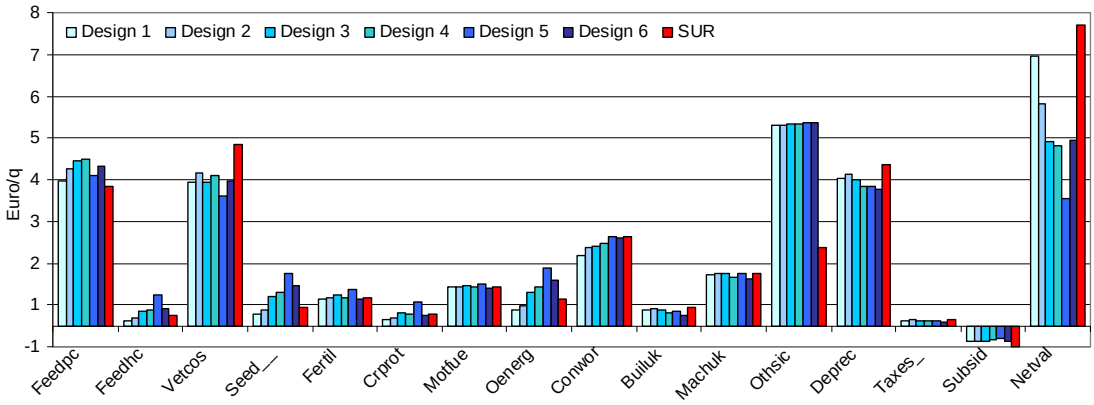
Table 2-18: Cost estimates for milk using Cross Entropy and SUR, 2005

	Design 1	Design 2	Design 3	Design 4	Design 5	Design 6	SUR
Feedpc	3.47	3.75	3.94	4.00	3.58	3.81	3.33
Feedhc	0.13	0.17	0.36	0.38	0.75	0.41	0.26
Vetcos	3.45	3.67	3.44	3.58	3.12	3.46	4.36
Seed__	0.29	0.38	0.70	0.80	1.26	0.95	0.45
Fertil	0.64	0.68	0.75	0.68	0.85	0.65	0.67
Crprot	0.15	0.19	0.30	0.27	0.56	0.25	0.27
Motfue	0.92	0.94	0.98	0.92	1.01	0.88	0.92
Oenerg	0.39	0.49	0.79	0.93	1.37	1.11	0.63
Conwor	1.69	1.87	1.92	1.98	2.13	2.11	2.12
Builuk	0.39	0.40	0.37	0.31	0.36	0.25	0.45
Machuk	1.23	1.25	1.25	1.17	1.25	1.12	1.27
Othsic	4.79	4.79	4.83	4.84	4.86	4.85	1.86
Deprec	3.52	3.62	3.51	3.34	3.35	3.26	3.86
Taxes_	0.13	0.14	0.13	0.11	0.11	0.10	0.14
Subsid	-0.37	-0.37	-0.38	-0.33	-0.31	-0.36	-0.50
Netval	6.47	5.33	4.40	4.31	3.04	4.43	7.20

Source: German national FADN 2005.

The cost estimates in Table 2-18 and Figure 2-45 show clear lower results regarding net value added for Design 5 compared to the SUR estimates, which is due to the lower values estimated by the SUR approach for various inputs, e.g. 'feed costs', 'seed costs' or costs for 'crop protection'. A clear difference between the results of entropy and SUR estimation can also be found for 'other costs', where entropy estimation achieved for all model designs a quite higher value.

Figure 2-45: Entropy cost estimates for milk, 2005



Source: German national FADN 2005.

2.6.4 Conclusions and next steps

The cross entropy estimation avoids the occurrence of negative coefficients, and allows to include a-priori information on the probable level of individual cost coefficients. However, the results reported in the preceding chapters also highlighted that the SUR estimation generally provides good results for the main products, at least for large sample sizes. The entropy estimation therefore is no universal substitute for the general cost of production model. Its benefits will be larger for small sample sizes, for which the SUR method generally doesn't provide reliable estimates.

To select the right model specification, some other measures need to be implemented. First steps have been taken in this direction by calculation a Pseudo-R^2 for each column. Another possibility for an overall measure of the model accuracy could be a weighted average Pseudo-R^2 or a System-R^2. Also, a measure should be included which makes it possible to compare results across different methods.

Furthermore the selections of prior probabilities need to be made carefully, as they can have huge influence on the results. The results of the national workshops could be a good source for such kind of information.

2.7 Validation

2.7.1 Costs other sources

To provide a first plausibility check of the GECOM results, the estimated costs of production for milk and wheat in 2005 were compared to the results of cost surveys from other sources. A complete validation often proved to be impossible, due to a multitude of differences in definitions of cost categories and treatment of imputed costs.

a) Wheat

Few studies on the cost of production of wheat in Germany exist. The comparison reported here is based on results from the Agribenchmark network (Agribenchmark, 2006). For this database it was possible to get access to detailed costs calculations, making it possible to (dis-)aggregate cost components to the same detail as provided by the GECOM model. The

Agribenchmark figures refer to the simple mean of production costs collected on a few typical farms in Northern Germany. The comparison between the two studies shows a remarkable similarity of wheat production costs per ha (Table 2-19). Total costs as well as most individual cost components differ only slightly. The difference in depreciation is reflecting the difference in average farm size in the two studies: The Agribenchmark farms are significantly larger than the average farm in Germany, leading to lower depreciation cost per hectare. The difference in fertiliser costs can partly be explained by the fact that the Agribenchmark farms are all quite specialised cash crop farms, whereas the GECOM model was applied to all farms: As a significant share of all farms producing wheat also keep livestock, the nutrients available in the manure reduce expenses for mineral fertilisers.

Table 2-19: Comparison of wheat production cost in Germany, 2005/06, between GECOM results and other cost surveys

		GECOM	Agribenchmark
Seeds	€/ha	31	48
Fertiliser	€/ha	96	145
Plant Protection	€/ha	144	123
Fuel	€/ha	80	73
Maintenance	€/ha	67	70
Depreciation	€/ha	138	99
Miscellaneous and overheads	€/ha	94	79
Sum of production costs I	€/ha	**651**	**636**

Source: Own calculations based on German national FADN and Agribenchmark (2006).

b) Milk

In Germany, many studies on milk production costs exist. Most of these report costs at the level of individual Bundesländer, based on surveys of specialised farms of farms taking part in specific ‘milk networks’. The cost reports partly differ between sources by the aggregation of cost items, the calculation of replacement costs, of roughage fodder and of imputed costs for farm labour and interest. Three general problems for the comparisons with the GECOM model arise:

- In Germany, cost calculation for milk production always include the cost category ‘roughage fodder costs’, which is based on a separate calculation of production costs in fodder production. Often, the reported costs for fodder refer to full cost calculations only (i.e. including imputed costs for land, labour and capital).
- Similarly, replacement costs are generally a separate cost category. Depending on the source, these are either imputed at full costs (purchase prices) or refer only to accounting costs from actual purchases made.
- Generally, even though costs are reported per kg of milk produced, the values actually refer to all output from milk cows, i.e. including calves and old cows. In contrast, the GECOM model only reports costs allocated to milk.

To provide a meaningful comparison, these aspect need to be taken into account. Therefore, the comparison is made not at the national, but at the level of a Bundesland. Bavaria was chosen because of the detailed information provided in the studies, which allows to recalculate some the values to account for some of the described differences to the GECOM approach (e.g., excluding imputed costs for production costs of roughage

fodder). The report (LFL, 2006) is based on an analysis of 320 dairy farm accounts in Bavaria, allocating costs to different farm enterprises using a budgeting approach.

Table 2-20 provides an overview of the comparison. The comparison is done at the level of cost shares rather than absolute costs per kg due to the different definition of the 'output' of milk production. The total cost share is remarkably similar (80% vs. 78%, Table 2-20), as are those costs categories which can be compared directly (e.g., concentrates). Other cost categories differ in definition and can be compared only at the level of higher aggregates (e.g., "roughage fodder" plus depreciation, machinery, fuel and contract work). At the aggregated level, again, the level of cost shares is very similar. Overall, the comparison supports the plausibility of GECOM estimates of milk production costs for Germany, though it has to be noted that the validation was restricted to one Bundesland due to the limited availability of comparable cost studies.

Table 2-20: Comparison of milk production cost in Bavaria, 2005, between GECOM results and other cost surveys

	GECOM	LFL
	Percentage of output value 1)	
Concentrates	18%	20%
Roughage fodder *		
seeds, fertiliser, plant protection	3%	
all direct costs		30%
Other livestock specifc costs	7%	5%
MotorFuel	4%	1%
Other energy	3%	3%
ContractWork	4%	1%
Building maintenance	1%	1%
Machinery maintenance	5%	1%
Other miscellaneous	9%	7%
Depreciation	25%	7%
Livestock purchases		1%
Total	80%	78%
** Roughage fodder plus depreciation, machinery, fuel and contract work*	*41%*	*40%*

1) GECOM: Output = milk. LFL: Output = milk, calf, slaughter cows

Source: Own calculations based on German national FADN and LFL (2006).

2.7.2 National Workshop

The workshop with national experts took place in Braunschweig on 24th June 2010. Specific care was taken to ensure that the regional diversity of German agriculture is reflected in the composition of experts. In total, 16 experts attended the workshop, representing a diverse mixture of expertise from regional public institutions with a focus on advisory services, administration and applied research (11 persons), the federal agricultural ministry (1), agricultural research (2) and organisations involved in the establishment and dissemination of farm planning data (2). Four presentations were given: an introduction to the project including a short description of the methodology and the definition of the terminology (e.g. definition of cost categories), an overview of time series results for the total German sample and selected EU Member States, a detailed analysis of costs for

different farm groups in Germany, and a presentation reporting the results of an extension of the cost model to account for land, labour and capital including family-owned resources. The presentation of results focussed on wheat, milk and pig products.

Initially, the main focus of the discussions was related to the definition of production costs. Despite the introductory presentation, there was obviously considerable room for misunderstandings concerning the range of costs included and the income indicator which results from the difference between the presented production costs and the returns/revenues. Some reasons for these problems may be specific to the German situation: The income indicator "(farm) net value added", which is resulting from the FACEPA model and which is a central indicator in EU FADN, is uncommon in applied farm economic analysis in Germany. Most of the experts automatically related to production cost calculations which include costs for labour, land and capital. In addition, many experts have the quite detailed cost allocations from other sources in their mind, which often group costs in a different way, which can not be replicated and compared with the FADN data. Generally, many experts saw a significant danger that FACEPA production cost estimates will mislead farmers and politicians as they do not refer to full costs. Many experts also had problems with the concept of product-specific costs for milk. They recommended to bundle milk and beef production of specialised dairy farms into a single production activity, as they are used to from cost allocation in other sources.

The discussion of individual results was somewhat overshadowed by the problems mentioned above. Especially the discussion of the detailed results by cost category was less intensive than originally desired. The main remarks concerning the plausibility of results can be summed up as follows:

- The general trend of estimated production costs for wheat, pigs and milk over time seems plausible.
- While not discussed in detail, some experts noted that the relative as well as absolute values of the specific cost categories (seeds; fertiliser; plant protection) correspond to their own experience.
- In addition some findings were presented concerning oilseed and sugar beet production. However, results for these products were judged implausible on the basis of the large variations for depreciation and subsidies in different years.
- With respect to the results from the differentiation between pig production and pig fattening, the experts noted that the relation between replacement costs and feeding costs in piglet production seems unrealistic for the earlier years.
- The differences between farm groups with respect to the cost category 'other costs' do not always seem plausible.
- The estimated level of coupled subsidies allocated to milk is implausible.

For the interpretation of results, the following comments were given:

- The differentiation by education level should be tested with respect to its correlation with farm size.[15]

[15] A check of model results showed that there is indeed a close correlation of education and farm size in pig production.

- There were several explanations for the higher level of estimated production costs for wheat in specialised cereal farms compared to non-specialised farms:
  - The higher level of specific costs per ton of wheat in specialised cereal farms may be due to the higher expenditures for mineral fertiliser.[16]
  - The higher level of depreciation per ton of wheat in specialised cereal farms may be due to 'luxury' depreciation, as many arable farms are over-mechanised due to their comparably comfortable income situation.
  - The higher level of labour costs per ton of wheat in specialised cereal farms compared to non-specialised farms may be due to the fact that arable farms have a much lower work load in the winter time, and so a family working unit (FWU) of arable farms effectively equals fewer working hours than a FWU in mixed farms. Therefore, the use of standard hours for FWU may be misleading.

Many helpful comments and suggestions were given with respect to the presentation of results:

- All graphs should be fully self-explaining, including a clear definition of costs included or excluded. Information on the sample used and the sample size of all groups shown as well as their yield levels should be included.
- Milk production cost should in addition be calculated per cow, as this is a common figure used for comparisons in Germany.
- Presenting results for pig production in Germany only makes sense if a differentiation is made between pork and piglet production. Costs should be shown per pig rather than per livestock unit

Experts also commented on the usefulness of the data base

- Several experts highlighted that the quality of farm accounts is very variable. In addition, for the interpretation it is important to keep in mind that the main purpose of the farm accounts is for tax reasons; an adjustment of the accounts to receive a true farm economic account would be desirable but may not be feasible for FADN data.
- It was pointed out that for Germany results on pig production are not representative, as the FADN includes few large pig farms and no commercial (i.e. 'non-agricultural') farms, which are important in pig production in Germany.
- For more recent years, production of energy maize may distort results in some regions of Germany.
- Due to the definition of a farm accounting year used in many of the German farm accounts, expenses and revenues for crop products in the accounting data may not relate to the same production period.[17]
- The information on labour / working time in FADN is rather unreliable.

Despite the often critical comments, the experts generally found the workshop very fruitful and expressed great interest in being informed on the progress of the project and maybe

[16] A check of model results showed that indeed the expenditures for mineral fertilizer are higher for specialized farms.
[17] This issue had been tested before with a sample of identical farms, but no significant influence of adjusting input and output data for time periods on results was detected.

even having a follow-up workshop concerning results from an improved cost estimation model.

3 Results for Italian national FADN

Authors: Luca Cesaro, Sonia Marongiu, Agostina Zanoli, Filippo Arfini, Michele Donati

Istituto Nazionale di Economia Agraria (INEA), Italy

This chapter presents and discusses the results obtained by applying the general cost of production model (GECOM) to the Italian FADN, named RICA. The main aim of this application is to compare Italian and European FADN dataset because there are some differences in the number of farms and in the cost details. As a consequence, the application of the model using both databases permits to test if the results are different or not. The comparison has been made for the 2004-2007 period and considering soft wheat, durum wheat, maize and cow milk. After a general description of Italian FADN, the data and the results will be presented separately for every production.

3.1 Brief description of the Italian Farm Accountancy Data Network (RICA)

The Italian Farm Accountancy Data Network (named RICA, Rete di Informazione Contabile Agricola) was set up in 1965 following an European regulation (N°79/65) establishing a common framework of principles and organizational directives for all the Member States. Following this common framework, accounting data for the agricultural sector started to be collected in a homogeneous way in the whole territory and the system became a thorough survey. Firstly, the results have been collected with the main aim to update the European database but during the time the role of Italian FADN changed and today it is the most important source of data for microeconomic and policy analysis. To answer to the informative needs of analysts and to satisfy evaluation of stakeholders requirements, additional information and details have been included in the Italian FADN scheme. Moreover, the European rules on designing FADN sample allow Member States to have a certain degree of discretional choices. For instance, the size of the strata in Italian random sample is influenced by the Standard Gross Margin (SGM) in every cell. A cell is defined crossing economic size with type of farming. If the Standard Gross Margin (SGM) of a cell is less than 1% of the regional SGM the Italian FADN aggregates this cell with another one. When this is not possible, the cell is excluded.

As a consequence, Italy has applied its own rules to manage the National FADN in order to create a specific file to complete the European FADN. Although the FADN datasets at the Member State and EU level are to a certain extent harmonized, some differences occur (Delame and Butault, 2009). In Italy the main differences between National FADN (RICA) and European FADN are:

- The Italian national FADN has a larger sample than included in the European FADN. The reason of this misalignment is due to the presence of “satellite farms” which data are collected to monitor specific issues in the regions but which data are not sent to European dataset. Table 3-1 shows the number of farms included in the Italian RICA and the number of Italian farms included in the European database from 2004-2007. The last column shows the difference in sample size.

Table 3-1: Sample size of Italian FADN (RICA) and European FADN for Italy.

	Italian FADN	EU - FADN	Difference
2004	14,322	13,661	661
2005	15,002	14,537	465
2006	15,183	14,689	494
2007	15,346	14,906	440

Source: RICA - INEA; EU-FADN, DG-AGRI L-3, dataset: Italy 2004-2007 and own calculation.

- Italian FADN has more detailed information than the EU FADN. Some of these differences have been described in a deliverable of FACEPA project (Delame and Butault, 2009). The most important ones are connected with some costs imputed to different products by the surveyor, the additional details for many products (for instance, milk is described in eight headings), and so on.
- INEA calculates weights according to the sample design. INEA weights are different from FADN weights, notwithstanding the calculation method is the same. The weight for the i-farm is

  $$w_{i=}N_h/n_h$$

  where:

  N_h is the number of farms in the universe for the strata h;

  n_h is the number of farms in the sample for the strata h

  Italian FADN has more farms, so n_h differs in the two dataset. Besides, FADN estimates N_h according to the last EUROSTAT Farm Structure Survey (FSS), instead INEA uses the Italian Agriculture General Census of 2000 and Farm Structure Survey 2005.

3.2 Description of the dataset (2004-2007)

The application of the GECOM model to the Italian dataset has considered only the last period, from 2004 to 2007. This choice is due to different reasons. First of all, as previously mentioned, in 2003 Italian FADN sampling system shifted from a volunteer to a stratified random plan. So, in order to avoid influences due to this change, only the last four years and only the random sample have been considered (excluding the first year of new sample). The second reason is linked to the validation of the results because of it is easier to understand the differences if few recent years are taken into account.

Before running the model, the outliers have been removed using the methodology implemented by the German team and the results in terms of number of farms for year and production are illustrated in Table 3-2. During the considered period, the number of farms has increased from about 13,000 to more than 14,200 units. The most common cultivation is durum wheat (about 3,000 farms on average grow this crop every year) and maize. The cultivation of soft wheat increased during the time while dairy activities remained more or less constants.

Table 3-2: Number of farms for year and cultivation after outlier elimination (2004-2007)

Year	Nr of farms	Nr of farms with:			
		Soft wheat	Durum Wheat	Maize	Cow milk
2004	12,968	1,638	3,076	2,720	1,964
2005	13,954	1,845	2,963	2,753	2,168
2006	14,135	1,834	2,808	2,710	2,112
2007	14,226	2,052	3,055	2,596	2,048

Source: RICA – INEA; dataset: Italy 2004-2007 and own calculation.

The application of GECOM model structure to the Italian dataset has required a sort of translation and adaptation of some codes necessary to the estimation. In fact, as mentioned in the previous paragraphs, cost categories in European FADN are more aggregated than the Italian ones, so they could include several components, disaggregated in the Italian FADN dataset. With this adaptation, the structure of GECOM model and the variables remained the same: 18 aggregated input variables and 31 aggregated output categories.

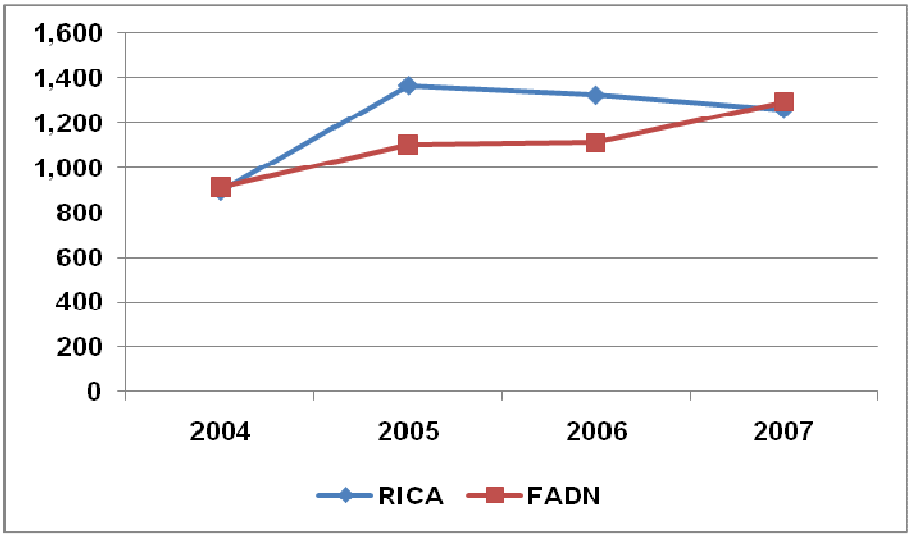
3.3 The GECOM model: differences between Italian and European FADN for the different sectors

This section presents the cost estimation results obtained by applying the GECOM model to the Italian and European FADN dataset during the period 2004-2007. For each product (soft wheat, durum wheat, maize and cow milk) the trend, the differences (on average) in the single cost components, the estimated coefficients for both datasets and their statistical significance will be given. A further table will show also the statistical significance of the difference between the coefficients. Some cost category have been aggregated in order to simplify the representation.

3.3.1 Soft Wheat

The estimation results for soft wheat obtained using Italian FADN are, more or less, the same than those obtained using EU-FADN dataset for 2004 and 2007 while for 2005-2006 some difference arise (Figure 3-1). In these two years, in fact, the total production cost estimated by the GECOM model is slightly higher in Italian FADN than in EU-FADN.

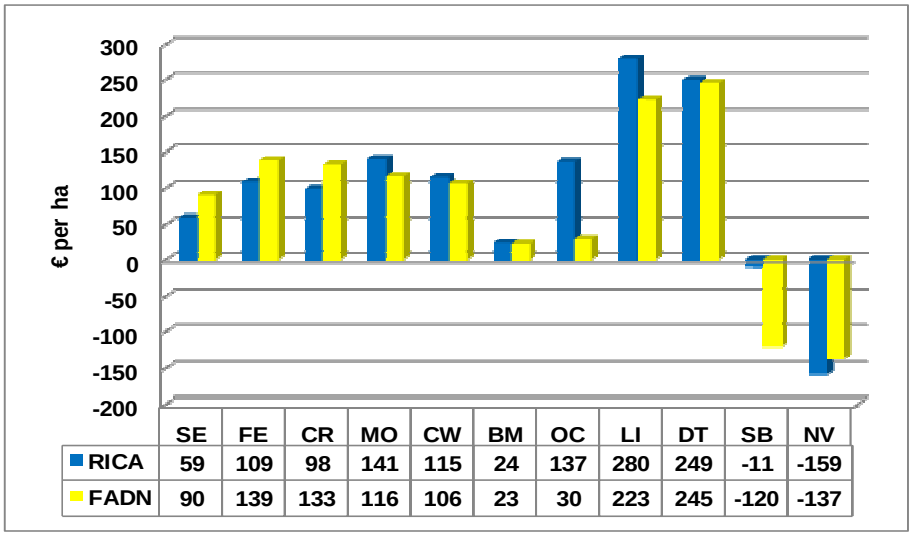
Figure 3-1: Production costs of Soft Wheat in Italian FADN (RICA) and EU-FADN (2004-2007)



Source: RICA – INEA; EU-FADN, DG-AGRI L-3 dataset: Italy 2004-2007 and own calculation.

The reason of the difference is illustrated in the Figure 3-2 which shows the average of the different cost components during the considered period 2004-2007. Using Italian FADN the estimated cost per hectare for seed, fertilizer and crop protection are lower than for EU-FADN, instead for land costs and depreciation Italian FADN has the highest values. The value obtained for subsidies is very different (also in the analysis that will follow): the reason could be due to a different aggregation way in the two datasets.

Figure 3-2: Production costs of Soft Wheat in Italian FADN (RICA) and EU-FADN by cost item (average 2004-2007)



	SE	FE	CR	MO	CW	BM	OC	LI	DT	SB	NV
RICA	59	109	98	141	115	24	137	280	249	-11	-159
FADN	90	139	133	116	106	23	30	223	245	-120	-137

Source: RICA – INEA; EU-FADN, DG-AGRI L-3 dataset: Italy 2004-2007 and own calculation.[18]

As concerns the estimated coefficients, Italian FADN results have a higher number of statistically significant coefficients than EU-FADN (Table 3-3), probably because in the former there are more farms involved. There are a lot of differences in estimated coefficients statistically significant, above all in 2007 (Table 3-4).

[18] For abbreviations see the general overview in the abbreviation and acronym section.

Table 3-3: Estimated coefficients for soft wheat in Italian FADN (RICA) and EU-FADN (2004-2007)

	RICA				FADN			
	2004	**2005**	**2006**	**2007**	**2004**	**2005**	**2006**	**2007**
SEED	0.03	0.07	0.06	0.07	0.10	0.05	0.05	0.19
FERTIL	0.12	0.13	0.07	0.10	0.17	0.24	0.14	0.13
CRPROT	0.10	0.12	0.09	0.08	0.13	0.29	0.11	0.12
MOTFUE	0.07	0.19	0.19	0.17	0.11	0.17	0.14	0.11
OENERG	-0.02	-0.03	-0.02	0.01	0.01	0.00	0.00	0.01
CONWOR	0.08	0.14	0.14	0.09	0.13	0.13	0.14	0.11
BUILUK	0.00	0.00	0.00	0.00	-0.01	0.00	0.00	0.00
MACHUK	0.01	0.05	0.01	0.02	0.03	0.01	0.04	0.03
OTHSIC	0.08	0.09	0.25	0.11	0.19	-0.07	0.03	0.01
LANDCO	0.16	0.34	0.40	0.21	0.22	0.34	0.35	0.18
INTERE	0.01	0.00	0.00	0.00	0.00	-0.01	0.00	0.00
DEPREC	0.16	0.49	0.21	0.15	0.17	0.34	0.37	0.27
TAXES	0.00	0.00	0.00	0.01	0.01	0.00	-0.01	0.01
SUBSID	0.01	-0.02	-0.01	-0.03	-0.49	-0.04	-0.03	-0.07
NETVAL	0.20	-0.57	-0.39	0.00	0.21	-0.46	-0.34	-0.08

Not statistically significant at 95% level.

Source: RICA – INEA; EU-FADN, DG-AGRI L-3 dataset: Italy 2004-2007 and own calculation.

Table 3-4: Differences between estimated coefficients in Italian FADN (RICA) and EU-FADN (2004-2007) for Soft Wheat

	Differences RICA-FADN			
	2004	**2005**	**2006**	**2007**
SEED	-0.07	0.02	0.01	-0.12
FERTIL	-0.05	-0.12	-0.07	-0.02
CRPROT	-0.03	-0.17	-0.02	-0.04
MOTFUE	-0.05	0.02	0.05	0.05
OENERG	-0.03	-0.03	-0.01	0.00
CONWOR	-0.04	0.01	0.00	-0.02
BUILUK	0.00	0.00	0.00	0.00
MACHUK	-0.02	0.04	-0.03	-0.01
OTHSIC	-0.12	0.16	0.23	0.11
LANDCO	-0.07	0.00	0.05	0.03
INTERE	0.01	0.01	0.00	0.00
DEPREC	-0.01	0.15	-0.16	-0.11
TAXES	0.00	0.00	0.00	0.00
SUBSID	0.50	0.02	0.02	0.04
NETVAL	-0.02	-0.12	-0.05	0.09

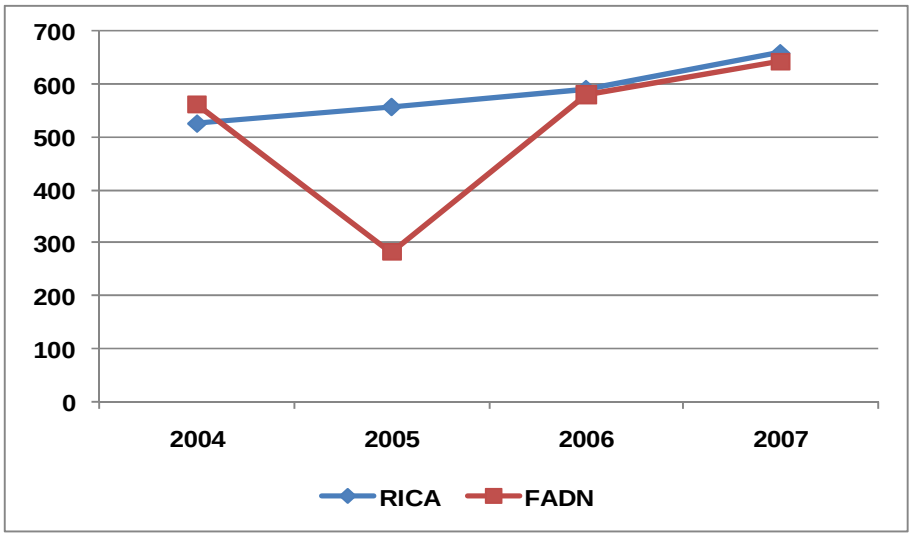
Differences statistically significant at 95%.

Source: RICA – INEA; EU-FADN, DG-AGRI L-3 dataset: Italy 2004-2007 and own calculation.

3.3.2 Durum Wheat

As for the previous case, also for durum wheat the estimation of the total cost of production coming from the application of the model to the different datasets is more or less the same. The only exception is 2005 (Figure 3-3). In this year, the result obtained from EU-FADN dataset is about 300 euro per hectare, which is really very low and not plausible. The result for Italian FADN (557 euro per hectare) seems to be reasonable and aligned with the increasing trend registered in the whole period.

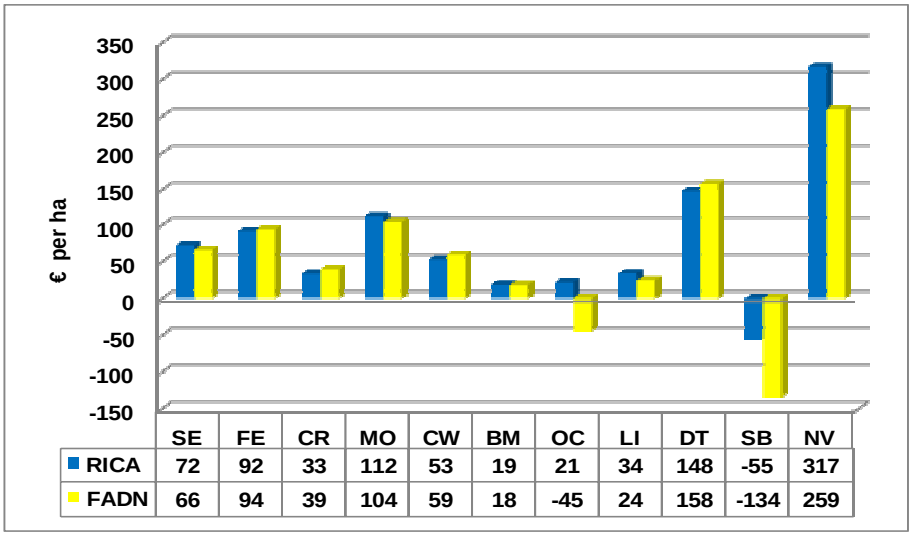
Figure 3-3: Production costs of Durum Wheat in Italian FADN (RICA) and EU-FADN (2004-2007)



Source: RICA – INEA; EU-FADN, DG-AGRI L-3 dataset: Italy 2004-2007 and own calculation.

On average, in the period analyzed, the main differences in costs per hectare between Italian-FADN and EU-FADN are in other costs, land costs and subsidies (Figure 3-4).

Figure 3-4 : Production costs of Durum Wheat in Italian FADN (RICA) and EU-FADN cost item (average 2004-2007)



	SE	FE	CR	MO	CW	BM	OC	LI	DT	SB	NV
RICA	72	92	33	112	53	19	21	34	148	-55	317
FADN	66	94	39	104	59	18	-45	24	158	-134	259

Source: RICA – INEA; EU-FADN, DG-AGRI L-3 dataset: Italy 2004-2007 and own calculation.

Also for durum wheat the number of coefficients statistically significant in Italian FADN is higher than in EU-FADN (Table 3-5). The differences in estimated coefficients are only statistically significant for seed, interest and electricity and heating fuels over the whole period (Table 3-6), whereas for the other cost items the results vary year by year.

Table 3-5: Estimated coefficients for Durum wheat in Italian FADN (RICA) and EU-FADN (2004-2007).

	RICA				FADN			
	2004	**2005**	**2006**	**2007**	**2004**	**2005**	**2006**	**2007**
SEED	0.08	0.15	0.11	0.05	0.12	0.18	0.10	0.06
FERTIL	0.09	0.16	0.13	0.08	0.20	0.18	0.16	0.10
CRPROT	0.03	0.05	0.06	0.03	0.10	0.04	0.07	0.05
MOTFUE	0.09	0.19	0.17	0.13	0.18	0.22	0.23	0.12
OENERG	-0.01	-0.01	-0.01	0.00	-0.02	-0.02	-0.01	-0.01
CONWOR	0.06	0.07	0.09	0.04	0.15	0.09	0.11	0.06
BUILUK	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00
MACHUK	0.02	0.02	0.02	0.02	0.06	-0.04	0.04	0.03
OTHSIC	0.02	0.05	0.00	0.03	-0.01	-0.33	-0.03	-0.01
LANDCO	0.02	0.03	0.07	0.04	0.05	-0.01	0.07	0.03
INTERE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DEPREC	0.17	0.23	0.20	0.10	0.35	0.26	0.26	0.15
TAXES	0.01	0.02	0.02	0.02	0.02	0.03	0.02	0.01
SUBSID	-0.02	-0.11	-0.10	-0.06	-1.00	-0.06	-0.04	-0.03
NETVAL	0.44	0.14	0.24	0.51	0.77	0.46	0.01	0.43

Not statistically significant at 95% level.

Source: RICA – INEA; EU-FADN, DG-AGRI L-3 dataset: Italy 2004-2007 and own calculation.

Table 3-6: Differences between estimated coefficients in Italian FADN (RICA) and EU-FADN (2004-2007) for Durum Wheat.

	Differences RICA-FADN			
	2004	**2005**	**2006**	**2007**
SEED__	-0.05	-0.03	0.01	-0.01
FERTIL	-0.11	-0.02	-0.03	-0.02
CRPROT	-0.07	0.01	-0.01	-0.02
MOTFUE	-0.09	-0.03	-0.05	0.01
OENERG	0.01	0.00	0.00	0.01
CONWOR	-0.09	-0.02	-0.02	-0.02
BUILUK	0.00	0.01	0.00	0.00
MACHUK	-0.04	0.06	-0.02	-0.01
OTHSIC	0.03	0.38	0.03	0.04
LANDCO	-0.03	0.04	0.00	0.01
INTERE	0.00	0.00	0.00	0.00
DEPREC	-0.19	-0.03	-0.06	-0.04
TAXES_	-0.01	-0.01	0.00	0.00
SUBSID	0.98	-0.05	-0.05	-0.03
NETVAL	-0.33	-0.31	0.23	0.08

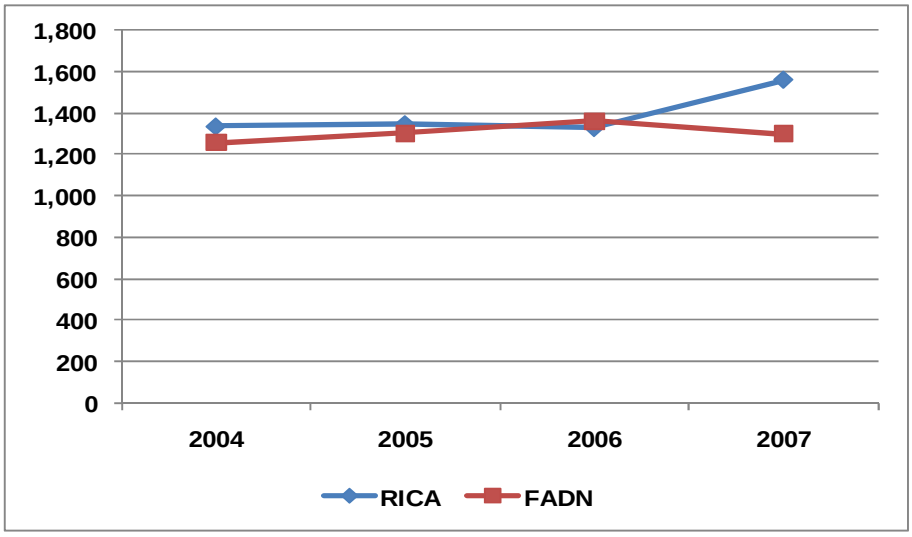
Differences statistically significant at 95%.

Source: RICA – INEA; EU-FADN, DG-AGRI L-3 dataset: Italy 2004-2007 and own calculation.

3.3.3 Maize

The results for maize are very similar, except for 2007, when the estimation obtained from Italian FADN results in an increasing of total cost up to 1,562 euro per hectare (Figure 3-5). This increase is due to the higher estimated value per hectare for fertilizer, crop protection and other costs.

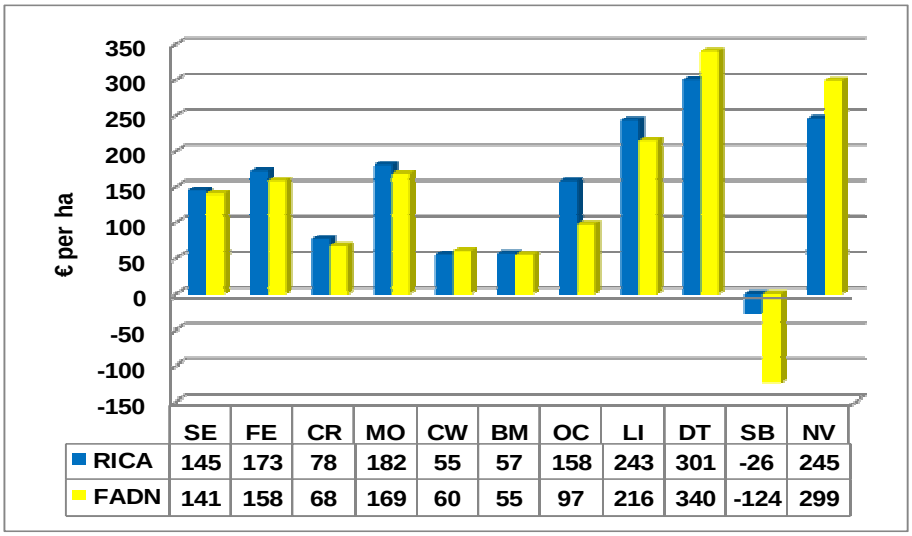
Figure 3-5: Production costs of Maize in Italian FADN (RICA) and EU-FADN (2004-2007)



Source: RICA – INEA; EU-FADN, DG-AGRI L-3 dataset: Italy 2004-2007 and own calculation.

Figure 3-6 shows the differences in the cost components as average of the considered period. There are no relevant differences and generally speaking, it could be argued that for the most important components, the costs estimated by using the Italian FADN are higher than those obtained with EU-FADN. Only estimates for depreciation costs are higher in EU-FADN results.

Figure 3-6: Production costs of Maize in Italian FADN (RICA) and EU-FADN by cost item (average 2004-2007)



	SE	FE	CR	MO	CW	BM	OC	LI	DT	SB	NV
RICA	145	173	78	182	55	57	158	243	301	-26	245
FADN	141	158	68	169	60	55	97	216	340	-124	299

Source: RICA – INEA; EU-FADN, DG-AGRI L-3 dataset: Italy 2004-2007 and own calculation.

Only few cost coefficients are not statistically significant in both data sets (Table 3-7) while concerning the differences in the estimated coefficients, they are not significant (Table 3-8).

Table 3-7: Estimated coefficients for Maize in Italian FADN (RICA) and EU-FADN (2004-2007).

	RICA				FADN			
	2004	**2005**	**2006**	**2007**	**2004**	**2005**	**2006**	**2007**
SEED	0.09	0.10	0.10	0.07	0.13	0.12	0.11	0.05
FERTIL	0.10	0.14	0.10	0.10	0.12	0.12	0.11	0.09
CRPROT	0.04	0.06	0.05	0.05	0.06	0.05	0.04	0.03
MOTFUE	0.07	0.13	0.12	0.10	0.09	0.12	0.14	0.09
OENERG	0.02	0.02	0.01	0.00	0.01	0.01	0.01	0.00
CONWOR	0.04	0.03	0.04	0.03	0.05	0.05	0.04	0.03
BUILUK	0.00	0.01	0.00	0.01	0.00	0.01	0.01	0.01
MACHUK	0.02	0.03	0.03	0.04	0.04	0.04	0.03	0.02
OTHSIC	0.07	0.12	0.09	0.11	0.08	0.06	0.08	0.05
LANDCO	0.12	0.19	0.18	0.12	0.13	0.18	0.15	0.10
INTERE	0.00	0.00	0.01	0.00	0.01	0.01	0.01	0.00
DEPREC	0.20	0.19	0.18	0.12	0.28	0.27	0.23	0.14
TAXES	0.02	0.03	0.02	0.01	0.02	0.02	0.01	0.01
SUBSID	-0.01	-0.02	-0.01	-0.02	-0.37	-0.03	-0.01	0.00
NETVAL	0.21	-0.02	0.10	0.25	0.34	-0.02	0.05	0.36

Not statistically significant at 95% level.

Source: RICA – INEA; EU-FADN, DG-AGRI L-3 dataset: Italy 2004-2007 and own calculation.

Table 3-8: Differences between estimated coefficients in Italian FADN (RICA) and EU-FADN (2004-2007) for Maize.

	Differences RICA-FADN			
	2004	**2005**	**2006**	**2007**
SEED	-0.04	-0.01	-0.01	0.02
FERTIL	-0.02	0.02	-0.01	0.01
CRPROT	-0.02	0.01	0.00	0.01
MOTFUE	-0.02	0.01	-0.02	0.01
OENERG	0.01	0.01	0.00	0.00
CONWOR	-0.01	-0.02	0.00	0.00
BUILUK	0.00	0.00	0.00	0.00
MACHUK	-0.01	-0.01	0.00	0.01
OTHSIC	-0.01	0.06	0.01	0.06
LANDCO	-0.02	0.01	0.03	0.02
INTERE	-0.01	-0.01	0.00	0.00
DEPREC	-0.07	-0.09	-0.05	-0.01
TAXES	0.00	0.01	0.00	0.00
SUBSID	0.36	0.01	0.00	-0.02
NETVAL	-0.13	0.00	0.05	-0.11

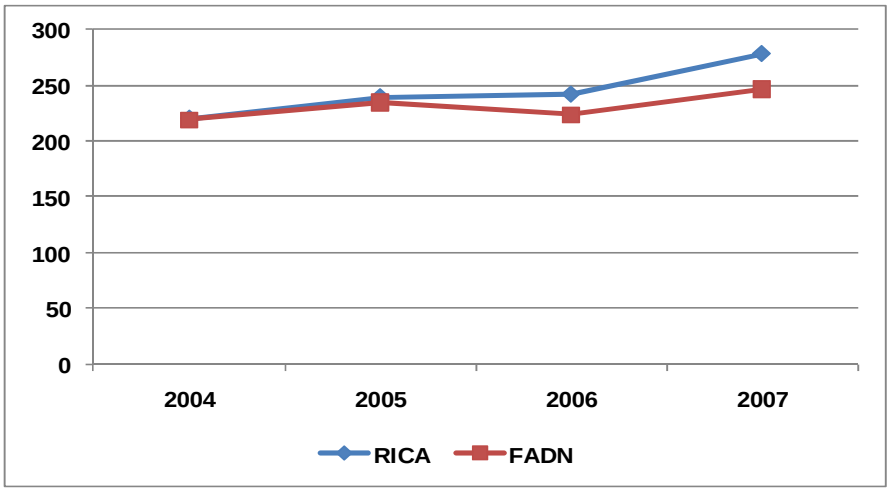
Not statistically significant at 95% level.

Source: RICA – INEA; EU-FADN, DG-AGRI L-3 dataset: Italy 2004-2007 and own calculation.

3.3.4 Cow Milk

In 2004 and in 2005 the cost of production of milk is basically the same in the two data set analyzed. After that, there is an increase in the estimated cost for Italian FADN, until 278 euro per ton in 2007 (Figure 3-7).

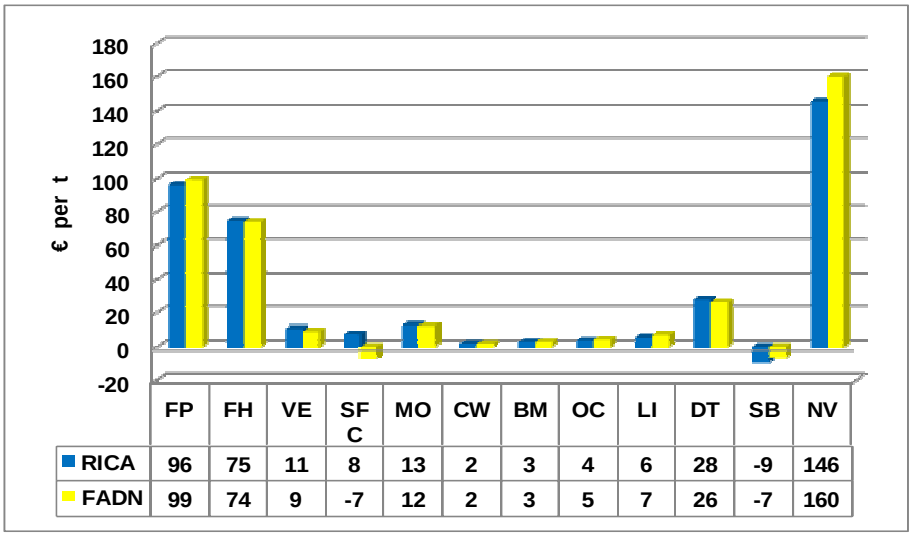
Figure 3-7: Production costs of Cow Milk in Italian FADN (RICA) and EU-FADN (2004-2007)



Source: RICA – INEA; EU-FADN, DG-AGRI L-3 dataset: Italy 2004-2007 and own calculation.

On average, over the period analyzed, the differences in the cost items between the Italian FADN and the EU-FADN are small (Figure 3-8).

Figure 3-8: Production costs of Cow Milk in Italian FADN (RICA) and EU-FADN by cost item (average 2004-2007)



	FP	FH	VE	SFC	MO	CW	BM	OC	LI	DT	SB	NV
RICA	96	75	11	8	13	2	3	4	6	28	-9	146
FADN	99	74	9	-7	12	2	3	5	7	26	-7	160

Source: RICA – INEA; EU-FADN, DG-AGRI L-3 dataset: Italy 2004-2007 and own calculation.

On the contrary, if we consider the cost coefficients year by year most of the differences between Italian FADN and EU-FADN are statistically significant (Table 3-10). This is true also in 2004-2005, when the total cost of production is very close in the two estimations.

So if we compare specific cost items there are differences, but the total cost of production per ton is almost the same.

Table 3-9: Estimated coefficients for Cow Milk in Italian FADN (RICA) and EU-FADN (2004-2007).

	RICA				FADN			
	2004	**2005**	**2006**	**2007**	**2004**	**2005**	**2006**	**2007**
FEEDPC	0.23	0.24	0.26	0.29	0.28	0.28	0.22	0.26
FEEDHC	0.18	0.19	0.21	0.20	0.15	0.21	0.21	0.19
VETCOS	0.02	0.03	0.03	0.03	0.03	0.02	0.02	0.02
SEED	-0.01	0.00	-0.01	-0.02	-0.02	-0.01	-0.03	-0.01
FERTIL	0.02	0.02	0.03	0.03	0.00	0.00	0.01	0.01
CRPROT	0.00	0.00	0.00	0.00	0.00	-0.01	0.00	0.01
MOTFUE	0.02	0.03	0.03	0.02	0.02	0.03	0.03	0.02
OENERG	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
CONWOR	0.00	0.01	0.01	0.01	0.00	0.00	0.01	0.00
BUILUK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MACHUK	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00
OTHSIC	0.00	0.02	0.01	0.01	0.01	0.01	0.01	0.01
LANDCO	0.01	0.01	0.01	0.02	0.02	0.01	0.02	0.02
INTERE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DEPREC	0.06	0.07	0.08	0.07	0.06	0.07	0.07	0.06
TAXES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SUBSID	-0.02	-0.06	-0.02	0.00	-0.02	-0.05	0.00	0.00
NETVAL	0.47	0.42	0.34	0.29	0.45	0.42	0.40	0.38

Not statistically significant at 95% level.

Source: RICA – INEA; EU-FADN, DG-AGRI L-3 dataset: Italy 2004-2007 and own calculation.

Table 3-10: Differences between estimated coefficients in Italian FADN (RICA) and EU-FADN (2004-2007) for Cow Milk.

	Differences RICA-FADN			
	2004	**2005**	**2006**	**2007**
FEEDPC	-0.055	-0.043	0.041	0.032
FEEDHC	0.025	-0.020	-0.006	0.014
VETCOS	-0.004	0.008	0.009	0.005
SEED__	0.011	0.012	0.016	-0.010
FERTIL	0.022	0.027	0.029	0.025
CRPROT	-0.005	0.009	-0.003	-0.001
MOTFUE	0.002	0.001	0.001	0.002
OENERG	0.001	-0.001	-0.003	0.001
CONWOR	-0.001	0.002	-0.001	0.002
BUILUK	0.000	0.000	0.000	0.001
MACHUK	-0.002	0.001	0.000	0.002
OTHSIC	-0.010	0.009	-0.004	0.000
LANDCO	-0.006	0.004	-0.006	0.000
INTERE	-0.002	-0.002	-0.001	0.000
DEPREC	0.002	0.003	0.003	0.011
TAXES_	0.001	0.001	0.001	0.001
SUBSID	-0.004	-0.007	-0.017	-0.002
NETVAL	0.025	-0.002	-0.060	-0.083

Not statistically significant at 95% level.

Source: RICA – INEA; EU-FADN, DG-AGRI L-3 dataset: Italy 2004-2007 and own calculation.

4 Results for Dutch national FADN

Authors: Mark Dolman, Walter van Everdingen, David Verhoog

LEI Wageningen UR

This chapter presents the results obtained by applying the general cost of production (GECOM) model for adjusted Dutch FADN data. Instead of replacing all Dutch EU-FADN data, only a number of cost variables were replaced. Furthermore, the EU-FADN weighting scheme was replaced by the weighting scheme used for national FADN-data. A more exhaustive description of the data replaced will be given in section 4.1. After the description of the data, main results will be presented for the three main products (dairy, pig and wheat). Subsequently, we will focus on comparing data in national FADN with data in EU-FADN and investigate the effect of using different weighting schemes and using price information from the national FADN instead of Eurostat prices.

4.1 Data

The Dutch FADN has a history going back to 1975. In the course of time, the Dutch FADN has been under revision on several occasions. The last major revision was in 2000. A consequence of this change is that data before and after 2000 are different. Besides this, the last revision of the Dutch FADN created some problem in delivery of data to DG-Agri. For this reason, the year 2000 is excluded from our analysis. Therefore, in most Dutch FADN research, results are presented in two periods, one before 2000 and one after 2000. In this chapter, we focus on the period from 2001 to 2007. Although the FADN datasets at the Member State and EU level are to a certain extent harmonized, differences occur. For example, FADN data for input and output categories tend to be more aggregated at the EU than at the Member State level (Delame and Butault, 2010). Furthermore, weighting schemes differ between EU-FADN and the national FADN because the Commission is determining its own weighting. Finally, there can be different definitions in bookkeeping of, for example, depreciation.

To test the difference between the national FADN and the EU-FADN for the Netherlands we have not chosen to replace completely the one by the other. Instead, we have chosen to replace some data only. The major advance of replacing only some data is that we do not have to adjust all the data used within the GECOM to national codes. Therefore, more time is available for assessing the model runs. The data that have been replaced concern all costs excluding depreciation (EU Table F) and the weighting scheme (variable SYS02). To test for the effect of each step, four separate model runs were performed.

Figure 4-1 gives an overview of the steps taken on group of farms selected, data and weighting in the first step, to the selection of farms, replaced data and national weighting scheme in the last step. In the first step (model run I), the total Dutch EU-FADN sample of farms is used, with the 'old' data for the costs categories (EU Table F). Furthermore, the EU-FADN weighting scheme (variable SYS02) was used to present results (GECOM-group in Figure 4-1). From the EU-FADN sample farms, in step 2 only farms were selected of which a national weighting factor was available (NL-group in Figure 4-1). The effect of the exclusion off farms with no national weighting factor was tested in model run II. After

the selection of farms with national weighting, in step 3 Table F was replaced by 'new' data, so discovered data errors since the year the data was delivered, were now replaced with newer data (model run III). Finally, the national weighting scheme was applied in the last step (model run IV).

Figure 4-1: Farm selection, data and weighting scheme replacement on the EU-FADN - DG AGRI L-3 dataset (4 model runs).

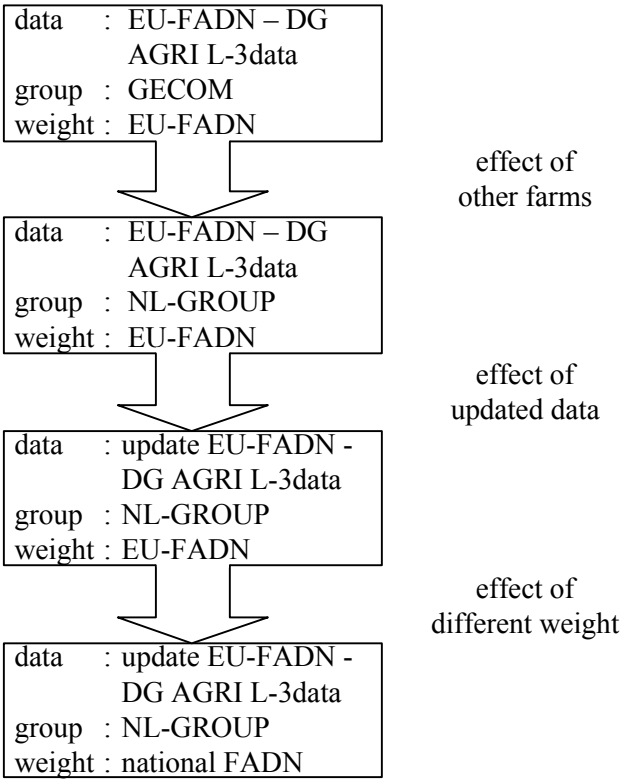


Table 4-1 shows that the NL-group used in model run II to IV, for all years, has less farms. Only farms present in the original GECOM-group are used for the NL-group sample. The difference between both samples is the number of farms with a weighting factor in the EU-FADN sample, and without a weighting factor in the national FADN sample. In most cases, this is caused by the fact the Dutch national weighting scheme is based on the agricultural census, instead of the actual recorded farm size within FADN. Some farms are below the lower threshold for farm size in the agricultural census (situation on the first of May). The average yearly farm size, however, can still exceed the lower threshold.

Table 4-1: Description of data samples used in the four model runs

	2001	2002	2003	2004	2005	2006	2007
Model run I (GECOM group, EU-FADN - DG AGRI L-3 data, sys-02 weight)							
Number of farms represented	76278	62637	63289	60144	59280	56334	55363
Number of farms in sample	1276	1305	1370	1352	1399	1440	1441
Milk production (ton), ∅ per farm	161	173	178	181	191	198	202
UAA (ha), ∅ per farm	28	29	30	31	32	31	32
Livestock units, ∅ per farm	107	103	100	111	113	121	126
Model run II (NL group, EU-FADN - DG AGRI L-3 data, sys-02 weight)							
Number of farms represented	74417	61697	61387	59060	57742	54933	54254
Number of farms in sample	1253	1280	1324	1320	1349	1403	1411
Milk production (ton), ∅ per farm	164	176	181	184	196	203	206
UAA (ha), ∅ per farm	28	29	30	31	32	32	32
Livestock units, ∅ per farm	107	103	99	111	114	123	126
Model run III (NL group, updated EU-FADN - DG AGRI L-3 data, sys-02 weight)							
Number of farms represented	74417	61697	61387	59060	57742	54933	54254
Number of farms in sample	1253	1280	1324	1320	1349	1403	1411
Milk production (ton), ∅ per farm	164	176	181	184	196	203	206
UAA (ha), ∅ per farm	28	29	30	31	32	32	32
Livestock units, ∅ per farm	107	103	99	111	114	123	126
Model run IV (NL group, updated EU-FADN - DG AGRI L-3 data, national weight)							
Number of farms represented	70720	67784	63957	62724	61072	58193	56745
Number of farms in sample	1253	1280	1324	1320	1349	1403	1411
Milk production (ton), ∅ per farm	165	172	186	179	187	198	203
UAA (ha), ∅ per farm	29	29	31	31	32	33	36
Livestock units, ∅ per farm	104	104	112	113	116	125	126

4.2 Results using the GECOM

This section presents GECOM results using the four model runs described in section 4.1 for the three main outputs, namely milk (CMILK), pig (PIG_) and wheat (WHEAT). For each output, a comparison is made for the total production costs between the four model runs. Subsequently, the differences found are further addressed by using the aggregated costs categories, and the effects of using other farms, updated data and another weighting scheme separately.

4.2.1 Dairy

The total production costs for output CMILK differ slightly between model run IV and the other model runs (Figure 4-2). Structurally, the level of production costs in model run IV is lower. However, the difference expressed per 100 kg of milk is considered low.

In Table 4-2, a comparison (in percentage change) is made for aggregated cost categories between model run I and the other three model runs. The aggregated cost categories are equal to the one used within the GECOM model. Variable costs include costs of: purchased feed, homegrown crops, veterinary and other specific livestock, fertilizer, crop protection, seeds, motor fuels. Other intermediate costs are: other energy, contract work, upkeep of buildings and machinery and other specific cost. Other input costs are land and interest.

Figure 4-2: Total production costs for output CMILK of the GECOM.

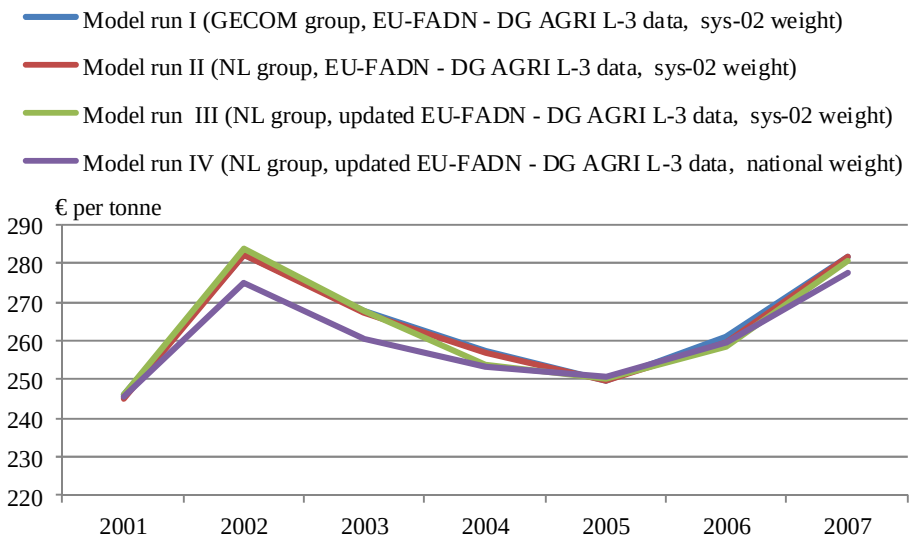


Table 4-2: Development and comparison (in percentage change) of the total production costs and aggregated cost categories for output CMILK (in € per 1000 kg).

	2001	2002	2003	2004	2005	2006	2007
Model run I (GECOM group, EU-FADN - DG AGRI L-3, sys-02 weight)							
total	246	282	267	257	250	261	282
- variable costs	87	92	86	83	73	81	87
- other ic	64	81	76	72	73	71	80
- other input	62	68	63	59	58	62	69
- depreciation	33	41	43	43	46	46	46
Difference (in %) between model run I and model run II							
total	0	0	0	0	0	0	0
- variable costs	0	0	0	0	0	0	0
- other ic	-1	0	0	0	0	0	0
- other input	0	0	0	-1	0	-1	0
- depreciation	0	0	0	0	0	-1	0
Difference (in %) between model run I and model run III							
total	0	0	0	-1	0	-1	0
- variable costs	0	0	0	-3	1	-1	0
- other ic	0	1	1	-1	-1	-1	-1
- other input	0	1	0	-1	1	-1	0
- depreciation	0	0	0	0	0	-1	0
Difference (in %) between model run I and model run IV							
total	0	-2	-3	-2	1	0	-1
- variable costs	-2	0	-1	-2	1	-4	-1
- other ic	2	-4	-5	-1	1	3	-2
- other input	0	0	0	-1	1	1	0
- depreciation	2	-8	-4	-2	-2	-1	-4

For CMILK, the effect of using only another sample of farms is small. If there are differences, the difference is smaller than 1%. The same conclusion can be drawn after updating the data. The difference seen is smaller than 1% with model run I. Only for the variable costs (2004), the differences are wider, however, the difference with model run I is

still small (-3%). When a different weighting scheme is applied (model run IV), more differences are seen compared with model run I. For the total production costs, differences are small. For the aggregated cost categories the difference vary between -8% up to 3%. This effect is caused by the difference in the weighting scheme applied.

4.2.2 Pig

The total production costs for output PIG_ differ slightly between the four model runs (Figure 4-3). Structurally, the level of production costs in model run IV is lower for almost all years. However, the difference expressed per livestock unit pig is considered to be low. In 2004, the level of production costs in model run IV is equal to the other model runs. The difference between model run I and model run IV vary between 0 and -5%. When we go in more detail on the aggregated cost categories, a similar tendency is seen. The largest difference is seen for other intermediate costs in 2005 and other input costs in 2006 (both -8%) (Table 4-3). Only in 2004 the differences are smaller. For variable costs and other input costs the difference between model run I and model run IV is even positive. The absolute largest difference is seen for variable costs for 2002 and 2006 (both -4%).

Figure 4-3: Total production costs for output PIG_ of the GECOM.

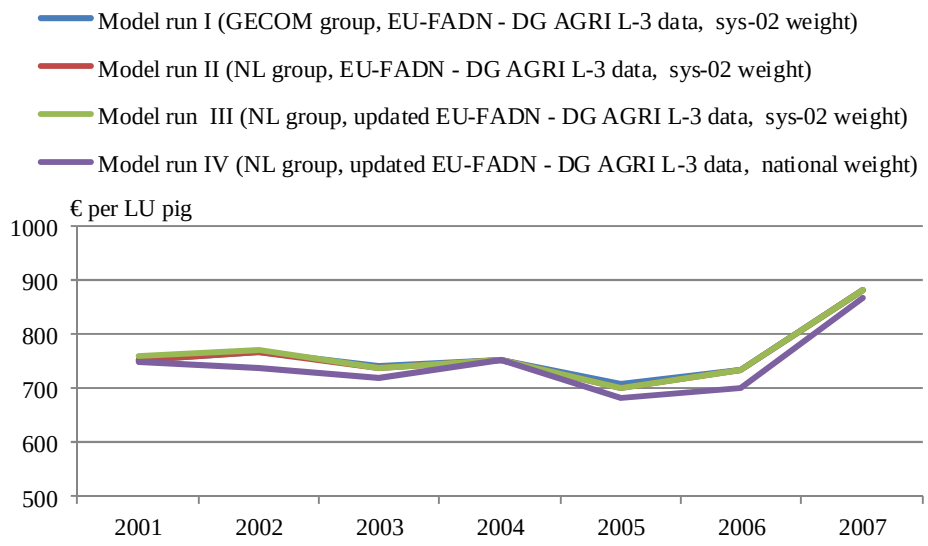


Table 4-3: Development and comparison (in percentage change) of the total production costs and aggregated cost categories for output PIG_ (in € per LU pig)

	2001	2002	2003	2004	2005	2006	2007
Model run I (GECOM group, EU-FADN data, sys-02 weight)							
total	753	768	742	753	709	736	882
- variable costs	500	521	515	536	488	510	644
- other ic	100	95	83	87	96	100	97
- other input	71	71	70	60	55	58	68
- depreciation	82	80	74	70	70	68	73
Difference (in %) between model run I and model run II							
total	0	0	-1	0	-1	0	0
- variable costs	0	0	0	0	-1	0	0
- other ic	0	0	-1	0	-2	0	0
- other input	0	0	-1	0	-1	0	0
- depreciation	0	0	-2	0	-2	-1	0
Difference (in %) between model run I and model run III							
total	1	0	-1	0	-1	0	0
- variable costs	1	0	0	0	-1	0	0
- other ic	0	0	0	-1	-3	-2	-1
- other input	0	0	-1	0	-1	0	1
- depreciation	1	0	-2	0	-2	-1	0
Difference (in %) between model run I and model run IV							
total	-1	-4	-3	0	-4	-5	-2
- variable costs	1	-4	-3	1	-3	-4	-2
- other ic	-3	-5	-1	-4	-8	-3	1
- other input	-7	-2	-7	1	1	-8	-2
- depreciation	-3	-1	-6	-3	-3	-5	-1

4.2.3 Wheat

In contradiction to the other two outputs discussed above, there are rather large differences seen in the total level of production costs of WHEAT.

Figure 4-4: Total production costs for output WHEAT of the GECOM.

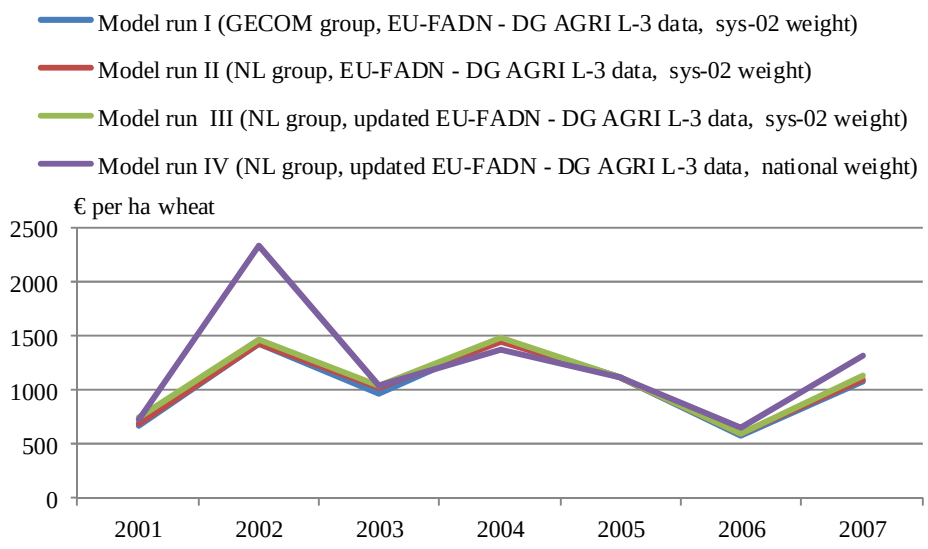


Table 4-4: Development and comparison of the total production costs and aggregated cost categories for output WHEAT (in € per ha wheat)

	2001	2002	2003	2004	2005	2006	2007
Model run I (GECOM group, EU-FADN - DG AGRI L-3, sys-02 weight)							
total	676	1425	958	1459	1108	585	1075
- variable costs	73	319	306	394	187	174	281
- other ic	364	552	433	597	514	352	417
- other input	77	218	-35	97	115	-163	-34
- depreciation	161	335	255	371	293	222	411
Difference (in %) between model run I and model run II							
total	2	0	8	-1	1	2	3
- variable costs	7	0	6	-1	15	11	0
- other ic	1	-1	4	0	-1	-3	0
- other input	1	-1	46	-8	-6	0	51
- depreciation	3	1	8	0	-2	1	2
Difference (in %) between model run I and model run III							
total	10	3	9	1	1	1	5
- variable costs	30	-4	6	-10	17	18	9
- other ic	8	8	8	2	-1	-8	0
- other input	18	6	53	33	-12	2	54
- depreciation	3	1	7	2	-1	0	2
Difference (in %) between model run I and model run IV							
total	7	64	9	-6	1	10	22
- variable costs	71	66	-2	-11	22	36	-7
- other ic	-22	86	18	-4	-6	-3	35
- other input	49	135	199	36	27	27	344
- depreciation	23	-22	-23	-16	-10	-17	-2

For the year 2002, the production costs are much higher per ha of wheat in model run IV. Similar results, although smaller, are seen in 2007. Model run I through III give similar results for the total level of production costs. In Table 4-4, the development of the production costs for aggregated cost categories of model run I is given for output wheat. The rest of Table 4-4 shows the relative changes per aggregated cost category for the other three model runs. Proper judgment of the results, however, is hard to make. When the results of model run I over the years is assessed, wide fluctuations can be seen. Example given, in 2002 the other input costs are 218 euro, which is very high compared with the other years. In 2003, 2006 and 2007 the other input costs are even negative. In some way, the GECOM cannot deal with output WHEAT in the Netherlands. This problem is discussed in more detail in the Dutch contribution to deliverable 3.2 of the FACEPA project.

4.3 Specific issues

In section 4.2, the total production costs for output CMILK, PIG_ and WHEAT are given for four model runs. In these model runs the effect of using other farms, different data and other weighting factors are visualized. In section 4.3 we will deal with some specific issues. To go in more detail, section 4.3.1 discusses the difference between the EU-FADN and the updated EU-FADN data using a simple ANOVA test. Furthermore, the effect of weighting is discussed in section 4.3.2.

4.3.1 Comparing data in national FADN with comparable data in EU FADN

To test for differences in data, an ANOVA test is used (P<0.05). This test is performed per year, and for three different ways of weighting, representing most of the output of CMILK, PIG_ and WHEAT in the general cost of production model. For all model runs, the NL-group was used (see Figure 4-1).

Dairy farms

Most of the production of CMILK in the Netherlands takes place on specialized dairy farms (A30=4110). Therefore, changes in data are tested separately for this group of farms (Table 4-5).

Table 4-5: Significant P-values for difference between EU-FADN - DG AGRI L-3 and updated EU-FADN - DG AGRI L-3 data for specialized dairy farms (2001-2007).

	2001	2002	2003	2004	2005	2006	2007
Dairy farms (A30=4110)							
F61	0.025	.	.	0.001	0.000	0.002	.
F62	.	.	.	.	.	.	.
F63	0.000	0.000	0.000	0.022	0.004	0.001	0.000
F64	.	.	.	.	.	.	.
F65	.	.	.	.	.	.	.
F66	.	.	.	.	.	.	.
F67	.	.	.	.	.	.	.
F69	.	.	.	.	.	.	.
F70	.	.	.	.	.	.	.
F72	.	.	.	.	.	.	.
F78	.	.	.	0.028	0.000	0.000	.
F79	.	.	.	.	.	.	.
F80	0.035	.	.	.	.	.	.
F81	.	.	.	.	.	.	.
F82	.	.	.	.	.	.	.
F83	.	.	.	.	.	.	.
F84	.	.	.	.	.	.	.
F87	.	.	.	.	.	.	.
F88	.	.	.	.	.	.	.
F89	.	.	.	.	.	.	.
SE290	.	.	.	.	.	.	.
SE295	.	.	.	0.014	0.023	0.005	.
SE300	.	.	.	.	.	.	.
SE305	.	.	.	.	.	.	.
SE315	.	.	.	.	.	.	.
SE330	.	.	.	.	.	.	.
SE331	.	.	.	.	.	.	.
SE350	.	.	.	.	.	.	.
SE370	.	.	.	.	.	.	.
SE375	.	.	.	.	.	.	.

For all years, a significant difference is seen for car expenses (variable F63). In the GECOM, car expenses are included in other intermediate costs as cost category OTHSIC. In the updated EU-FADN data, the car expenses per farm are lower. However, the value of car expenses is low compared to total value of production costs and therefore the impact of

this change in data is considered negligible. Another variable where data significantly differs is upkeep of machinery and equipment (variable F61). In the GECOM, these costs are part of MACHUK, which is aggregated within other intermediate costs as well. In 2001, the machinery costs are significantly higher within the updated EU-FADN data (on average, ~1350 euro per farm (unweighted)). From 2004 thru 2006 these costs are significantly lower (on average, ~2000 euro per farm (unweighted). For the time span 2004-2006 variable F78 (upkeep of land and buildings), significantly changed as well. Due to changes in definitions, only the allocation of costs between variable F61 and F78 changes. In the past, maintenance costs were not divided in F61 and F78. Due to the update of the data, the costs for upkeep of land and buildings more than doubled (e.g., on average 1290 to 3261 euro per farm in 2005 (unweighted)), and variable F61 decreased. The fertilizer costs (variable SE295) raised as well, however, the absolute change was lower (on average, ~850 euro per farm (unweighted)). The increase SE295 is caused by changes in definitions as well. In the past, if a farmer purchased manure (which has a negative value), the revenues of purchased manure were subtracted from the costs of fertilizer. Nowadays, the revenues of purchased manure are included in other revenues, and no longer subtracted within variable SE295. The updated data, therefore, gives a better presentation of the actual fertilizer costs.

In section 4.2, the costs per ton of milk produced were approximately equal for the updated data and EU-FADN data (model run I vs. model run II). The changes in data, for dairy farms, did not influence the production costs per ton of milk produced, nor for one of the aggregated cost categories.

Pig farms

Similar to dairy farms, a simple ANOVA was performed for pig farms as well (A30=5011, 5012, 5013) (Table 4-6). For most of the variables replaced no significant differences were seen. The variables were data significantly differs are similar to dairy. The car expenses changed (variable F63) and some significant difference is seen for the upkeep costs of machinery and equipment (F61) and the upkeep costs of land and buildings. A similar significant trade-off as seen in dairy is not seen for pig farms. However, the other not significant years still have a strong tendency of a trade-off between both upkeep costs variables. There are no differences seen for variable SE295 (fertilizer costs), since pig farms in general do not purchase animal manure, because pig farms have (almost) no cultivated area and a surplus of slurry.

In section 4.2, the costs per livestock unit pig were approximately equal for the updated data and EU-FADN data (model run I vs. model run II). The changes in data, for pig farms, did not influence the production costs per livestock unit pig produced, nor for one of the aggregated cost categories.

Table 4-6: Significant P-values for difference between EU-FADN - DG AGRI L-3 and updated EU-FADN - DG AGRI L-3 data for specialized pig farms (2001-2007).

	2001	2002	2003	2004	2005	2006	2007
Pig farms (A30=5011-5012-5013)							
F61	.	.	.	.	0.021	0.006	.
F62	.	.	.	.	.	.	.
F63	.	.	0.015	.	.	.	0.000
F64	.	.	.	.	.	.	.
F65	.	.	.	.	.	.	.
F66	.	.	.	.	.	.	.
F67	.	.	.	.	.	.	.
F69	.	.	.	.	.	.	.
F70	.	.	.	.	.	.	.
F72	.	.	.	.	.	.	.
F78	.	.	.	.	.	0.000	.
F79	.	.	.	.	.	.	.
F80	.	.	.	.	.	.	.
F81	.	.	.	.	.	.	.
F82	.	.	.	.	.	.	.
F83	.	.	.	.	.	.	.
F84	.	.	.	.	.	.	.
F87	.	.	.	.	.	.	.
F88	.	.	.	.	.	.	.
F89	.	.	.	.	.	.	.
SE290	.	.	.	.	.	.	.
SE295	.	.	.	.	.	.	.
SE300	.	.	.	.	.	.	.
SE305	.	.	.	.	.	.	.
SE315	.	.	.	.	.	.	.
SE330	.	.	.	.	.	.	.
SE331	.	.	.	.	.	.	.
SE350	.	.	.	.	.	.	.
SE370	.	.	.	.	.	.	.
SE375	.	.	.	.	.	.	.

Arable farms

Similar to dairy and pig farms, a simple ANOVA was performed for arable farms as well (TF8=1) (Table 4-7). Most of the production of wheat takes place on specialized arable farms. For most of the variables replaced no significant differences were found. The variables were data significantly differs are similar to dairy and caused by the same reasons.

Table 4-7: Significant P-values for difference between EU-FADN - DG AGRI L-3 and updated EU-FADN - DG AGRI L-3 data for specialized arable farms (2001-2007).

	2001	2002	2003	2004	2005	2006	2007
Arable farms (TF1)							
F61	.	.	.	0.021	0.029	0.010	.
F62	.	.	.	.	.	.	.
F63	0.015	0.008	0.029	.	.	.	0.000
F64	.	.	.	.	.	.	.
F65	.	.	.	.	.	.	.
F66	.	.	.	.	.	.	.
F67	.	.	.	.	.	.	.
F69	.	.	.	.	.	.	.
F70	.	.	.	.	.	.	.
F72	.	.	.	.	.	.	.
F78	.	.	.	0.000	0.000	0.000	.
F79	.	.	.	.	.	.	.
F80	.	.	.	.	.	.	.
F81	.	.	.	.	.	.	.
F82	.	.	.	.	.	.	.
F83	.	.	.	.	.	.	.
F84	.	.	.	.	.	.	.
F87	.	.	.	.	.	.	.
F88	.	.	.	.	.	.	.
F89	.	.	.	.	.	.	.
SE290	.	.	.	.	.	.	.
SE295	0.019	.	.	.	.	0.001	0.000
SE300	.	.	.	.	.	.	.
SE305	.	.	.	.	.	.	.
SE315	.	.	.	.	.	.	.
SE330	.	.	.	.	.	.	.
SE331	.	.	.	.	.	.	.
SE350	.	.	.	.	.	.	.
SE370	.	.	.	.	.	.	.
SE375	.	.	.	.	.	.	.

4.3.2 Weighting

The weighting scheme in the Netherlands is different from the weighting scheme used by the Commission. It is interesting to investigate the effect on results of using a different weighting scheme. Table 4-8 presents descriptive statistics of 3 weighting schemes. In the three samples, only farms that are present in the updated EU-FADN data (with national weighting factor) are used. So, effects of differences in number of farms, or different data are isolated. The three weighting schemes applied are SYS02 (the EU-FADN weight), NL (the national FADN weight) and WF1 (equal weighting for each farm). The effect of weighting is presented for the three most import output produced namely: milk, pig and wheat. The sum of the weighting factors for SYS02 and national weight, are not equal to the sum of weighting factor that where presented before. This is caused by the fact of excluding farms that are only used in one sample and that are not represented in the other samples. For WF1, the average number of livestock unit and the farm area are higher compared to the other variants. This is caused by a high proportion of large sample farms. The average milk production per farm is lower for WF1. This is caused by the proportion of dairy farms within the total sample of farms and by the fact that milk production in the

Netherlands mainly takes place on specialized dairy farms. The proportion of dairy farms within model run V is roughly 1/6. In the other two model runs this is roughly 1/4.5.

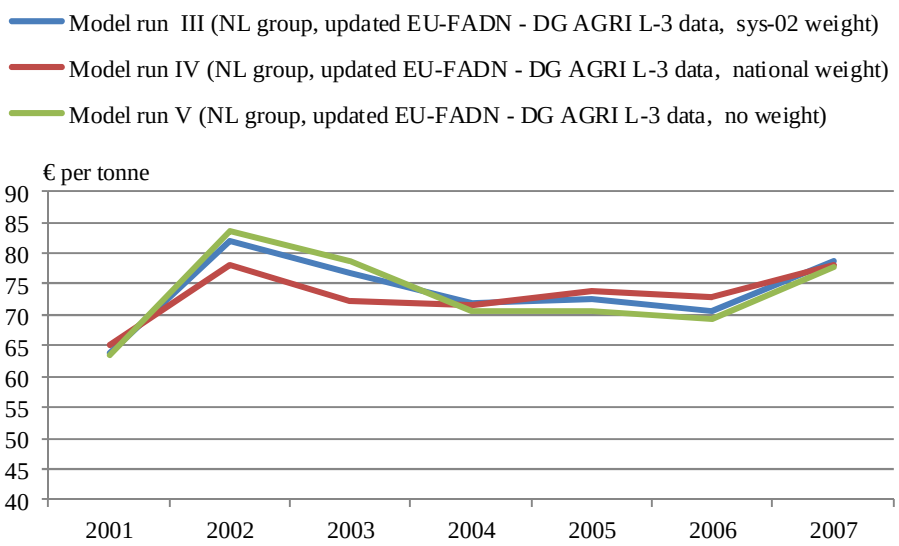
Table 4-8: Descriptive statistics of three variants of weighting (2001-2007)

	2001	2002	2003	2004	2005	2006	2007
Model run III (NL group, updated EU-FADN - DG AGRI L-3 data, sys-02 weight)							
Number of farms represented	1253	1280	1324	1320	1349	1403	1411
Number of farms in sample	74417	61697	61387	59060	57742	54933	54254
Milk production (ton), ∅ per farm	164	176	181	184	196	203	206
UAA (ha), ∅ per farm	28	29	30	31	32	32	32
Livestock units, ∅ per farm	107	103	99	111	114	123	126
Model run IV (NL group, updated EU-FADN - DG AGRI L-3 data, national weight)							
Number of farms represented	1253	1280	1324	1320	1349	1403	1411
Number of farms in sample	70720	67784	63957	62724	61072	58193	56745
Milk production (ton), ∅ per farm	165	172	186	179	187	198	203
UAA (ha), ∅ per farm	29	29	31	31	32	33	36
Livestock units, ∅ per farm	104	104	112	113	116	125	126
Model run V (NL group, updated EU-FADN - DG AGRI L-3 data, no weight)							
Number of farms represented	1253	1280	1324	1320	1349	1403	1411
Number of farms in sample	1253	1280	1324	1320	1349	1403	1411
Milk production (ton), ∅ per farm	145	152	169	156	157	171	175
UAA (ha), ∅ per farm	32	33	34	33	32	34	37
Livestock units, ∅ per farm	138	144	135	176	180	181	178

Output CMILK

In section 4.2, the largest difference per ton of milk produced between model run I and model run IV were seen within the other intermediate costs. Therefore, the effect of using another weighting scheme is applied on other intermediate costs (Figure 4-5).

Figure 4-5: Development of other intermediate costs for output CMILK for three weighting variants (2001-2007).



Model run V presents the results without weighting. The difference between weighting with SYS02 and no weighting is small. Weighting with the national weighting scheme, however, caused a lower level in other intermediate costs, especially for 2002 and 2003.

When we compare the cost-coefficients between the three model runs, small differences are seen between model run IV (national weight) and the other two runs (Table 4-9). The lower intermediate costs seen in Figure 4-5 are caused by difference in weighting, since cost-coefficients (Table 4-9) and data (Table 4-5) were comparable.

Table 4-9: Cost-coefficients for other intermediate costs for output CMILK of three variants of weighting (2002 and 2003).

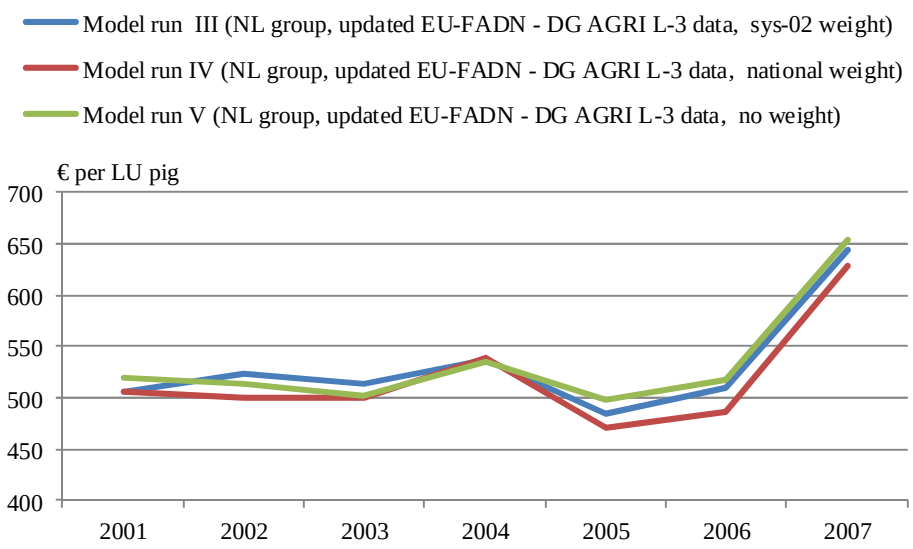
	2002	2002	2002	2003	2003	2003
	RUN III	RUN IV	RUN V	RUN III	RUN IV	RUN V
- OENERG	18	19	18	20	19	20
- CONWOR	48	51	48	68	65	69
- BUILUK	6	4	6	3	3	2
- MACHUK	50	50	50	67	67	66
- OTHSIC	58	61	58	86	79	91

Source: updated EU-FADN - DG AGRI L-3 data.

*Output PIG_*

In section 4.2, the largest difference per livestock unit of pig produced between model run I and model run IV were seen within the variable costs. Furthermore, variable costs are the most important cost category within the total production costs of pigs. Therefore, the effect of using another weighting scheme is applied for variable costs (Figure 4-6).

Figure 4-6: Development of variable costs for output PIG_ for three weighting variants (2001-2007).



Again, model run V presents the results without weighting. The differences between the three model runs are small. When we go in detail on the most important costs (FEEDPC and VETCOS) within the variable costs on pig production (Table 4-10), again rather small differences are seen. In 2004, the level of variable costs in all model runs is equal in Figure 4-6. The relative largest difference between the model runs is seen in 2006. When we compare the cost-coefficients between groups for 2004 and 2006, there are small differences. These differences in costs-coefficients in 2004, however, do not affect the difference in variable costs per unit of livestock produced. Given the results in section 4.2

and the comparison of cost-coefficients in Table 4-10, it can be concluded that the (small) difference seen are caused by the choice of weighting factor.

Table 4-10: Cost-coefficients for output PIG_ of three variants of weighting (2004 and 2006)

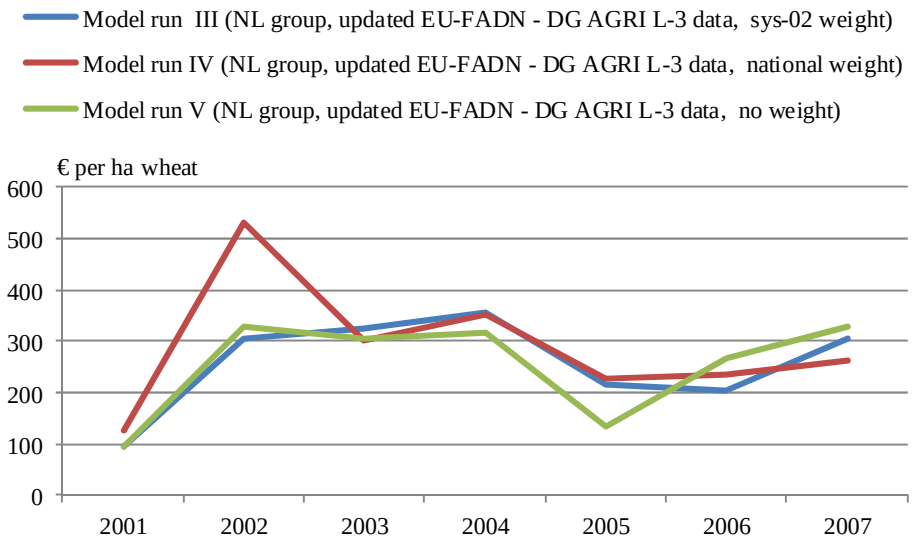
	2004	2004	2004	2006	2006	2006
	RUN III	RUN IV	RUN V	RUN III	RUN IV	RUN V
- FEEDPC	500	496	487	464	454	454
- FEEDHC	1	1	1	2	1	1
- VETCOS	98	101	98	112	117	114

Source: updated EU-FADN - DG AGRI L-3

Output WHEAT

In Figure 4-7, the development of the variable costs is present for the three model runs. Overall, all three model runs give similar results. However, in 2005 and especially in 2002 wide variation between model runs is seen. In some way, too many costs are allocated to output WHEAT in model run IV.

Figure 4-7: Development of variable costs for output WHEAT for three weighting variants (2001-2007).



When the descriptive are compared (average area of wheat per farm), no difference is seen between the model runs. The rather strange development of the costs for WHEAT is partly related to the costs allocated to the two common outputs on arable farms, namely potatoes and sugar beets. This issue is discussed in detail in deliverable 3.2 of the FACEPA project.

Table 4-11: Cost-coefficients for output WHEAT of three variants of weighting (2002 and 2005)

	2002	2002	2002	2005	2005	2005
	RUN III	RUN IV	RUN V	RUN III	RUN IV	RUN V
- SEED__	49	225	20	23	-4	5
- FERTIL	140	249	172	142	148	121
- CRPROT	171	147	184	74	104	20
- MOTFUE	74	95	88	55	39	47

Source: updated EU-FADN - DG AGRI L-3

4.3.3 Price information

In the GECOM model, there is also a possibility to express result using output prices for output PIG_. A possibility is to use Eurostat prices per 100 kg of live weight. If we compare these output prices with output prices collected within the national FADN sample, we see a structural lower live weight price in the national FADN sample (Table 4-12). Moreover, the difference ranges between 12.3% and 1.4%. When prices are used to present GECOM results for output PIG_, it is better to use national prices.

Table 4-12: Prices per 100 kg live weight excl. VAT, 2001-2006.

Year	LEI	CPM	Δ%
2001	103.1	117.5	-12.3
2002	90.3	95.1	-5.1
2003	82.8	86.0	-3.7
2004	96.6	97.9	-1.4
2005	98.7	103.7	-4.9
2006	105.3	108.9	-3.4

Source: CPM: Eurostat; LEI: national-FADN

5 Results for the French national FADN

Authors: Dominique Desbois, Jean-Pierre Butault, Nathalie Delame, Guillaume Zardet

Institut National de la Recherche Agronomique (INRA)

The aim of this chapter is to give an insight into the French national database and the results when applying the general cost of production (GECOM) model to this dataset. The results are compared to the results using EU-FADN and with the version of the INRA-INSEE model (*Coutprod*), currently in use by the French Office for Agricultural Statistics (*SSP*).

5.1 Data

A microeconomic observatory of the French farm holdings has been considered for the first time in the Agricultural Orientation Law of 5 August 1960. However, the founding administrative act of the French FADN is in fact the Regulation No 79/65/EEC of the Council of 15 June 1965 setting up a network for the collection of accountancy data on the incomes and business operation of agricultural holdings in the European Economic Community. The French administrative acts have been adopted in February and May 1967. Notwithstanding some difficulties that have arisen from the initial choice of a random sampling design, the 1968 results were published in May 1972, just before the first publication of European results occurred in September 1972.

In the absence of a unified European Accounting Framework, the DG-Agri/L3 instructions leave choices with regards to the accounting rules and the level of details characterizing the farming activities. For example, depreciation is computed into the French FADN by the straight line rather than by the reducing balance method, despite many efforts of harmonization. Deriving from the national sample, the European one slightly differs in France, according to the differences between the national and the European rules in the validation process (see Table 1). The level of those differences ranges from 0.04% to 1.44%. Hence, except the elimination of very atypical observations, those slight differences are not supposed to influence the estimates issued from the *GECOM* model.

Table 5-1: Comparison of sample size between French excerpt of EU-FADN and national French FADN.

French FADN	EU	national
1995	7,524	7,532
1996	7,600	7,607
1997	7,565	7,572
1998	7,705	7,713
1999	7,747	7,750
2000	7,710	7,758
2001	7,690	7,802
2002	7,729	7,767
2003	7,296	7,315
2004	7,326	7,332
2005	7,352	7,363
2006	7,320	7,346
2007	7,369	7,377

Source: *SSP*/INRA for the national French FADN & DG AGRI L-3 for the French excerpt of the EU-FADN.

However, the EU weighting process is different from the French weighting process issued from the bi-proportional fitting CALMAR procedure (Sautory, 1993). A comparison has been made in order to try to assess the influence of the weights on the estimates.

5.2 The influence of outlier elimination on the estimates of production costs

In general, outliers have been identified a major source of troubles in estimation procedures based on least squares methods. Based on the Young and Sarle proposal (1989), a SAS outlier Macro has been written by Friendly (2008). This SAS macro program for outlier detection is subsequently modified for this study in order to be applied to FADN data sets. Below, are outlined the main results obtained, applying this procedure to the EU samples of the French FADN, from 1995 to 2007.

The trimming process is based on a projection pursuit method proposed by Caussinus and Ruiz (1990) in order to identify the dimensions which reveal outliers, using the Generalized Principal Component Analysis (GPCA). Mahalanobis distances using standardized principal component scores for each observation are computed on the basis of robust estimates for the covariance matrix of each group. Applying this trimming process to the procedure to the EU samples of the French FADN, from 1995 to 2007, generates EU trimmed samples that are used for an alternative estimation of the production costs by the GECOM model (see Table 5-2 for a size comparison between the original and the trimmed samples).

Table 5-2: Comparison of size between original and trimmed samples for the French FADN.

French FADN	EU-trimmed	EU	% Frequency	% Output
1995	6674	7524	88.70%	87.25%
1996	6730	7600	88.55%	87.88%
1997	6787	7565	89.72%	88.40%
1998	6819	7705	88.50%	87.55%
1999	6949	7747	89.70%	89.12%
2000	6927	7710	89.84%	89.45%
2001	6916	7690	89.93%	88.47%
2002	6991	7729	90.45%	89.97%
2003	6555	7296	89.84%	89.24%
2004	6625	7326	90.43%	90.90%
2005	6601	7352	89.79%	89.77%
2006	6 514	7 320	88.99%	88.91%
2007	6 628	7 369	89.94%	89.67%

Source: *SSP*/INRA for the national French FADN & DG AGRI L-3 for the French excerpt of the EU-FADN.

Over the 1995-2007 period, the trimming process eliminates from 9.55 % to 11.50% of the sampled farms. This trimming process eliminates a similar proportion of output, ranging from 10.10% to 12.75%, according to the fiscal year. For the products of reference (Common Wheat, Dairy Milk and Fattening Pigs), the default in the coverage of production is lesser : fewer than 8% for Common Wheat, 15% for Dairy Milk and 9% for Pigs. However, this default of coverage reaches 33% for Potatoes on average over the 1995-2007 period. The trimming process affects simultaneously the inputs by a coverage default rate ranging from 8.41 % for Crop Protection to 14.7% for Building Upkeep costs.

- Estimating the production costs on the basis of the standard aggregation of outputs and inputs provides the empirical basis for a comparison between trimmed (without outliers) versus original (with outliers) estimates (Table 5-3). For this estimation, the vTI alpha implementation of the GECOM model and the French excerpt of the EU-FADN database (French FADN) over the 1995-2007 period has been used in order to asses the impact of trimming on the estimates (outlier analysis).
- The costs which are better fitted by the GECOM model, are on the overall the Purchased Feed, followed by the Crop Protection, the Fertilizers, the Motor Fuel and the Veterinary Cares among the specific costs. For the structural costs, Depreciation and Subsidies (interpreted as a negative input) are the best fitted equations. The worse fitted equations are those for Building Upkeep for structural costs and Home-grown Feed for the specific costs. Those fitting rates vary over the reference period from a standard-error of 0.9% for Purchased Feed to 9% for Subsidies (registering the decoupling impact).
- As expected for the trimmed French FADN sample, there is an improvement of the regression coefficients of determination but with a relatively small impact (ranging from 0.5% to 3.5%) with regards the general level of the R-square coefficient (which can be used because the equations have the same number of regressors, except for the animal specific costs). There is no improvement for Seed Costs, Land Cost and Depreciation.

Table 5-3: Regression R-squares over the 1995-2007, on the basis of the EU-French FADN : trimmed (without outliers) versus original (with outliers) estimation.

Regression Rsquare		EU-French FADN	1995-2007
		Trimmed	Original
FEEDPC	Purchased Feed	95.30%	94.54%
FEEDHC	Homegrown Feed	40.21%	38.86%
VETCOS	Veterinary Cares	84.66%	82.10%
SEED__	Seeds	74.43%	74.70%
FERTIL	Fertilizers	88.55%	88.05%
CRPROT	Crop protection	89.30%	88.97%
MOTFUE	Motor Fuel	83.37%	82.39%
OENERG	Energy	65.91%	65.81%
CONWOR	Contract work	64.09%	60.95%
BUILUK	Building	35.33%	33.18%
MACHUK	Machinery	78.13%	74.76%
OTHSIC	Other costs	77.78%	74.72%
LANDCO	Land cost	77.71%	77.77%
INTERE	Interest	67.36%	66.48%
DEPREC	Depreciation	84.58%	84.21%
TAXES_	Taxes	59.62%	56.43%
SUBSID	Subsidies	89.17%	87.52%
NETVAL	Net value added	82.16%	80.59%

The weighted estimation of production costs implies that the variance is larger, due to the fact that the degrees of freedom of the sample doesn't correspond to the sum of weights for the sample. Nevertheless, because those weights do not differ so much between the trimmed and the original sample, this larger variance doesn't preclude estimate variability comparisons by the way of Student *t* statistics between the trimmed and original sample. The ratio between the Student *t* statistics shows that the trimming process decreases the variability of production cost estimates by a ratio ranging from 3 % for the Motor Fuel to 11.65% for the Seeds, on the one hand. On the other hand, it increases the variability of cost production estimates for Building UpKeep (3%), Machinery (4%), Contracted Work (6%) and last but not least, Other specific inputs (15%).

For common wheat, the comparison of production cost estimates between the trimmed and the original sample leads to the conclusion that the estimation with outliers tends to be greater than the estimation without outliers, for most of the input categories (Table 5-4). Those differences range from 1.30% for Land costs to 10.5 % for Seed costs, on the one hand. On the other hand, some "with outliers" estimates are lower than the trimmed estimates: it occurs for Building UpKeeping (6.5 %), Machinery UpKeeping (2 %), Contracted Work (3 %) and last but not least, Other specific inputs (12%). Interest and Depreciation costs are not impacted.

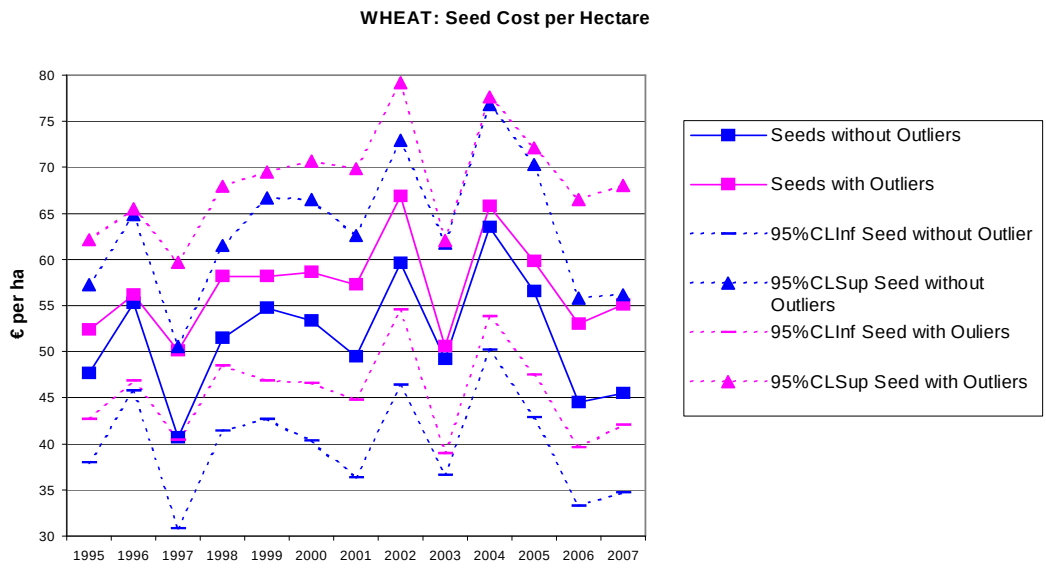
Table 5-4: Averaged production cost estimates over the 1995-2007 period for Common Wheat, on the basis of the EU-French FADN : trimmed (without outliers) versus original (with outliers) estimation.

Production Cost, Subsidies and Net Value Estimates		Technical Coefficient		Unit Estimates per hectare	
WHEAT	1995-2007, EU-French FADN	trimmed	original-EU	trimmed	original-EU
SEED__	Seeds	65.77	72.44	51.67	57.08
FERTIL	Fertilizer	155.76	158.78	123.52	126.12
CRPROT	Crop protection	205.07	207.72	161.61	164.10
MOTFUE	Motor Fuel	44.06	44.88	34.83	35.52
OENERG	Energy	7.82	8.31	6.25	6.55
CONWOR	Contracted work	52.17	50.62	40.62	39.26
BUILUK	Upkeeping Building	12.19	11.50	9.63	9.01
MACHUK	Upkeeping Machinery & Equipment	63.07	64.16	50.25	51.25
OTHSIC	Other costs	75.62	66.56	59.76	52.37
LANDCO	Land cost	179.98	182.12	141.09	142.92
INTERE	Interest	62.98	62.99	49.51	49.41
DEPREC	Depreciation	246.75	246.42	193.61	193.65
TAXES_	Taxes	18.78	19.06	14.83	15.12
SUBSID	Subsidies	425.70	437.16	327.73	336.96
NETVAL	Net value added	235.66	241.63	195.37	199.94

Source: DG AGRI L-3 for the French excerpt of the EU-FADN.

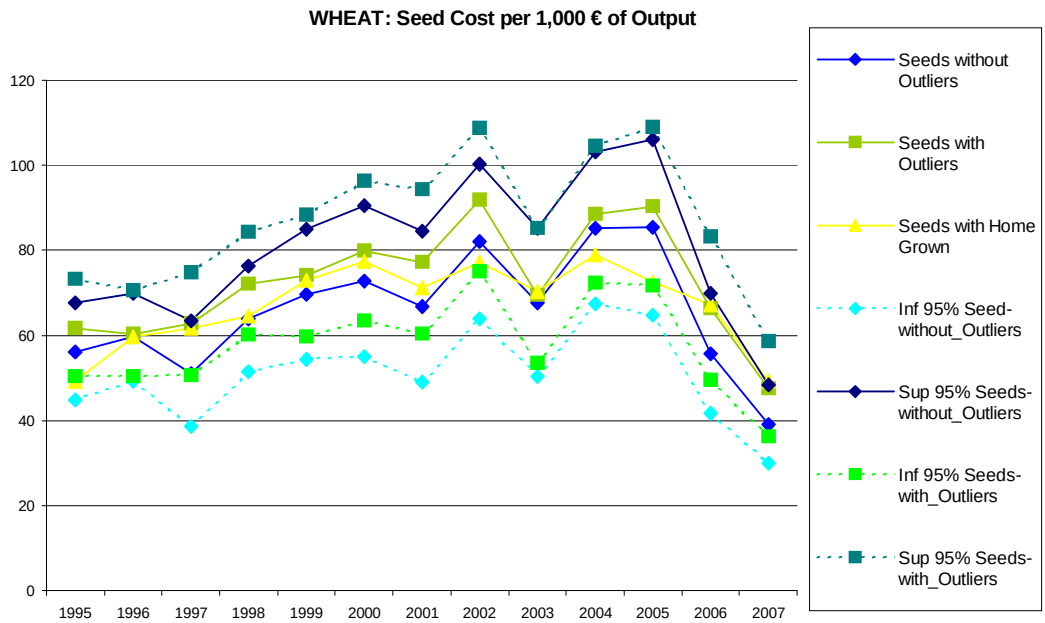
However, even for the Seed costs that are the most variable estimates among the specific costs, the differences between the "with" and "without outliers" estimates are not beyond the span of the 95% Confidence Interval, except for the 1997 and 2003 fiscal years (cf. Figure 5-1) It must be noticed that the technical coefficient of the excluding farm-grown consumption is within the confidence intervals of the two specifications including the farm-grown consumption (Figure 5-2).

Figure 5-1: Common Wheat, Seed Costs per Hectare



Source: EU-FADN - DG AGRI L-3.

Figure 5-2: Common Wheat, Seed Costs per 1,000 € of Output



Source: EU-FADN - DG AGRI L-3.

5.3 A comparative analysis by reference products

5.3.1 The items considered for the comparison

The general cost of production model (GECOM) has been applied to the French excerpt of the European FADN with a specification excluding farm-grown consumption, in order to be compared with the *Coutprod*[19] former INRA-INSEE specification of this model for the three reference products (common wheat, dairy milk and fattening pigs) applied to the French national FADN (*RICA*). The INRA beta implementation of the GECOM model has been used to produce those estimates. The *SSP* implementation of the *Coutprod* INRA-INSEE model has been used in order to provide RICA estimates. For assessment purposes, these production cost estimates are compared with the results of technical surveys conducted by FranceAgriMer (*FAM*), the French governmental organization managing the production and marketing of agricultural products. This comparison has been made along the 1995-2007 time period for the model estimates, and over the 2002-2007 time period for the results of technical surveys. Additional estimates and comparisons are provided for the corn (grain maize). Furthermore, some results of the technical surveys are provided at the NUTS 2 (French "région") or NUTS 3 (French "département") levels.

[19] The *Coutprod* model is the original specification of the INRA-INSEE production cost model. The current specification of the *Coutprod* model, as implemented and maintained for the needs of the French agricultural statistics Office (*SSP*), is described by the following report: '*The Agricultural Production Costs Model* ", by Pascale POLLET, Agriculture Division, *INSEE*, in collaboration with J-P. BUTAULT (INRA) and E. CHANTRY (SCEES, MAP), FACEPA, *INSEE*, Business Statistical Division , Paris, 2001.

Common Wheat *FAM-ONIGC* Survey Methodology:

The common wheat production cost survey is carried out by 'Office national interprofessionnel des grandes cultures' (*ONIGC*), currently a Division of FranceAgriMer (*FAM*), since 1988 in four 'départements' (territorial units at the NUTS 3 level): *Marne*, *Seine-et-Marne*, *Somme*, *Yonne*. This survey does not cover all the French production but aims at being representative of the main common wheat production basins in the northern France .

The sampling scheme leads to favour the farm holdings of medium and large economic sizes. The average yields obtained are thus generally higher than the statistical figures for these territorial units.

The production costs are established according to an indirect costing approach derived from the methodology used by the US Department for Agriculture (USDA), known as the "method of reconstructed costs". The technical information collected by direct interview of one hundred farmers per NUTS 3 are crossed with economic information resulting from the main provisioning organizations of these territorial units.

Various others sources and price observatories make it possible to compute the various components of the production costs.

This method takes into account only the effective working time for the crop, to which one adds the periods devoted to the ways, repairs, the observations and thoughts on the plot (estimated by a fixed ratio of 50% additional time). However, one excludes some periods from dead time (bad weather, dead season) during which the labour force is not employed on the farm holding.

Paid or unpaid, the work is valued at the minimum salary, but the unpaid work of the manager is valued as a qualified paid work (2 fold the minimum salary).

The cost of land is equal to the cost of tenant farming whatever its tenancy mode and ownership.

The production costs consist of two parts:

- the operational costs: seeds, manures and amendments, crop protection products, motor fuel, material maintenance, irrigation expenditure, on farm drying, third party harvest work and returns on the operational capital (short-term interests);
- the structural costs: paid or unpaid work, machinery depreciation (long-term renewal and interests), land, taxes, insurances, overheads

The computing method was rectified in 2006 for better taking account of developments in the cultivation technologies and methods. The series were readjusted over four years.

5.3.2 The common wheat estimates

In France, common wheat is a major commodity: the French production is estimated from 30 (1995-96) to 38 (1998-99) millions of tons over the 1995-2007 period, the first in the UE and the fifth on the world range. Common wheat is produced by a very large number of

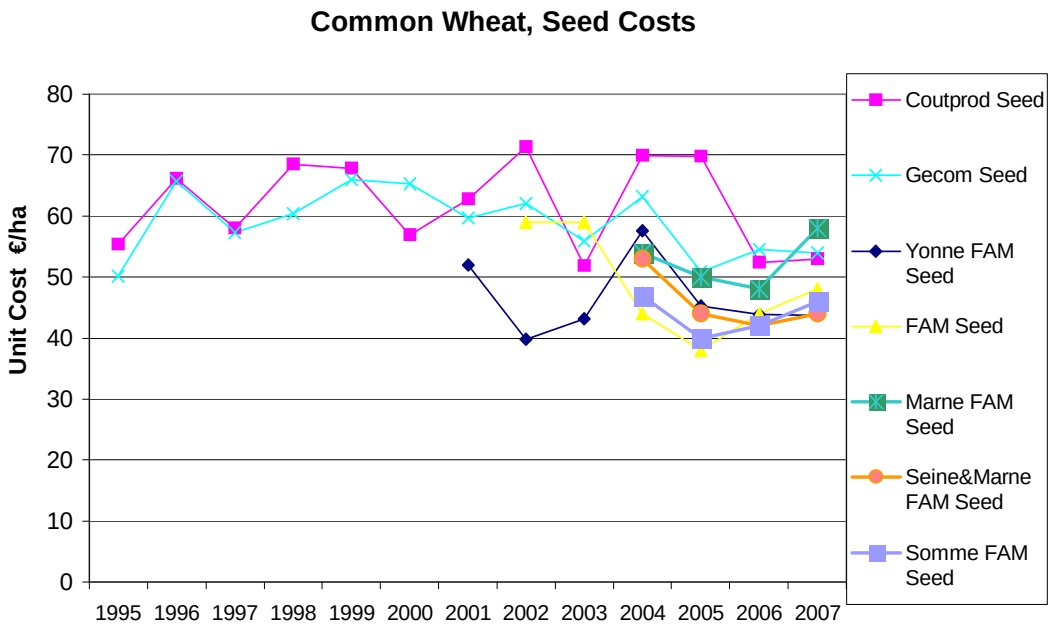
farm holdings ranging from 260,000 (1995) to 185,000 (2007), according to the French FADN estimates. In France, the common wheat cropping accounts for 5.1 millions of hectares which represent 52% of the agricultural area devoted to the cereal production. Some results at the NUTS 3 level are provided by the *FAM* technical surveys.

A detailed comparison of the model estimates of production cost for common wheat with the results of technical surveys conducted by *FAM* is provided, making a distinction between fixed and variable costs. More precisely, the variable costs are supposed to be better estimated than the fixed ones, with respect to the fact that their amounts are theoretically proportional to the production, in line with model specification. Conversely, by their nature, the fixed costs are not supposed to vary with the production, in contradiction with the model specifications used.

5.3.2.1 The specific cost estimates

The three major specific inputs for cereals are the seeds, the plant protection and the fertilizers. Over the 1995-2007 period, crop protection is the better fitted input with an almost 89% average R-square, followed by the fertilizers with a 88% R-square and the seeds with a 75% R-square. Those percentages of explained variance can be considered as very high with regards of the estimation scale, covering all the agricultural systems in France.

Figure 5-3: Seed Production Costs of Common Wheat over the 1995-2007 period.

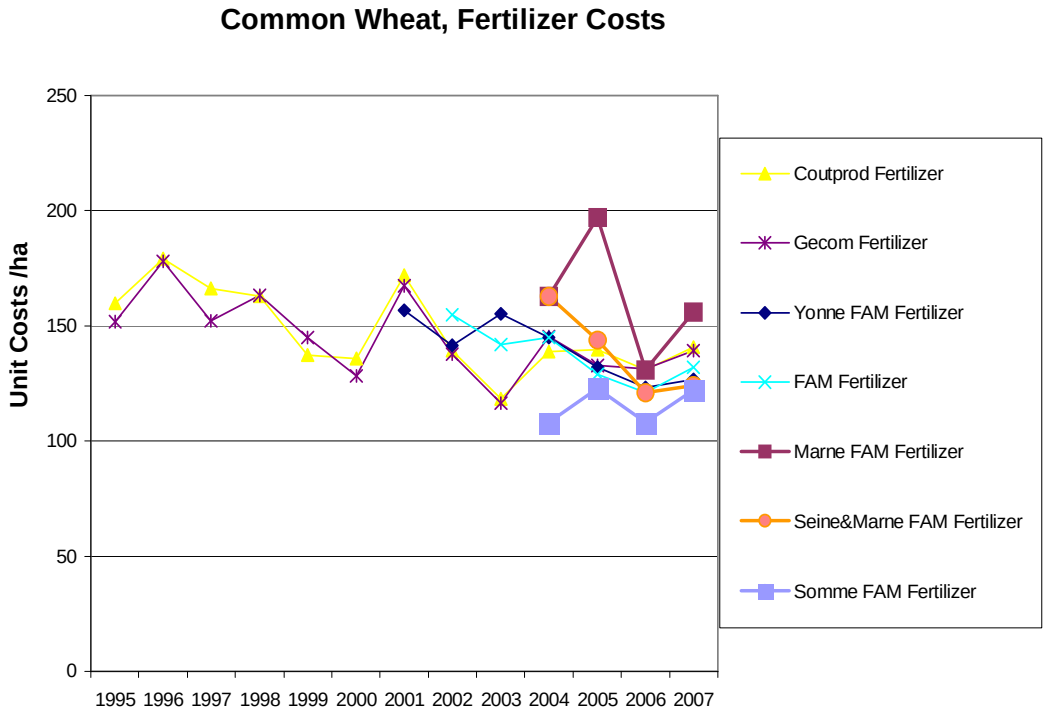


Source: EU-FADN - DG AGRI L-3, French FADN-*SSP* & *FAM-ONIGC* Surveys.

For the seed cost per hectare, the level of *Coutprod* and GECOM estimates is slightly greater than the levels of the FAM survey results estimates. This evidence can be explained by a model artifact: the levels of output in common wheat for France as a whole are lower than the ones of those cereal oriented regions, inducing a higher common wheat coefficient. The cross-correlation between the model estimates of seed costs and the yield per ha is very high (r = 0.82).

The *GECOM* estimates appear to be less variable than the *Coutprod* ones, particularly after the 2000 farming year. It has to be reminded that the European (FADN) data differ from the national (*RICA*) ones: a correcting process for atypical values and a specific weighting scheme is applied to the European excerpt of the French data (FADN) by the DGAgri Information processing services. Taking in account farm-grown consumption, which is more important in seeds for cereals, can also explain some differences.

Figure 5-4: Fertilizer Production Costs of Common Wheat over the 1995-2007 period.

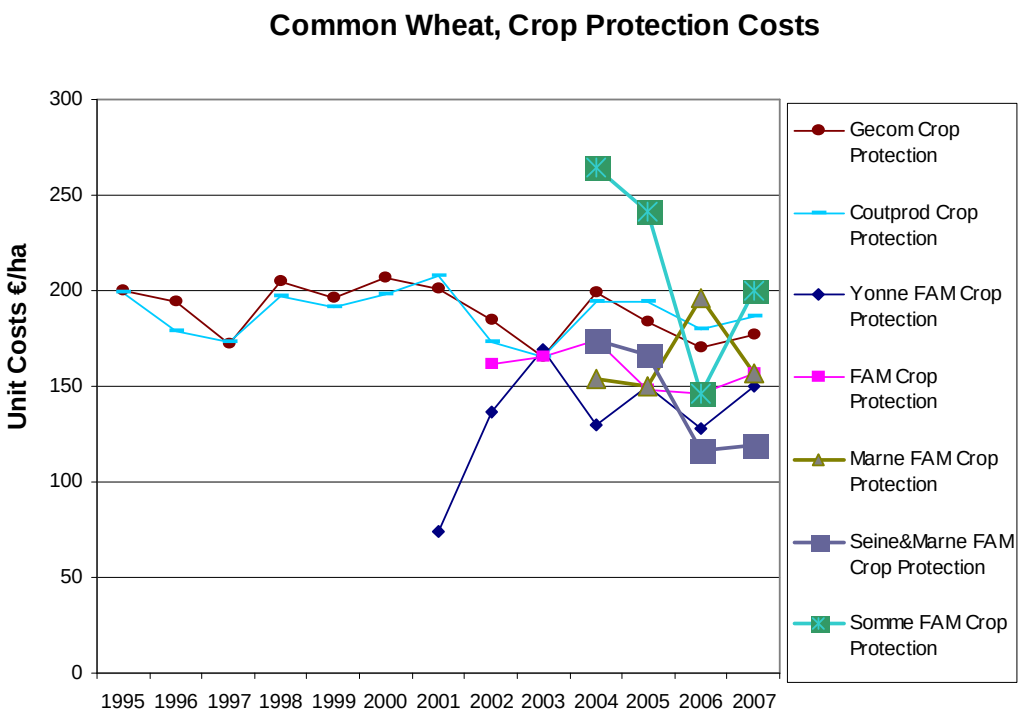


Source: EU-FADN - DG AGRI L-3, French FADN-*SSP* & *FAM-ONIGC* Surveys.

As well as for the seeds, the global trend of estimates for the fertilizers is decreasing, more strongly after 2000. The *Coutprod* and GECOM estimates appear to be verry correlated, more than for the seeds. The global level of estimates appears to be quite near to the average level of the *FAM* survey results, over the 2004 to 2007 period. The cross-time variability of the *FAM* NUTS 3 results has to be noticed, especially for the Marne *FAM* survey.

For the crop protection, the estimates of GECOM and the *Coutprod* model are very correlated, over the 1995-2007 period, but with a rather constant discrepancy from 2005. Over the 2004-2007 period, those estimates appear to be systematically higher than with the average *FAM* Survey figures. However, the general trend of the FAM figures during this period of time seems to be well apprehended by the common trend of the GECOM and *Coutprod* estimates

Figure 5-5: Crop Protection Production Costs of Common Wheat over the 1995-2007 period.



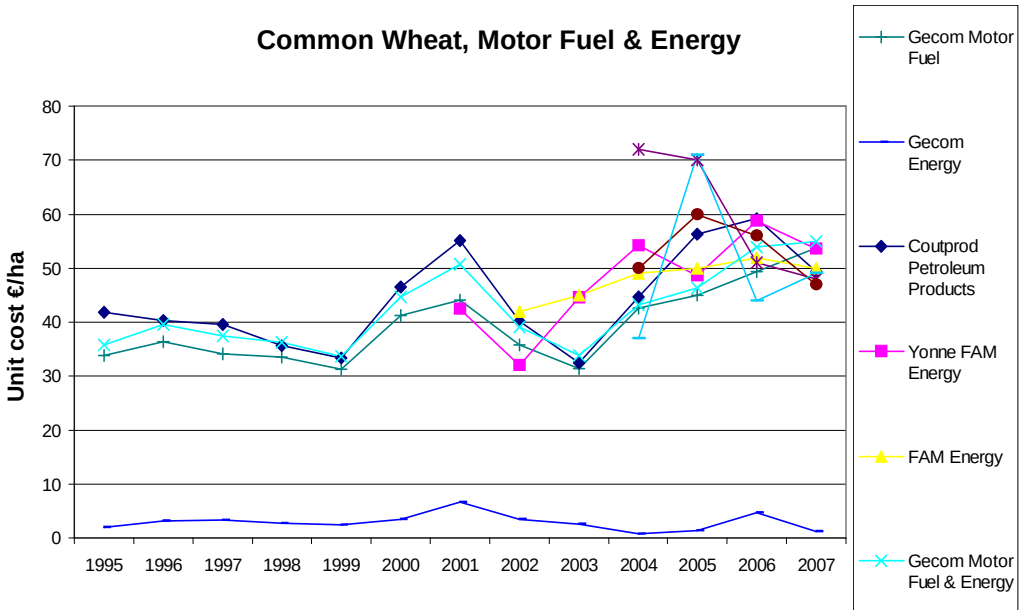
Source: EU-FADN - DG AGRI L-3, French FADN-*SSP* & *FAM-ONIGC* Surveys.

As being defined by the *Coutprod* specification, the concept of 'Variable Costs' includes for cereals: fertilizers and soil improvers; petroleum products (motor fuel and heating fuel); crop protection products; purchased seed. It can be compared with the following concepts of the *FAM* surveys: the Specific Input Costs including seeds, fertilizers and crop protection); and the Operation Costs including seeds, manures and amendments, crop protection products, motor fuel, material maintenance, irrigation expenditure, on farm drying, third party harvest work, short-term interests.

Among operation costs, a major concern in cereal production is the cost of energy linked with the soil cropping activities, mainly depending on the cultivation technology used. Figure 5-6 displays some of those cost estimates in comparison with the corresponding results issued from the FAM surveys. Beyond the definition of each energy, mostly with petroleum products, the sum of estimates of the GECOM model for Motor Fuel and Energy seems to be mainly correlated with the *Coutprod* estimates for Petroleum Products (Motor Fuel and Heating Fuel) estimates over the 1995-2007 period. Over the 2001-2007 period, the Energy *FAM* Cost results that includes motor fuel and heating, are consistent with the model estimates, even if they seem to be lower than those estimated by the models.

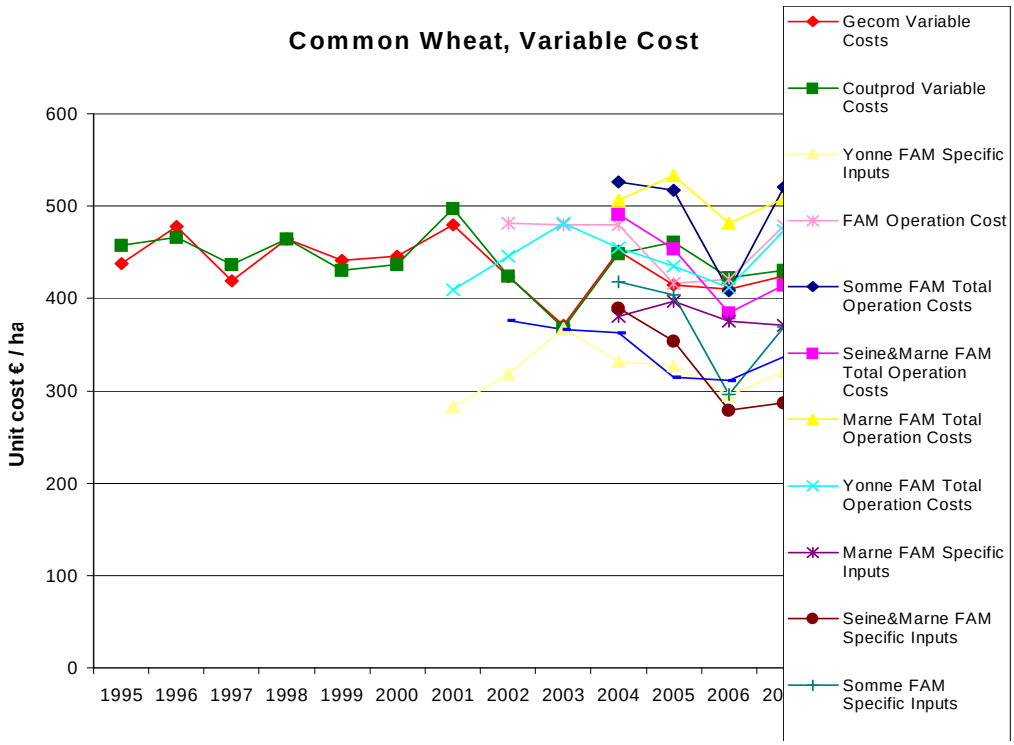
The Figure 5-7 displays that the variable cost estimates from the GECOM and the *Coutprod* models are located within the 100 € value interval boundaries between the *FAM* Operation Cost Series (the highest boundary) and the *FAM* Specific Cost Series (the lowest boundary). As the sum of the component estimates, the variable cost estimate is near from the Operation Cost Series due to the higher estimates of those models in the cost of components albeit the variable cost definition is much closer to the specific input definition.

Figure 5-6: Energy Costs for Common Wheat over the 1995-2007 period.



Source: EU-FADN - DG AGRI L-3, French FADN-*SSP* & *FAM-ONIGC* Surveys.

Figure 5-7: Variable Production Costs of Common Wheat over the 1995-2007 period.



Source: EU-FADN - DG AGRI L-3, French FADN-*SSP* & *FAM-ONIGC* Surveys.

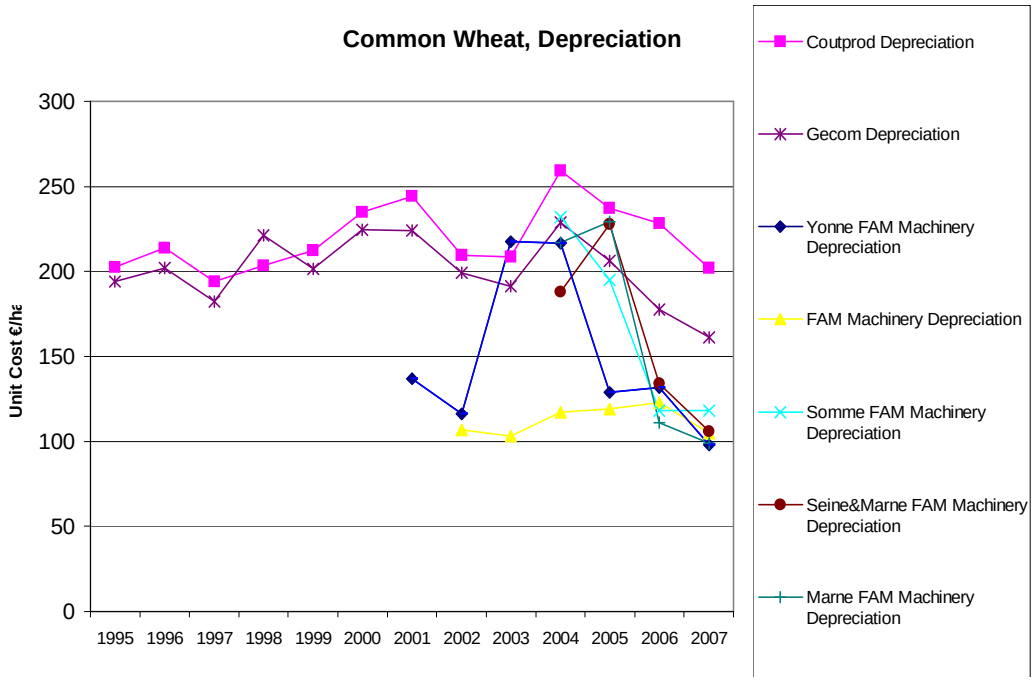
5.3.2.2 The structure cost estimates

As being defined by the common wheat *FAM* technical surveys, the concept of 'Structure Costs' includes: paid or unpaid work, machinery depreciation (long-term renewal and

interests), land, taxes, insurances, overheads. It can be compared with the following concept delineated by the specification of the *Coutprod* model: the Fixed Costs include current maintenance of buildings and equipment; property costs, which include farm rents, property taxes and interest on loans taken out to purchase land; insurance, taxes other than property taxes; financial charges except interest on property loans; depreciation of equipment, buildings, plantations and land improvements; other goods and services consumed, including third party work, motor vehicles electricity, water and other overheads.

Among those structure or fixed cost, the major components for crop production are the land cost and the machinery depreciation.

Figure 5-8: Depreciation Load for Common Wheat over the 1995-2007 period.



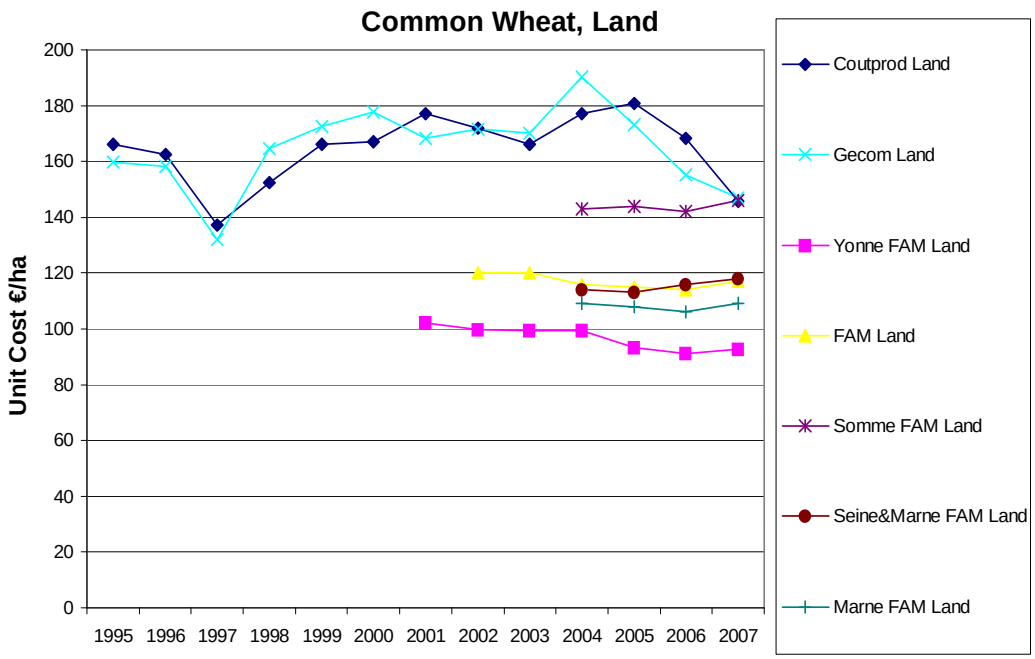
Source: EU-FADN - DG AGRI L-3, French FADN-*SSP* & *FAM-ONIGC* Surveys.

With regards to the depreciation costs, the Figure 5-8 shows that the GECOM depreciation cost estimates is well correlated to the *Coutprod* ones. However, from 2001, the GECOM depreciation estimates are systematically lower than the *Coutprod* estimates and this divergence tends to grow over the 2004-2007 period. Those estimates include depreciation for machinery and building and are not directly comparable with the *FAM* machinery depreciation figures. The variability of estimates seems to follow the variability of the yield, with some corrections due to the price variability.

The *FAM* survey results at the NUTS 3 level shows very high figures for machinery depreciation from 2003 to 2005. The *FAM* survey result at the national level for machinery depreciation registers an increase between 2004 and 2006, but this increase is not of the same scale as the rise in NUTS 3 figures that double the amount of depreciation machinery.

A linear rule is applied by the FADN for computing the depreciation. It seems that it is not the case for the *FAM* surveys. It stresses the need for harmonization between the *FAM* technical surveys and the French FADN, whenever it is possible, for the purpose of comparisons and cross-validation.

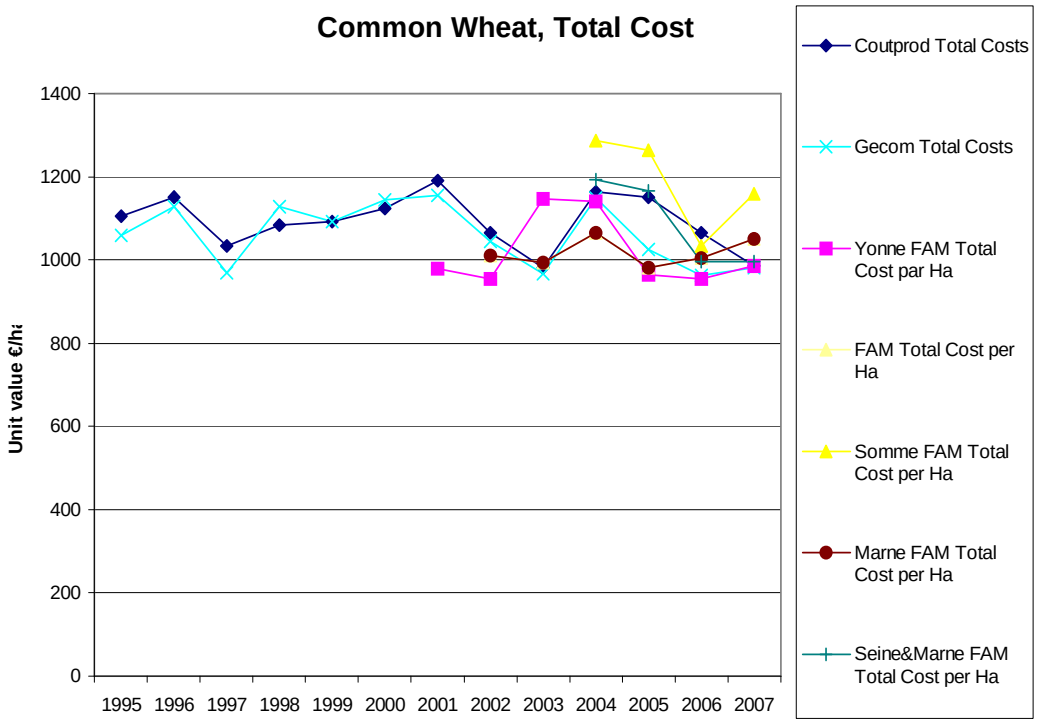
Figure 5-9: Land Cost for Common Wheat over the 1995-2007 period.



Source: EU-FADN - DG AGRI L-3, French FADN-*SSP* & *FAM-ONIGC* Surveys.

For cereals, land is the second major component of the structure costs. Over the 1995-2007 period, the correlation between the GECOM and the *Coutprod* models appears to be high. The Figure 5-9 shows evidence that the costs of land for common wheat estimated by the models are higher than the figures given by the *FAM* surveys. Moreover, the cross-time variability of the model estimates appears to be somewhat contradictory with the smooth trends of the *FAM* surveys, for the land cost: it can be underlined as an artifact deriving from the output variation, with regard to year to year different prices and yields. The cross-time variability of the model estimates seems to be much more important than the one of the *FAM* surveys, with regards to the 2000-2007 period. In such a case, smoothening the estimates with a moving average on a three-year basis can be a reasonable practice.

Figure 5-10: Total Production Costs of Common Wheat



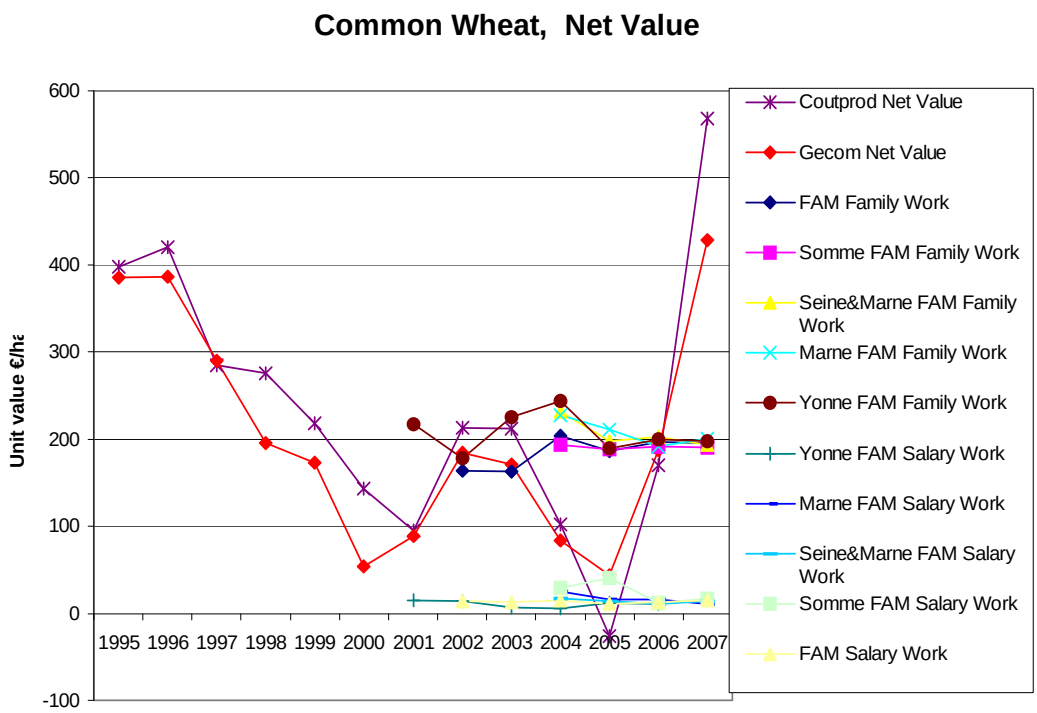
Source: EU-FADN - DG AGRI L-3, French FADN-*SSP* & *FAM-ONIGC* Surveys.

The GECOM total cost estimates are very near to the *Coutprod* ones over the period, except for the 2005 and 2006 years. It gives some evidence demonstrating the consistency between the GECOM and the *Coutprod* model, on the basis of the adapted GECOM model specification excluding farm-grown consumption.

Compared with the results of the technical surveys, over the 2002-2007 period of time, the total cost estimates of those models appear to be higher than the observed costs in average and to be much more variable. However, it is noticeable that the GECOM estimates are somewhat nearer from the technical results than the *Coutprod* ones. The *FAM* survey results at the NUTS 3 level give us an idea of the geographical variability of the common wheat production costs of northern France.

Through this comparison, we have to keep in mind that the *FAM* survey results include the cost of the salary and family workforce, determined on the basis of the minimum rate wages for the paid salary, respectively twofold this rate for the unpaid wages. Conversely, the model specifications, either GECOM or *Coutprod*, do not include in the econometric estimation process the workforce costs.

Figure 5-11: Net value estimates for Common Wheat.



Source: EU-FADN - DG AGRI L-3, French FADN-*SSP* & *FAM-ONIGC* Surveys.

Hence, it is worthwhile to display the net value added estimates provided by the GECOM and *Coutprod* models, with the figures of paid and unpaid wages of the technical *FAM* surveys giving the scale of cost for the family and salary workforce involved into the production process for common wheat. On the basis of the Figure 5-11, we can infer that for the worst campaign (2005) the net value estimates didn't cover the cost of the salary workforce involved. For the best common wheat production campaign, the net value estimates are greater than two fold the family work estimates. Eventually, the 2002 and 2003 net value estimates are almost equivalent to the unpaid wages fixed by the technical *FAM* survey at twofold the rate of minimum salary.

5.3.3 The corn estimates

France is the most important European producer of corn with 14.5 millions of tons produced in 2007, over 1,529 thousands of hectares at a yield of almost 9.5 tons per ha. It covers 18% of the French cereal cropping area. The production of corn is particularly favored in the southwest of France and in the Alsace region. Use of hybrid seeds and irrigation are the two main factors of those high yields. Almost 50% of this production (6.5 millions of tons over the 2007-2008 campaign) is exported to the European Union, mainly towards the EU15 (5 millions of tons).

The following analysis provides a detailed comparison of the model estimates of production cost for corn with the results of technical surveys conducted by FranceAgriMer (*FAM*). The methodology of those surveys is quite similar to the one defined for common wheat. The NUTS 3 areas surveyed are representative of the main production basins: *Ain*

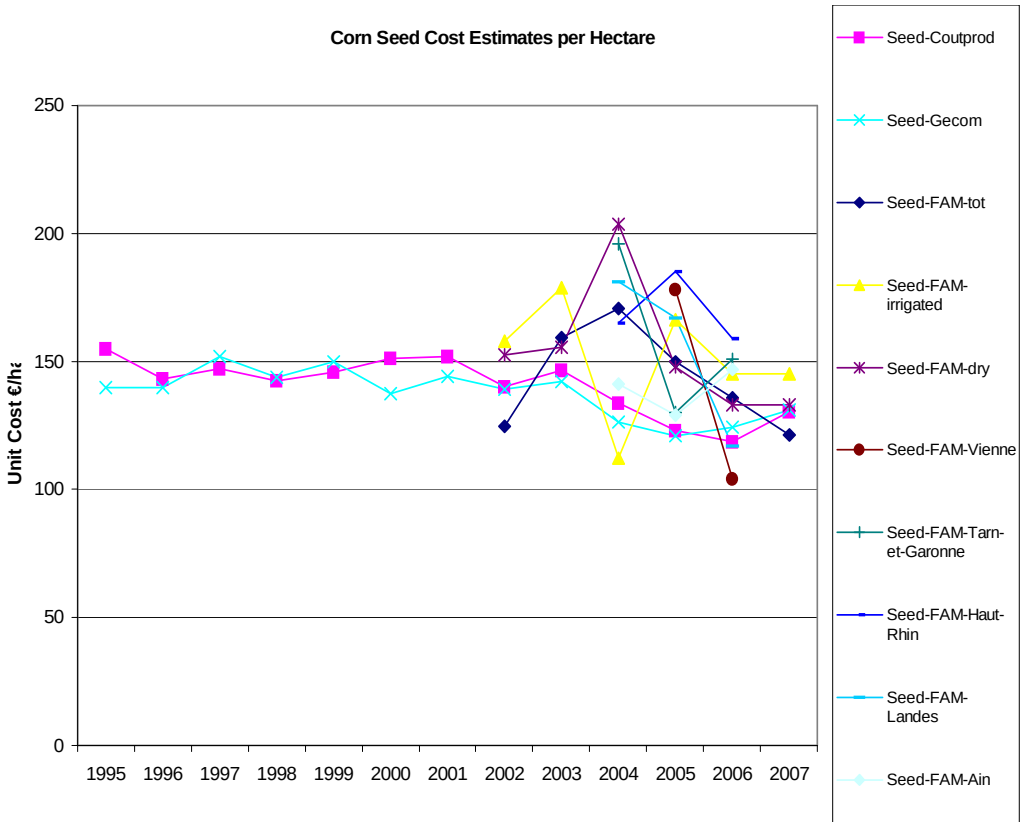
(*Rhônes-Alpes*), *Landes* (*Aquitaine*), *Haut-Rhin* (*Alsace*), *Tarn-et-Garonne* (*Midi-Pyrénées*) and, added in 2005, *Vienne* (*Poitou-Charentes*). The production costs consists of two parts: first the operational inputs such as seeds, manures and amendments, products, fuel, material maintenance, irrigation expenses, drying at the farm, work of harvest per third and return on the operational capital (interests with CT); second, the structural inputs such as paid and nonpaid work, material (renewal and long term-interests), land, taxes and taxes, insurances, overheads.

The corn cropping technology requires a higher level of more specific inputs, especially for the seeds (which are not home-grown because of the hybrid seeds used), the irrigation and drying process that can be more costly in material and energy, compared to the two other main cereals cropped in France, common wheat and barley. The cost of land is equal at the cost of tenant farming whatever the tenure status of the land.

5.3.3.1 The specific cost estimates of corn

Probably due to the use of hybridized seeds including seed-applied insecticide, the estimated cost of corn seed appears to be much higher than for the other cereals, more than twofold the estimated seed cost for common wheat. The GECOM and *Coutprod* estimates are very well correlated and rather constant over the 1995-2003 period, followed by a decreasing and a stabilization. The average level seems to be globally consistent albeit lower than the average level of the *FAM* results. However, the model estimates do not follow the global trend of the *FAM* results where the year to year variability appears to be high. Year 2004 seems to be atypical for the *FAM* surveys.

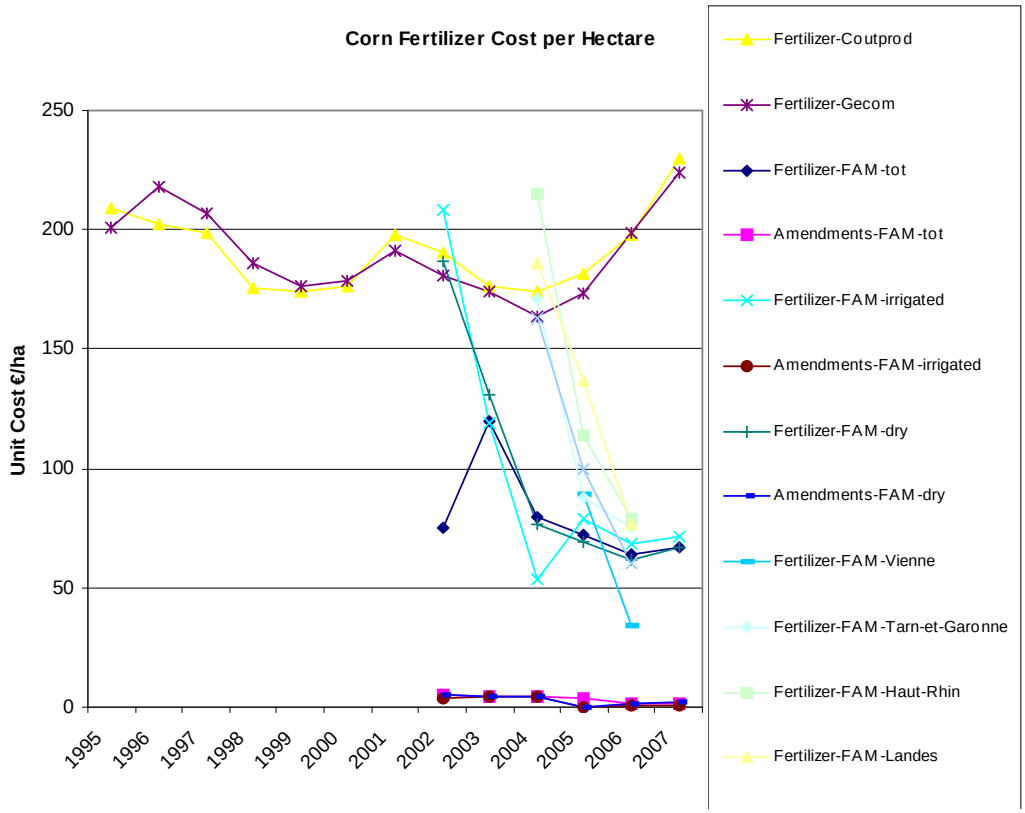
Figure 5-12: Seed Production Costs of Corn over the 1995-2007 period.



Source: EU-FADN - DG AGRI L-3 & *FAM-ONIGC* Surveys.

The GECOM and *Coutprod* fertilizer cost estimates, which are strongly correlated, appear to be not consistent in level with the *FAM* survey results. However, no explanation has been given to the decrease in fertilizer cost observed between 2004 and 2005 (more than 40%) reported by the *ONIGC* Factsheets[20]. This level difference, from 65 €/ha to 175 €/ha cannot be explained by the amendments which do not exceed the level of 5 € per ha. Despite this difference, the global trend of the survey results over the 2003-2007 period, even with a sharper decrease and one year lag, appears to be related with the trend of the two fertilizer cost estimates.

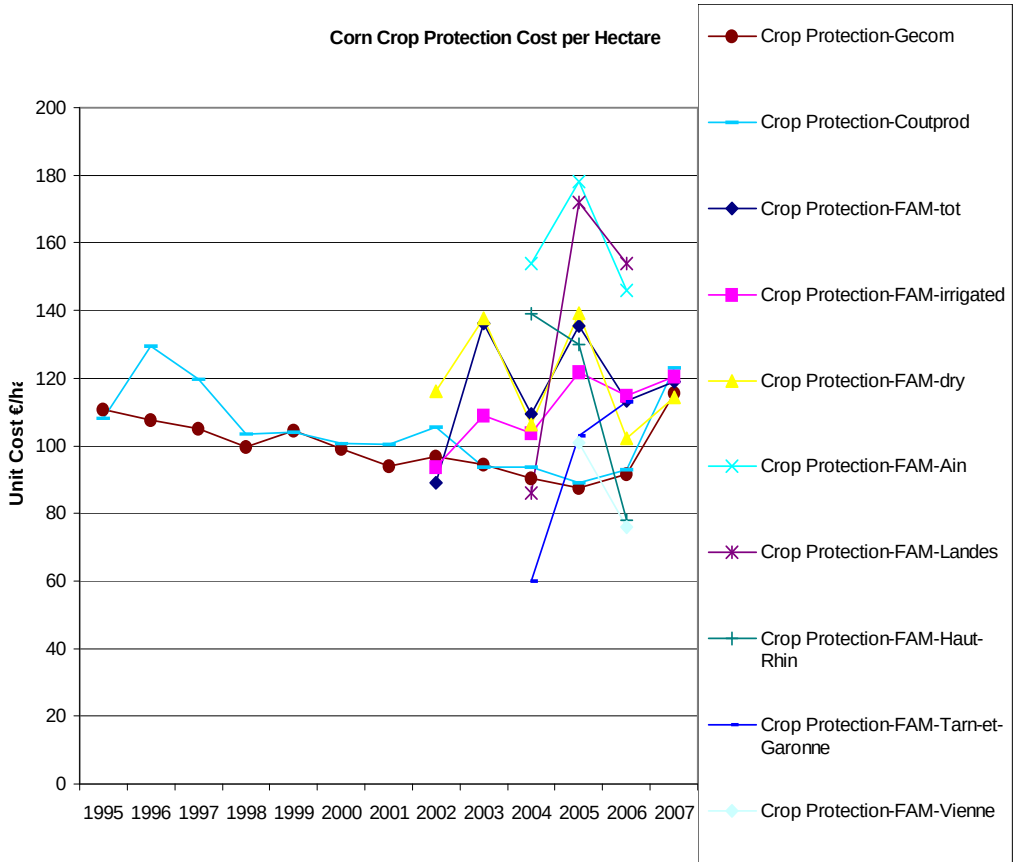
Figure 5-13: Fertilizer Costs of Corn over the 1995-2007 period.



Source: EU-FADN - DG AGRI L-3, French FADN-*SSP* & *FAM-ONIGC* Surveys.

[20] 'Maïs grain : coûts de production 2005', Alain Maillard, *ONIGC*, mars 2007-1, 4 p.

Figure 5-14: Crop Protection Costs of Corn over the 1995-2007 period.

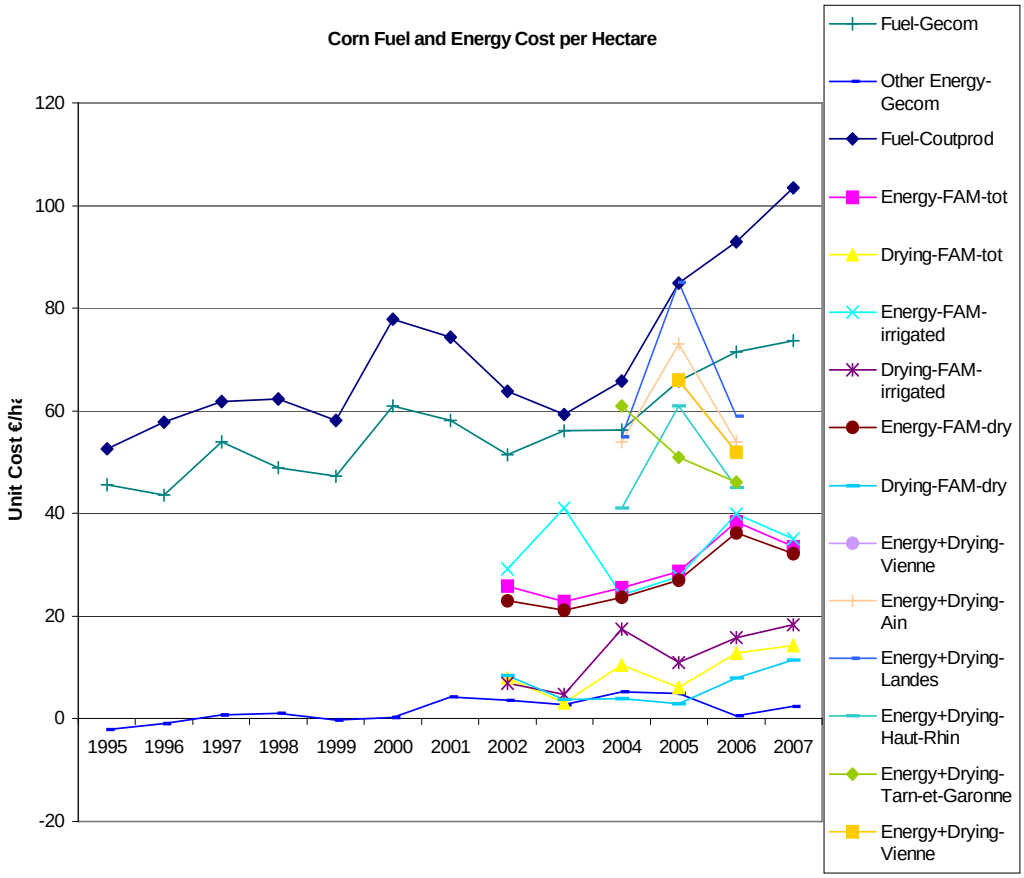


Source: EU-FADN - DG AGRI L-3, French FADN-*SSP* & *FAM-ONIGC* Surveys.

The 2007 model estimates for the corn crop protection are of the same level as the *FAM* survey results. However, over the 2002-2007 comparison period, the model estimates which are very close, seem to be lower than the crop protection costs of the *FAM* survey results, The global trend of estimates is similar to the one of seed cost, however somewhat contradictory with the *FAM* result trend over the 2002-2007 period of time. The model crop protection estimates for corn are significantly lower than the ones estimated for the common wheat, this evidence supporting the hypothesis that a fraction of the corn seed cost has to be imputed to the crop protection.

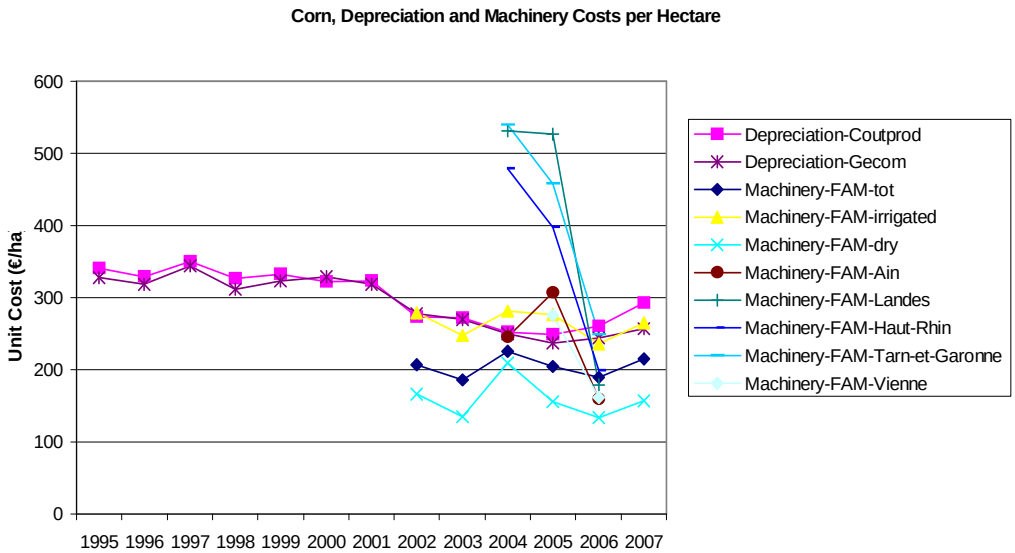
The fuel and energy costs for the corn are more complex to analyze due to the fact that those inputs are related to the irrigation and the drying of corn. The discrepancy between the GECOM and the *Coutprod* estimates is due to the slightly different specification of the GECOM model that distinguish fuel from other sources of energy. The national *FAM* survey results allow to compare energy (fuel and other energy) cost for irrigated and non-irrigated (dry) corn. The local *FAM* survey results give the level of energy and drying costs. However the fuel estimates from the models appear to be higher than the *FAM* survey results, taking in account other costs correlated to energy expenses, such as irrigation and drying.

Figure 5-15: Fuel & Energy Costs of Corn over the 1995-2007 period.



Source: EU-FADN - DG AGRI L-3, French FADN-*SSP* & *FAM-ONIGC* Surveys.

Figure 5-16: Depreciation Costs of Corn over the 1995-2007 period.

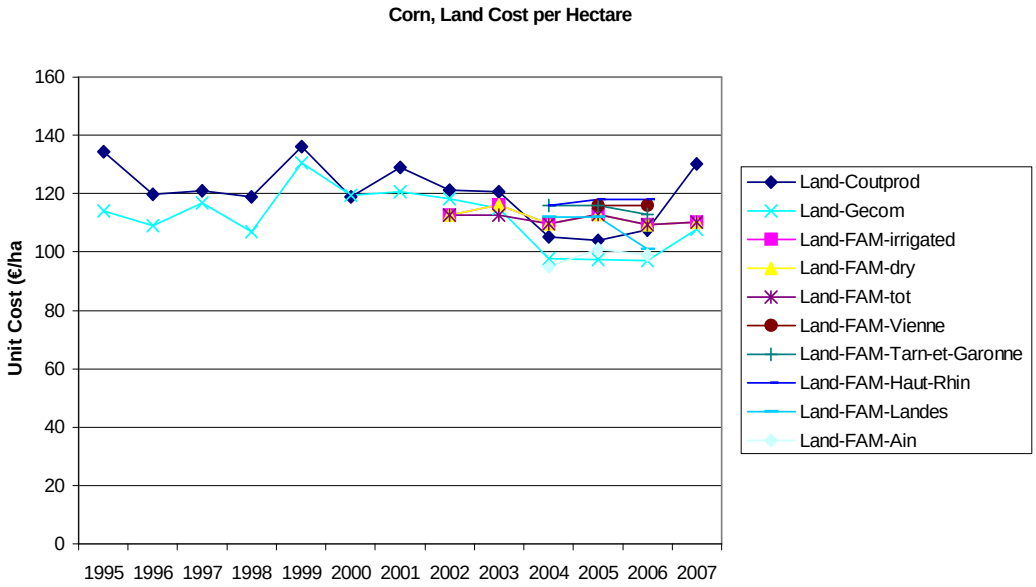


Source: EU-FADN - DG AGRI L-3, French FADN-*SSP* & *FAM-ONIGC* Surveys.

The depreciation estimates of the GECOM and the *Coutprod* models are well correlated, with some slight differences that can be attributed to the calibration step of the *Coutprod*

model. On the one hand, depreciation includes machinery and building into those model specifications. On the other hand, machinery costs include the renewal and the long-term interests. For general cropping, the machinery costs are one of the major structural costs. Hence, the machinery costs from the *FAM* survey results gives complementary information, evidencing that from 2002 the estimated depreciation costs by the model are lower than the FAM survey results. However, it has to be stressed that into the FADN, depreciation is computed according to a linear rule and as we can deduce it from local figures between 2004 and 2006. This is not the case into the *FAM* surveys, reflecting the actual practices of a majority of specialized cereal farmers.

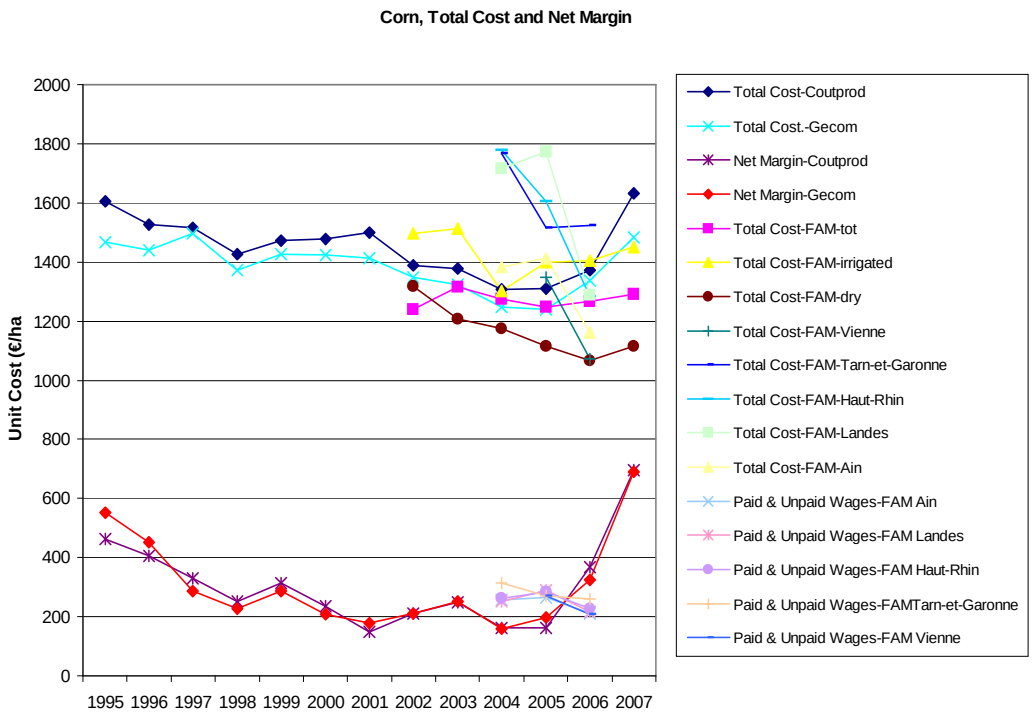
Figure 5-17: Land Costs of Corn over the 1995-2007 period.



Source: EU-FADN - DG AGRI L-3, French FADN-*SSP* & *FAM-ONIGC* Surveys.

According to the *FAM* survey results, the land cost appears to be very stable from 2002 to 2007, with a relatively moderated regional variability among the main French basins of corn production, according to the local NUTS 3 figures from 2004 to 2006. In comparison, the GECOM and *Coutprod* estimates appear to be too much influenced by the variability of the output. Further investigations about the *FAM* survey sources for the land cost are needed because this cost is probably getting from some computations rather than from direct observations.

Figure 5-18: Total Costs and the Net Margin of Corn over the 1995-2007 period.



Source: EU-FADN - DG AGRI L-3, French FADN-*SSP* & *FAM-ONIGC* Surveys.

Over the 1995-2007 period, the total estimates of cost for the GECOM and *Coutprod* models seem to be well correlated, the *Coutprod* estimates being systematically higher than the GECOM ones (probably coming from the calibration step of the *Coutprod* model). Albeit the total cost of the *FAM* survey are including the cost of paid wages (from 5 to 10 € per ha, on average at the national level), the *FAM* total costs appear to be almost at the same level (ranging from 1,160 €/ha for dry corn to 1,440 €/ha for irrigated one) as the model estimates (1,400 €) that do not make a distinction between the two production systems, over the 2002-2007 period.

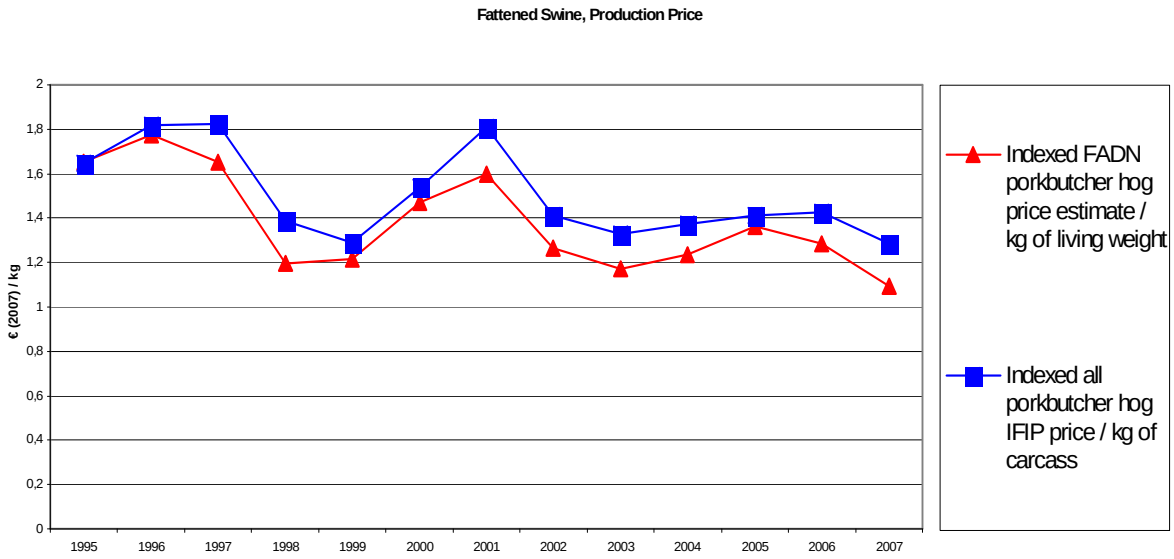
The net margin decreases from 450-500 €/ha in 1995 to 160-200 €/ha in 2005 at a level lower than the paid (the cost of salaried work computed according the rate of the minimum salary) and the unpaid wages (the cost of the family work computed according a twofold rate of the minimum salary) for the local NUTS 3 surveys from the main French basins of corn production, in 2004 and 2005 (260 €/ha). However, in 2006, the *FAM* results decrease conversely to the two model estimates. Hence, there is no supporting evidence in favor of a convergence between the net margin and the sum of wages.

5.3.4 The fattening pigs estimates

According to the 2007 structure survey, the livestock of fattening pigs counted in France 7.6 million heads distributed over 25,000 farm holdings. The concentration of the production is high: on the one hand, the pig producing holdings of more than 600 heads (either 18% of those holdings) account for 70% of the livestock and on the other hand, the holdings with less than 400 heads, or 40% of the porcine holdings, gather a little less than 15% of the French herd of pigs. According to *RICA*, the French FADN, the pork

production represented in 2007 12% of the gross product of the livestock production, that is to say in value the third sector after the dairy and bovine meat. Among the types of farming (TF), the pig and/or poultry TF has the lowest rate of the margin, that is to say 7%. Indeed, the farm holdings specialized in pig and/or poultry are characterized by the level from current inputs, highest in median (186,200 €), and their greatest dispersion (a difference of 233,700 € between the first and last quartiles of this subpopulation).

Figure 5-19: The Pork Producer Price over the 1995-2007 Period (IFIP versus FADN Estimates).



Source: EU-FADN - DG AGRI L-3, French FADN-*SSP* & *IFIP GTE* Surveys.

The French technical institute for pigs (*IFIP*), collects the technical and economic results from a large number of specialized farm holdings (from 787 to 495, respectively between 1995 and 2007) thanks to the Technico-Economic Management Survey (*GTE*). The *GTE* survey provides information on prices, performances and production costs[21].

The producers of pigs are facing the fluctuations of the production in Europe fixed on a business cycle of approximately three years and half of which an alternation from rise and price-cuttings, and must manage the variations of margins which result from this. Figure 5-19 displays in real terms (at their 2007 € value) on the one hand the butcher hog price per kilogram of living hog estimated on the basis of FADN output values and the *IFIP* mean weight of a living hog and on the other hand, the *IFIP* butcher hog price per kilogram of carcass which is the best correlated *IFIP* price index with the producer price derived from the FADN (r=0.95). Over the base period 1995-2007, one notes that the amplitudes of variation of the producer prices attenuated as from 2002, with a fall of the mean level of the FADN prices with a rate equal to 18% between 1995-2001 and 2002-2007. The variations of the producer price for one kilogram of living weight are practically equivalent to those around the price for one kilogram of carcass and the price trend annual is almost constant after 2002, around 1.37 € per kg of carcass, 11% higher than the mean price of 1 kg of living weight (1.23 €). Based upon professional standards, the discrepancy between the

[21] « Hausse des prix de l'aliment pour les porcs en 2007. Conséquences pour les coûts, la rentabilité, la compétitivité des produits », RIEU M., *12e Journées Sciences du Muscle et Technologies des Viandes - JSMTV*, pp. 23-24.

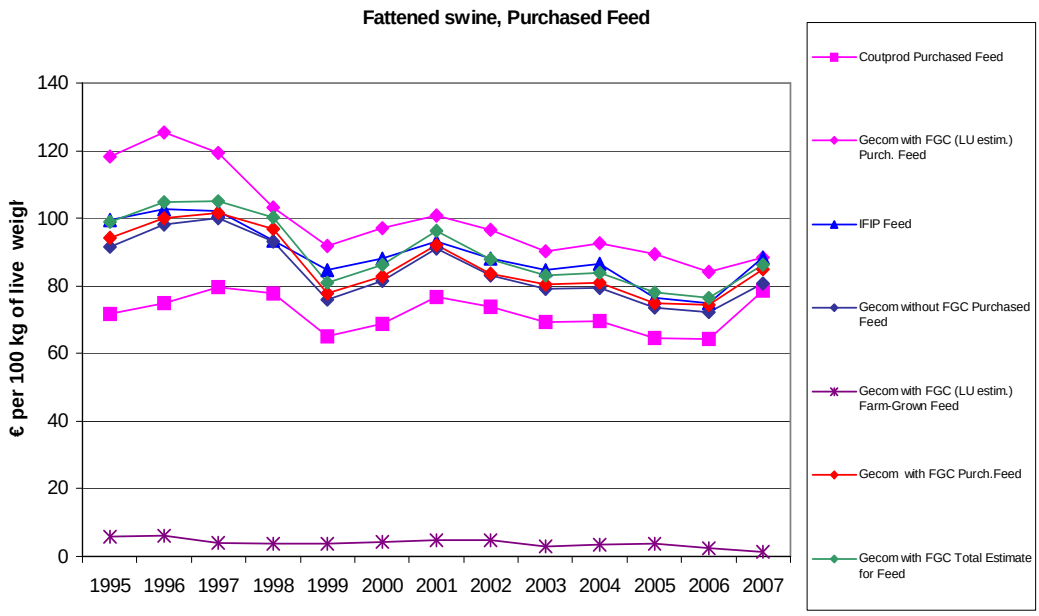
living weight price and the carcass price is around 20%: many factors can explain the observed departure from this standard, including the percentage of non-standard carcass (less than 80 kg and more than 110kg), the differences in slaughtering charges between the various regions (Aquitaine favored heavy carcass whereas Brittany defavoured them).

In the following, we provide a detailed comparison of the estimates of the model production costs for the pigs to the fattening with the results of the *GTE* technical survey carried out by *IFIP*, marking the distinction between two specifications of the *GECOM* model: with home-grown consumption ('Farm-Grown Feed') and without home-grown consumption. Another distinction is introduced by computing the 100 kg carcass estimate accordingly with the livestock unit (LU) estimate with the standard of 0.30 LU for a fattening pigs rather than computing it accordingly with the price of a standard butcher hog carcass. Because, in France, there are a lot of specialized holdings that get the piglets directly from their own sows and some of them are producing "heavy carcass" pork, under hypothesis of a bias for the LU estimates through the rather conventional 0.30 LU standard for fattening pigs, we assume that it can produce some differences with the standard hog carcass pricing approach. We report the differences for which the comparison of the inputs seems to be relevant with the *IFIP* technical survey.

5.3.4.1 The specific cost estimates of fattened swine.

Among the specific costs in pork production, the feed constitutes the major input representing, according to the professionals of the animal feeds (source: *AFAB*), approximately 60% of the production costs of a hog carcass. The average of the weight of the estimates for the cost animal feeds of porcine over the base period is: 60.1% for the specification of the GECOM model including the cost of home-grown consumption, breaking up between 57.9% for bought feed and 2.2% for feed produced by the farm holding; and of 56.6% for feed bought in the specification of the GECOM model excluding the cost of home-grown consumption. The cost of the animal feeds in the *IFIP* survey accounts for 59.5% of the cost price for a kilogram of hog carcass. Taking in account the differences induced by the various definitions of the expenditure in animal feeds, it thus leads according to the various sources to convergent estimates with the professional standards into force.

Figure 5-20: Feed Costs of Fattened Swine over the 1995-2007 period.

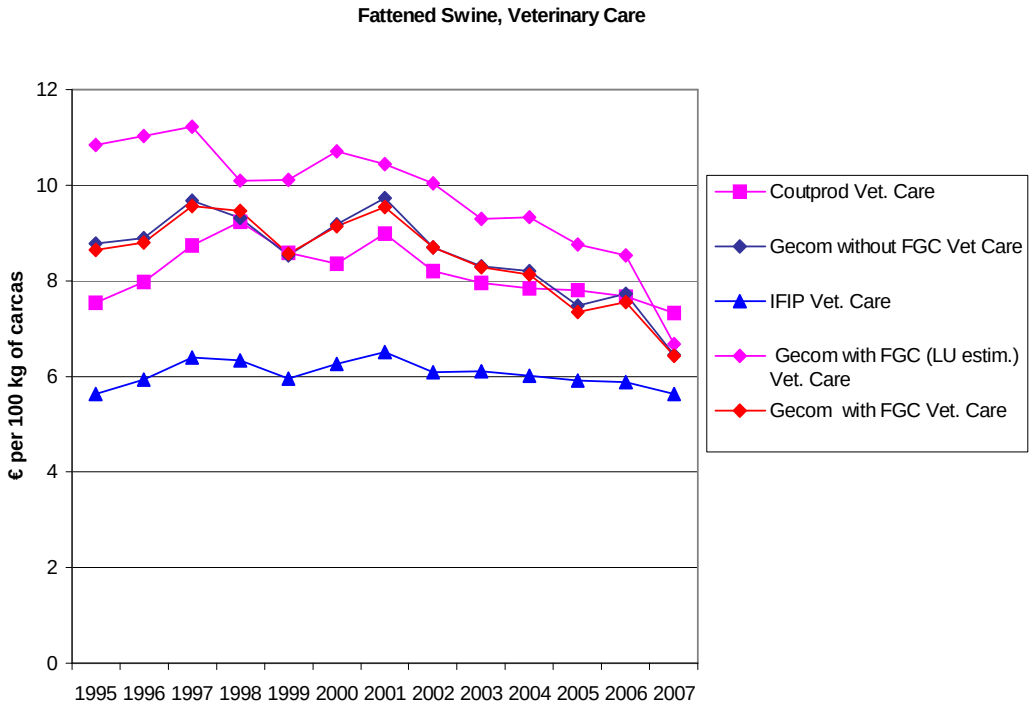


Source: EU-FADN - DG AGRI L-3, French FADN-*SSP* & *IFIP GTE* Surveys.

The IFIP feed cost is better correlated with the *Coutprod* estimate (r=0.89) than the corresponding GECOM estimates: respectively, (r=0.79) for the total estimate with Farm-Grown Consumption, (r=0.76) for the Purchased Feed estimate without Farm-Grown Consumption and (r=0.63) for the Livestock Unit estimate without Farm-Grown Consumption. However, in terms of cost level, the total (purchased plus farm-grown) estimate with Farm-Grown Consumption is nearer to the *IFIP* feed cost than to the other ones, while the *Coutprod* purchased feed estimate is notably lower and the living stock unit purchased feed estimate with Farm-Grown Consumption is higher, delineating a kind of empirical interval of variation for the feed estimates.

If we compare the model estimates with another indicator which is the butcher feed price index derived by *IFIP* from the *GTE* survey, we found that this index is slightly less correlated with the GECOM and *Coutprod* estimates than the plotted general IFIP feed cost index: r=0.86 with the *Coutprod* model estimates for the purchased feed (versus *r=0.89*, previously) , and *r=0.64* with the 'without FGC' *GECOM* model estimates for the purchased feed (vs *r=0.76*, previously). The breeding of sows and piglets favored by the French producers as a specific production process could explain those differences.

Figure 5-21: Veterinary Care Costs of Fattened Swine over the 1995-2007 period.

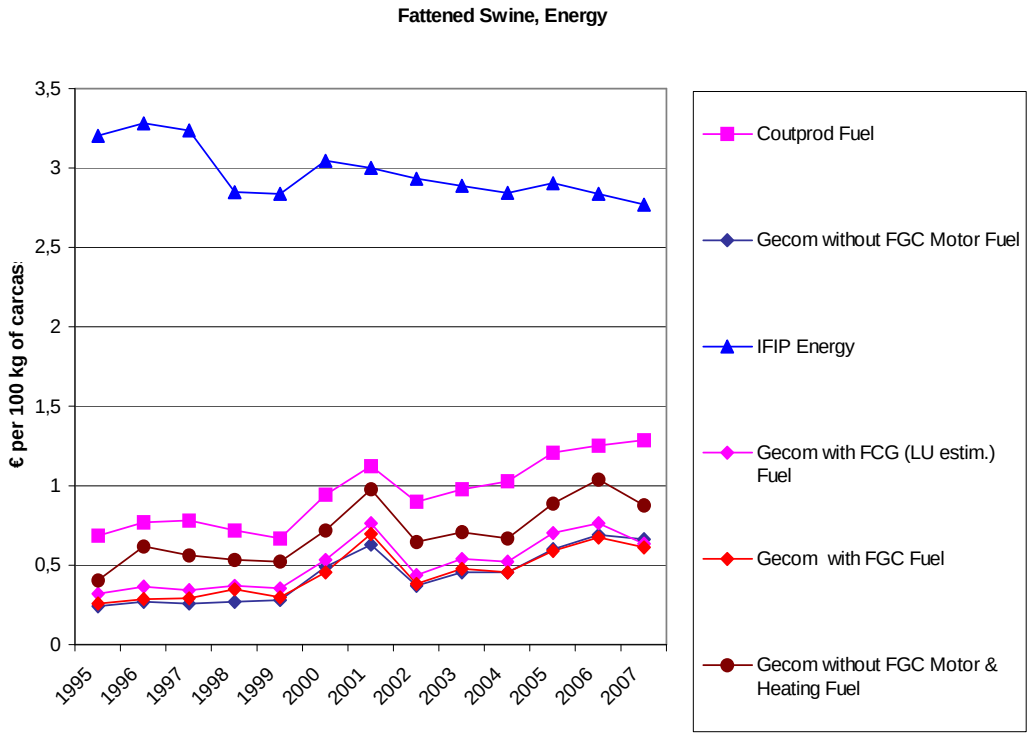


Source: EU-FADN - DG AGRI L-3, French FADN-*SSP* & *IFIP GTE* Surveys.

The second variable cost in value is the veterinary care. The Figure 5-21 shows that all the model estimates are higher in level than the *IFIP* veterinary cost estimate from the *GTE* survey. However, we find the same hierarchy among the different model estimates as previously with the feed costs: the Coutprod estimates are the lowest and the LU GECOM estimates, the highest. The best correlations are registered with the *Coutprod* estimates (r=0.87), followed by the consistent 'without FGC' GECOM estimates (r=0.76). The correlation with the 'with FGC' GECOM estimate is almost equivalent (r=0.77) while the lowest correlation is with the 'with FGC' GECOM 'LU-derived' estimate (r=0.50).

Because of the discrepancy between the *IFIP* index and the model estimates, it is necessary to check the consistency of the accounting definitions of this operational input index between the models and the *GTE* survey.

Figure 5-22: Energy Costs of Fattened Swine over the 1995-2007 period.



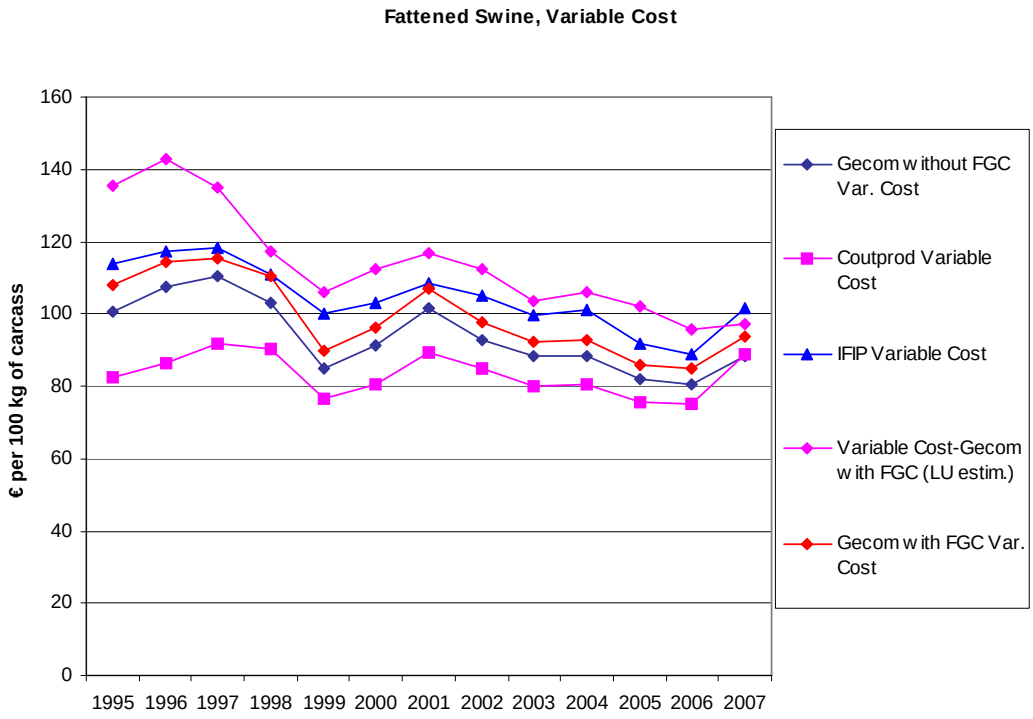
Source: EU-FADN - DG AGRI L-3, French FADN-*SSP* & *IFIP GTE* Surveys.

Another operational cost that can be compared with the results of the *GTE* survey is energy. The *IFIP* Energy cost accounts for 2.3% of the total cost (without wages) of a hog carcass. The above displayed and the values of correlation coefficients (almost equal to -0.5) computed between the model estimates and the survey results clearly show that the trends are inverted between the *GTE* results (decreasing over the time period) and the model estimates (respectively increasing). It is clear that fuel is not the only item of energy expenses in the accounting framework of the *GTE* survey: the level of the model estimates varies from the sixth (for GECOM estimates) to the third (for *Coutprod* estimates) of the energy expenses registered by the *GTE* survey for the pig breeding activity. Other sources of energy in addition with fuel are used: according to a recent enquiry conducted on the use of various sources of energy, electricity accounts for 38% and gas for 25% compared to the 27% figure for fuel, in 2007 with pig & poultry type of farming. One must bear in mind that facing the increases in fuel price, gas and electricity has been favored by consumers in France as alternative sources of energy for heating, due the relative stability of the gas price and special tariffs for electricity.

The *Coutprod* estimates for Fuel expenses (which encompass the overall of motor fuel and lubricant expenses) represents a 32% level of the IFIP Energy results, which is consistent with the energy profile of pig & poultry specialized farm holding accounting 27,6% of the energy expenses for motor fuel and lubricants, according to the 2007 French FADN. However the linear specification does not provide a full additivity for the model estimates: the sum of the GECOM estimates for motor fuel and lubricant plus heating fuel is lesser than the *Coutprod* equivalent estimate. Hence, it can be necessary to build an aggregated item for energy expenses with a specification of the GECOM model that includes other

sources of energy, in order to deliver estimates more comparable with the GTE survey figures. It has to be stressed that the *Coutprod* estimates are correlated at the r=0.93 level with the *Ipampa*[22] Index for fuel and lubricant, the GECOM without FGC estimates for motor-fuel at the r=0.83 level, the GECOM without FGC estimates for heating-fuel at the r=0.89 level, and at the r=0,81 level for GECOM with FGC estimates based on the carcass price as well as the one based on livestock units (LU).

Figure 5-23: Variable Costs of Fattened Swine over the 1995-2007 period.



Source: EU-FADN - DG AGRI L-3, French FADN-*SSP* & *IFIP GTE* Surveys.

Aggregating the IFIP costs, as much as possible in a consistent way, allows to compare an IFIP variable cost estimate to the different GECOM variable cost estimates, summing the following inputs : feed, renewing of swine, piglets, energy, animal health care, and water costs. The GECOM with FGC estimates based on the carcass price are correlated with the IFIP ones at the r=0.97 level, the ones based upon the livestock units at the r=0.72 level; the GECOM without FGC estimates at the r=0.58 level and the *Coutprod* estimates at the r=0.41 level. In terms of the value level of estimates, the GECOM with FGC estimates based on the carcass price is the nearest one, so it has to be favored in estimating the gross margin of fattened swine. The *Coutprod* model gives the lowest estimates for the variable cost while the LU-based estimates of the GECOM with FGC model are the highest ones.

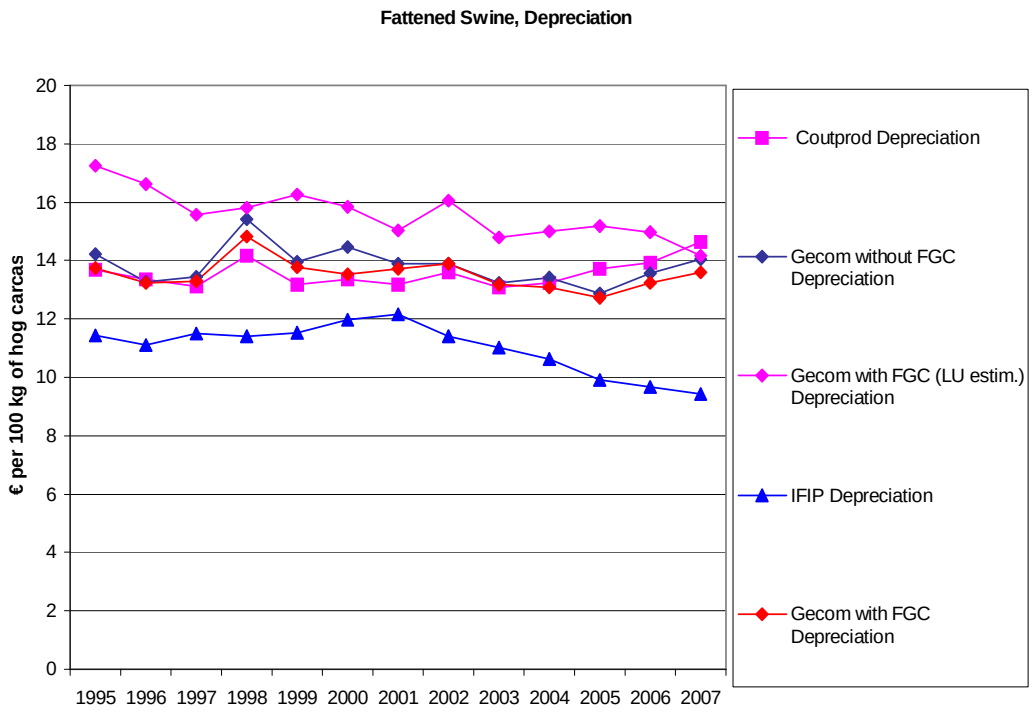
5.3.4.2 The structure cost estimates of fattening pigs.

From the *GTE* surveys, depreciation is the only *IFIP* result for fixed inputs that can be "reasonably" compared to the model estimates. Interpreting differences between the *IFIP*

[22] *Ipampa* ('*Indice de prix des achats de moyens de production agricole*') is the French price index at the production level for the agricultural inputs produced by the *SSP* and published by *INSEE* (cf. www.insee.fr).

results and the model estimates, it has to be kept in mind that the depreciation rule into the FADN is a linear one but into the accounting data into the *GTE* surveys are not submitted to such a rule.

Figure 5-24: Depreciation Costs of Fattened Swine over the 1995-2007 period.



Source: EU-FADN - DG AGRI L-3, French FADN-*SSP* & *IFIP GTE* Surveys.

The results issued from the *GTE* surveys of *IFIP* with an average level of 11 € per 100 kg of hog carcass are notably lower than the overall model estimates which range from 13.8 € for the carcass price based GECOM estimates with FGC. The correlation figures of the model estimates with the IFIP results are lower than for the variable costs previously studied: it ranges from r=0.39 for the GECOM estimates without FGC to r=0.55 for the LU-based GECOM estimates with FGC, and last but not least *Coutprod* estimates are negatively correlated with the *IFIP* results at a r=- 0.63 level.

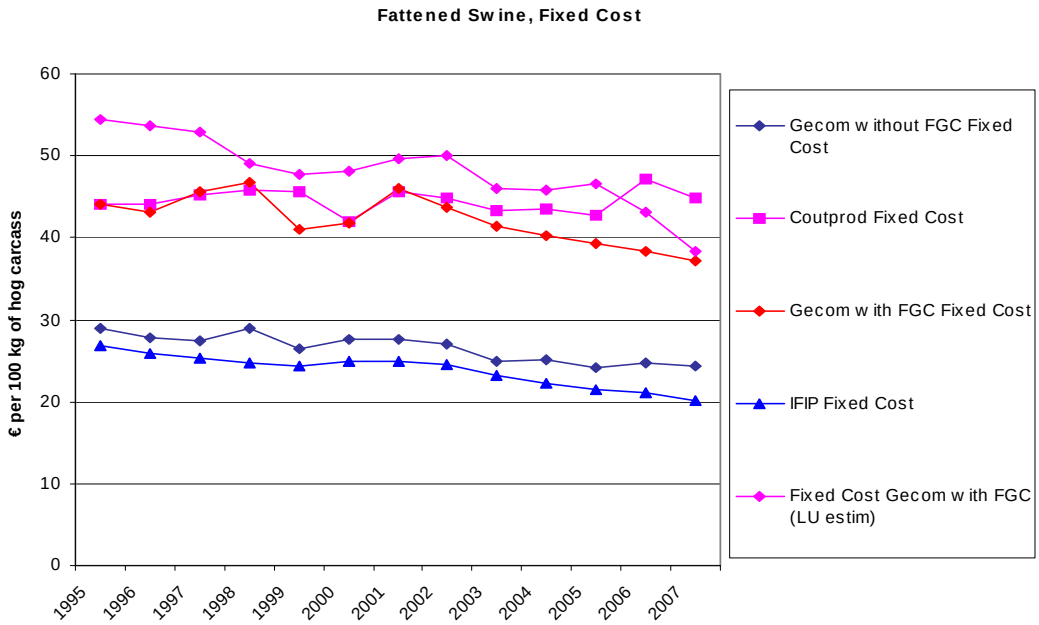
The aggregate of *IFIP* results for fixed cost has been defined as the sum of maintenance and repairs, small equipment, rents, make up work, depreciation, financial expenses and other inputs, complementarily to the aggregation of *IFIP* results for the variable costs.

Displaying the *IFIP* aggregate of results for fixed costs along with the corresponding model estimate (Figure 5-25) shows that the *IFIP* fixed costs are at the lowest level, with the GECOM without FGC model giving the nearest estimates. The correlation of the sum of model estimates for fixed cost with the *IFIP* aggregate of fixed cost range from r=0.79 for the LU-based GECOM with FGC estimate to r=0.83 for the carcass-price based GECOM estimates with FGC.

The *Coutprod* sum of fixed cost estimates are uncorrelated (r=-0.07) with the *IFIP* fixed cost aggregate , mainly because their level appears to be constant over the reference period,

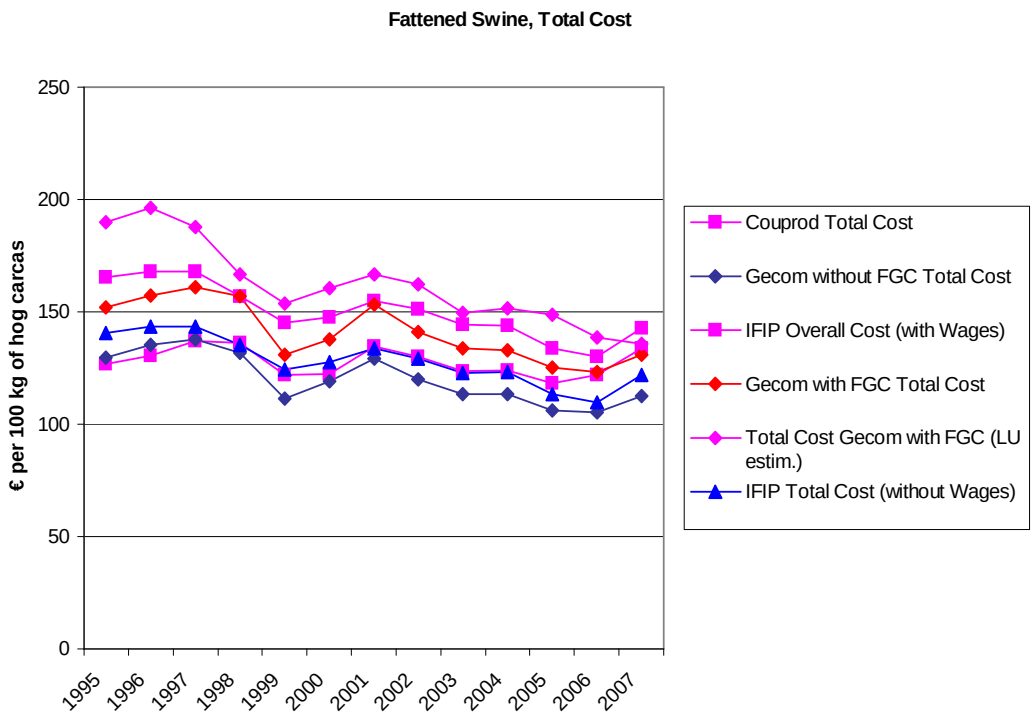
whereas the other aggregates have a decreasing trend. In this respect, it has to be reminded that fixed costs are not supposed to be correlated with the production.

Figure 5-25: Fixed Costs of Fattened Swine over the 1995-2007 period.



Source: EU-FADN - DG AGRI L-3, French FADN-*SSP* & *IFIP GTE* Surveys.

Figure 5-26: Total Costs of Fattened Swine over the 1995-2007 period.



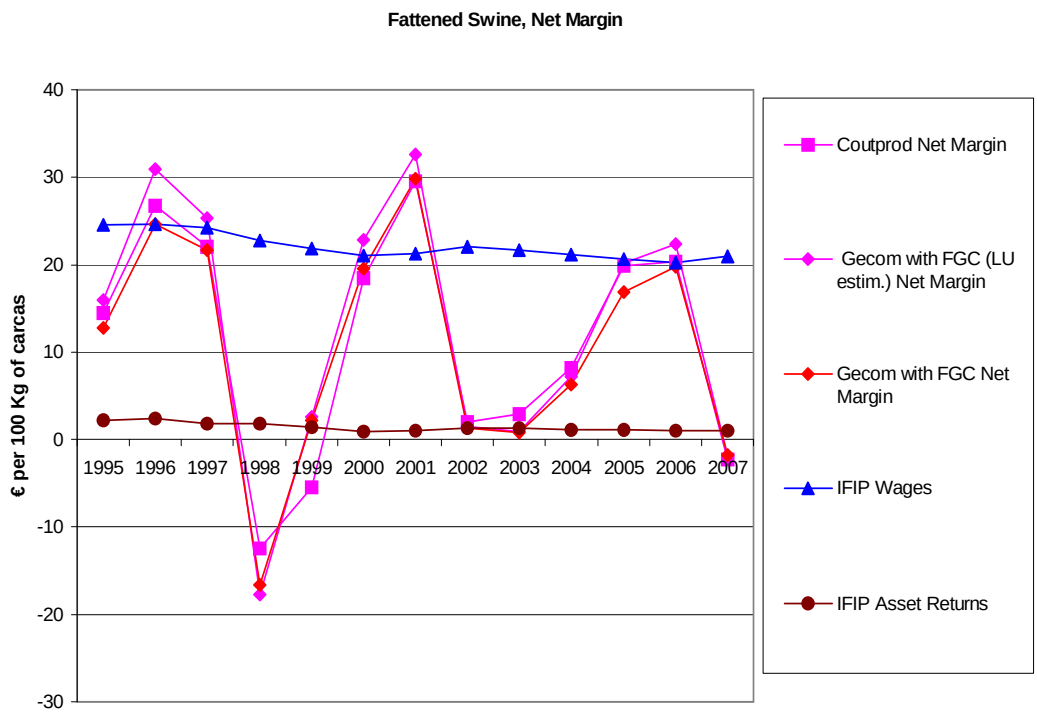
Source: EU-FADN - DG AGRI L-3, French FADN-*SSP* & *IFIP GTE* Surveys.

5.3.4.3 Total costs and revenue estimates of pig fattening.

In this study, the total cost aggregate is excluding the cost of workforce. The correlations between the *IFIP* total sum of costs and the total sums of the model costs estimates are high, ranging from the lowest one (r=0.67) for the *Coutprod* model to the highest one (r=0.97) for the GECOM model without FGC.

However, the level of *Coutprod* model estimates over the 1998 to 2005 period appears as the nearest one from the *IFIP* total cost estimates, according to a MAPE criterion: one must bear in mind that the GECOM model does not include currently a calibration step while the Coutprod model does. The *IFIP* overall cost including wages appears to be nearer from the LU based total cost estimates of the GECOM model without FGC. The set of correlations is almost equivalent to those registered with the *IFIP* total cost aggregates.

Figure 5-27: Wages, Returns and Net margin of Fattened Swine over the 1995-2007 period.



Source: EU-FADN - DG AGRI L-3, French FADN-SSP & IFIP GTE Surveys.

The net margin model estimates appear to be correlated with the carcass price and uncorrelated with the *IFIP* asset returns. More precisely, the *GECOM* model estimates of the net margin are highly correlated with the hog carcass prices at the *r=0.84* level while the *Coutprod* model ones are far less correlated (*r=0.40*). Probably because of dependent computation processes, *IFIP* wages and *IFIP* asset returns estimates are correlated at a very high level (*r=0.95*).

5.3.5 The cow milk estimates

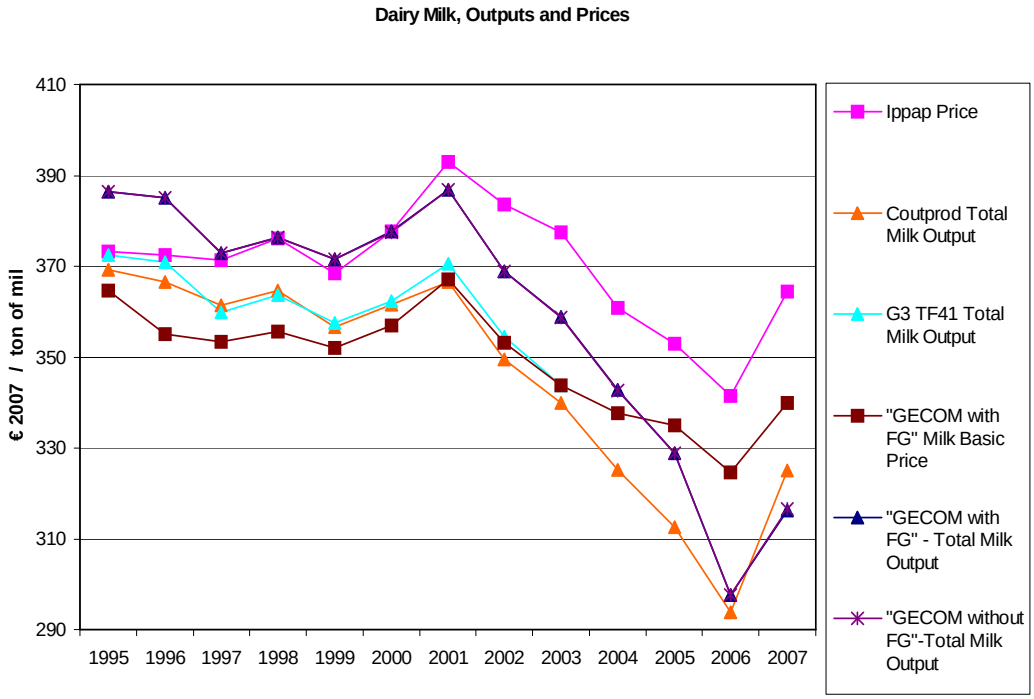
According to the Bovine Survey (CNIEL, 2009), the livestock of dairy cows counted in France 3.8 million of heads distributed over 87,800 farm holdings, on 2007. Since the beginning of the quota milk regulation policy enforced in 1984, the dairy cow herd decreases from 7.2 million of heads distributed over 384,900 farm holdings, on 1983. Due to the quota milk regulation, the French production of dairy milk has been stabilized at a 22.3 million tons level (2007), from the 1983 level of 25.3 million tons, before the regulation enforcement. During this period, the milk yield per dairy cow has been constantly increasing from 3,850 kg per cow yearly in 1983 to 6,341 kg per cow yearly in 2007, according to the yearly Dairy Survey[23]. According to the 2007 Structure Survey, the dairy French farm holding has on average a herd of 41 dairy cows (30% with a herd of less than 30 cows and 30% with a herd higher than 50 cows) with a milk quota of 263,000 liters. The number of specialized holdings (TF 41, Type of Farming) is 53,000, decreasing by 9% from the previous Structure Survey (2005).

Among the different output series (Figure 5-28), the best correlated ones are the Output GECOM Series with the French Type of Farming 41 (milk-specialized farm holdings) Output Series (DG Agri, 2006) over the 1995-2003 with a r=0.99 coefficient estimate: this correlation level shows the consistency of the two series computed on the French FADN excerpt of the EU Database. Although they are not derived from the same database, the Output Series issued from the GECOM and *Coutprod* are correlated at the r=0.97 level over the 1995-2007 period. These series are well correlated with the GECOM Basic Price (Output minus the milk complementary subsidies), namely at the same r=0.87 level than the correlation between the two index prices: the GECOM Basic Price the and price series derived from the 2005-based *Ippap* index (Indice des prix des produits agricoles à la production). These two output series are slightly less correlated with the 2005-based *Ippap* index, at the r=0.83 level. However, due to the low level of correlation between the G3 TF41 Total Milk Output and the 2005-based *Ippap* price (r=0.07), there is no evidence in favor of a statistical link between those two series. Over the 1995-2005 period, the *Coutprod* (r=0.97) and the GECOM (r=0.99) Output series are highly correlated with the G3/DG Agri TF41 Output estimates.

These comparisons show that the GECOM Basic Price is very consistent with the 2005-based *Ippap* price. The GECOM Output as an estimation basis for the production costs is highly consistent with the *Coutprod* Output. The discrepancy between the output and the basic price series on the Figure 5-28 shows from 2004 to 2007 the increasing impact of the complementary subsidies for dairy milk.

[23] 'Enquête annuelle laitière', *Service de la Statistique et de la Prospective*, 2007.

Figure 5-28: The Milk Producer Price Over the 1995-2007 Period (Ippap Versus FADN Estimates).



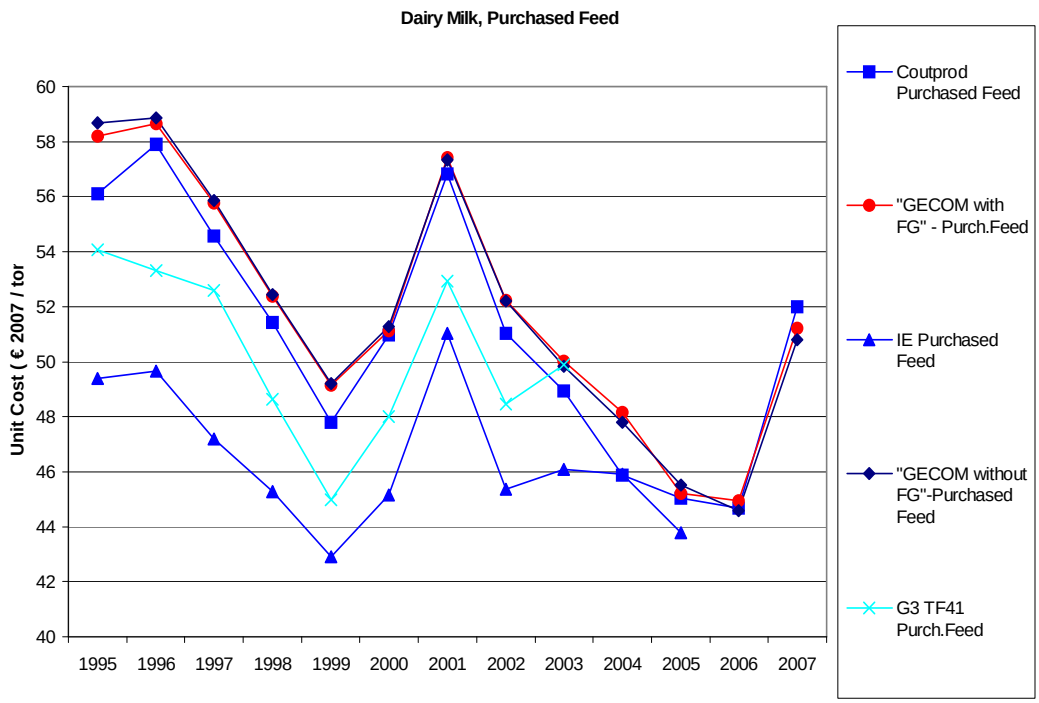
Source: EU-FADN - DG AGRI L-3, French FADN-*SSP* & *IE* Surveys.

5.3.5.1 The specific cost estimates of dairy milk

In dairy milk production, the food, the veterinary care and the fodder inputs are the major inputs among the specific costs. The dairy cows are feed by a mix of purchased feed and home-grown feed (essentially fodder and mainly fodder maize). As in the Institut de l'Elevage (IE) technical survey, a distinction can be made among purchased feed between concentrated feed and fodder feed. According to the model estimates, the Purchased+Farm-Grown Feed cost represents 71% of the dairy cow feed costs and 29% for the Fodder Inputs cost.

The estimates of the GECOM model (with and without Farm-Grown) are almost perfectly correlated (r=0.999) and the level difference is negligible (Figure 5-29). One must bear in mind that all the farm-grown fodders are not valued and the Farm-Grown consumption of cereals for dairy milk is much lower than for the fattened swine. For purchased feed estimates, meanwhile they are very highly correlated at the r=0.98 level, the Coutprod estimates are slightly lower (1.7%) than the GECOM estimates, reflecting to a lesser extent the departure between the outputs previously noted. The estimates of the G3/DG Agri study for purchased feed are 6.6 % smaller than the GECOM estimates over the period 1995-2003 (excepted on 2003). However, they are highly correlated (r=0.92). The IE technical survey results are 11.5% lower than the GECOM estimates for purchased feed but still very well correlated (r=0.87) with the GECOM estimates over the 1995-2005 period.

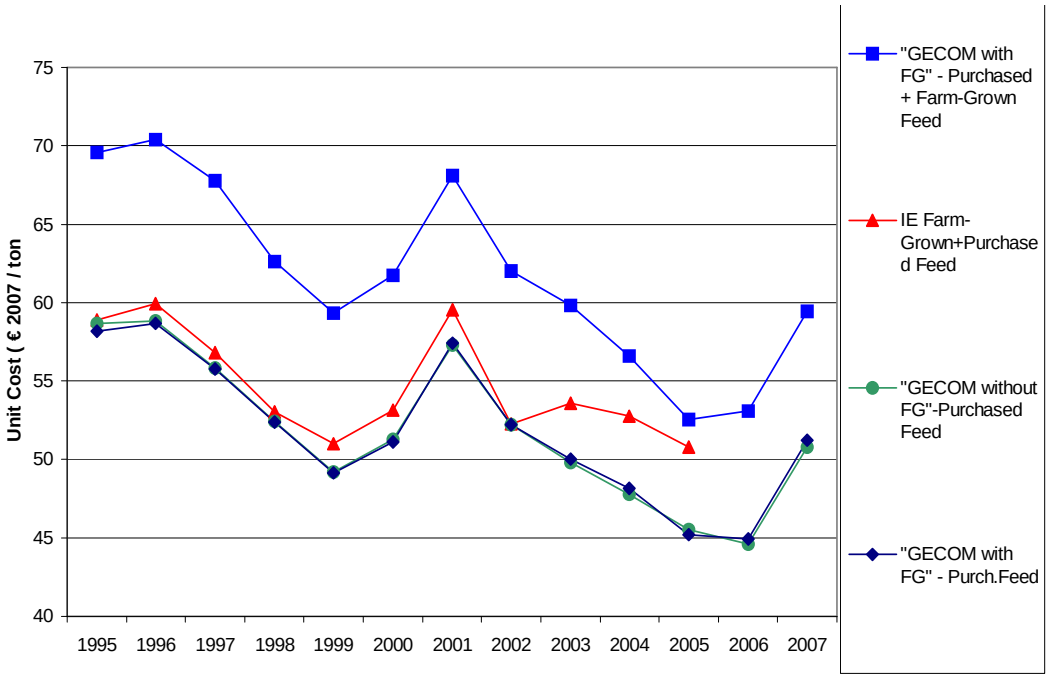
Figure 5-29: Purchased Feed Costs of Cow Milk over the 1995-2007 Period.



Source: EU-FADN - DG AGRI L-3, French FADN-SSP & IE Surveys.

In order to assess the impact of taking in account the farm-grown consumption of feed with the new GECOM specification, we compare the different GECOM estimates with and without farm-grown consumption (Figure 5-30). Over the 1990-2007 period, the Farm-Grown Feed cost is about 16% of the Purchased+Farm-Grown Feed cost (i.e. 9.9 € per ton of milk), both estimated according to the "GECOM with FG" specification of the model. While the discrepancy between the Purchased+Farm-Grown Feed estimates with the "GECOM without FG" and the Coutprod estimates of the Purchased Feed are about 16% and 18% (i.e. 11.05 €/ton), respectively. Over the 1990-2005 period, the discrepancy between the IE technical survey results and the "GECOM with FG" for the Purchased+Farm-Grown Feed is about 12.8% (i.e. 8.07 €/ton). Except for the 2005-2006 years, the IE results are nearer from the Purchased Feed estimates. The Purchased+Farm-Grown Feed estimates of the GECOM with FG model are very highly correlated with the Purchased Feed Coutprod estimates and to a lesser extend (r=0.9) with the IE Purchased+Farm-Grown Feed results, due to the impact of the drought on 2003 (we have to bear in mind there is no climatic information in the specification of these models which are only based on input/output information).

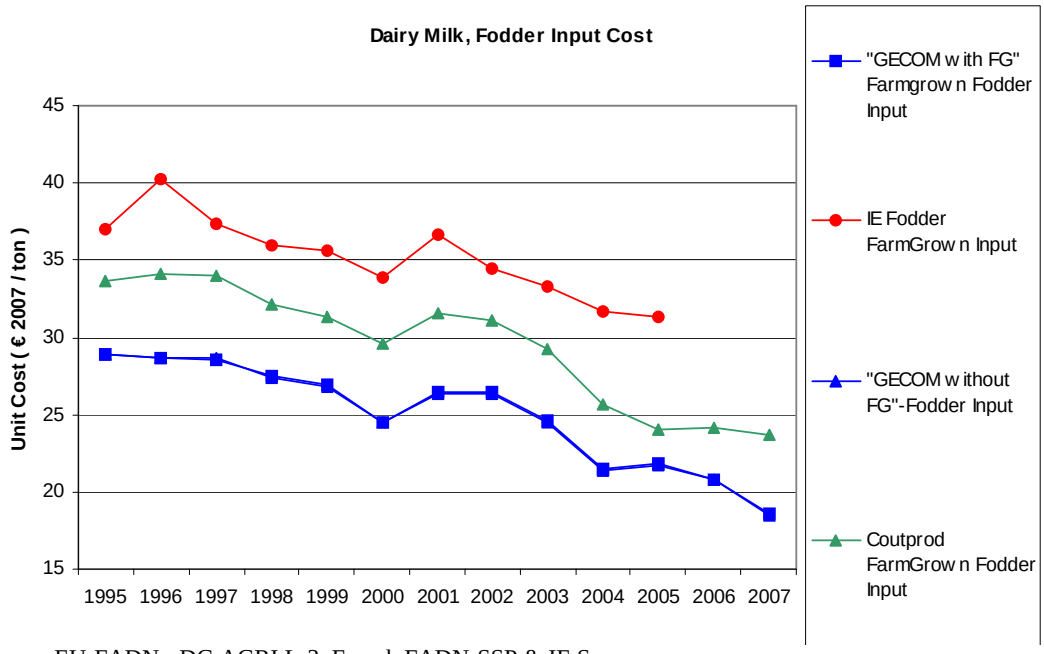
Figure 5-30: Purchased+Farm-Grown Feed Costs of Cow Milk over the 1995-2007 Period.



Source: EU-FADN - DG AGRI L-3, French FADN-SSP & IE Surveys.

The "GECOM" Farm-Grown Fodder Input cost estimates (which are almost identical between the "with FG" and "without FG") are lower than the Fodder Input cost estimates of the Coutprod model by 4.33 €/ton (about 17%), but very highly correlated (r=0.98) over the 1990-2007 period (Figure 5-31). The correlation with the IE technical survey results is high (r=0.92) although they are higher than the GECOM estimates close by twofold the previous discrepancy: 9.22 €/ton.

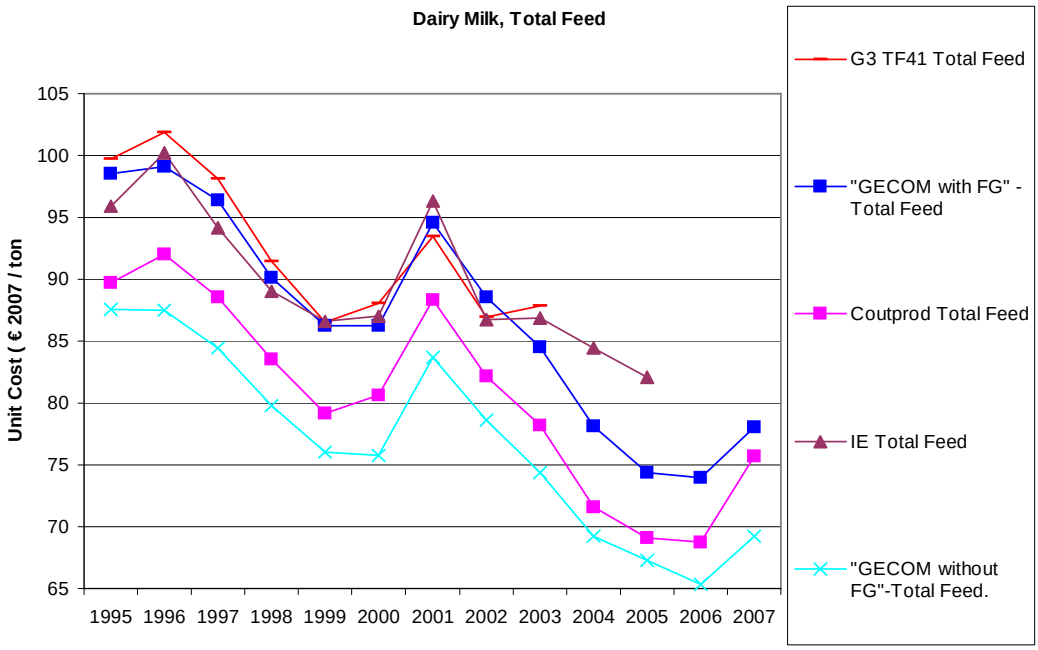
Figure 5-31: Fodder Input Costs of Cow Milk over the 1995-2007 Period.



Source: EU-FADN - DG AGRI L-3, French FADN-SSP & IE Surveys.

Comparing the 'GECOM with FG' Feed Total Cost estimates with the results issued from the IE technical survey (Figure 5-32) is quite satisfactory: over the 1995-2003 period, the gap between the two is less than 1.3% and the correlation coefficient is high (r=0.94) 'GECOM with FG' Feed Total Cost. Over the 1995-2005 period, the TF41 estimates are even better correlated (r=0.96) and the departure from the 'GECOM with FG' Feed Total estimates is about 1.2%. The deviations with other estimates are greater: the Coutprod estimates are lower than the 'GECOM with FG' Feed Total estimates by 7.2% (a nearly perfect correlation at a r=0.99 level), even by 11.5% for the 'GECOM without FG' Feed Total estimates (highly correlated at a r=0.94 level).

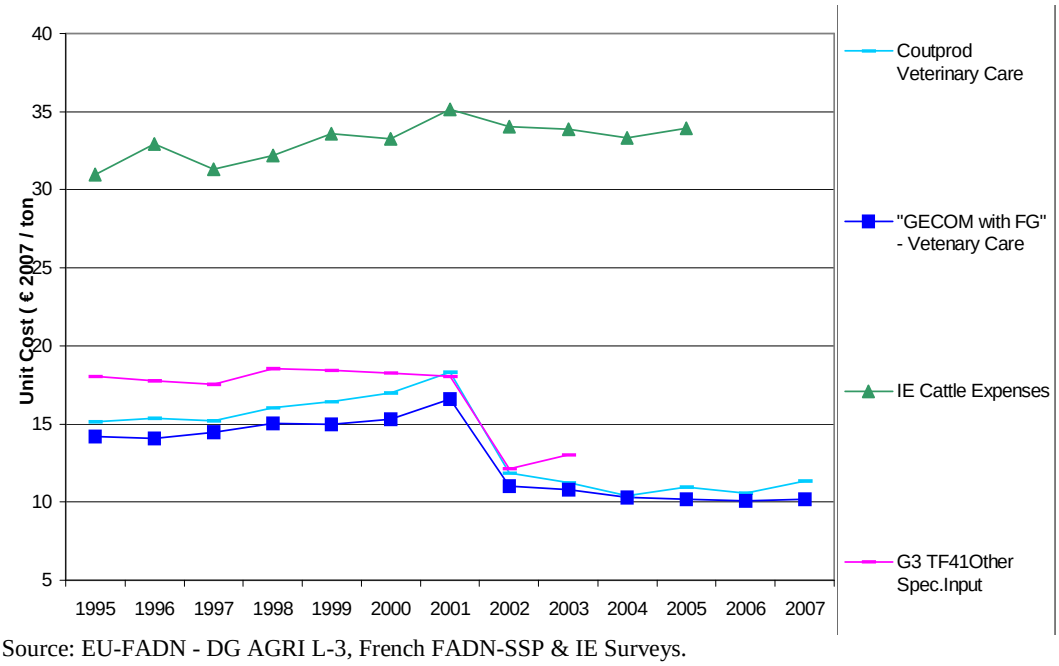
Figure 5-32: Total Feed Costs of Cow Milk over the 1995-2007 Period.



Source: EU-FADN - DG AGRI L-3, French FADN-SSP & IE Surveys.

The 'GECOM without FG' Veterinary Care Cost estimates are practically equal to the 'GECOM with FG' estimates (Figure 5-33). Outside from this, the best correlated series estimates with the 'GECOM with FG' Veterinary Care Cost estimates are the Coutprod Veterinary Care estimates (r=0.99), which is greater by 7.6%. The nearest estimates are those for the Other Specific Input (including Veterinary Care), given by the EU-G3 study on the type of farming specialized in dairy milk production (TF41): they are higher than the 'GECOM with FG' Veterinary Care Cost by 20% over the 1995-2003 period and correlated with at a r=0.92 level. The Cattle Expenses results issued from the IE technical survey, although they include veterinary cares, seem to be not related to the 'GECOM with FG' Veterinary Care Cost, since they are too poorly correlated with (r=-0.18) and they are valued at more than two-fold the level of the GECOM estimates.

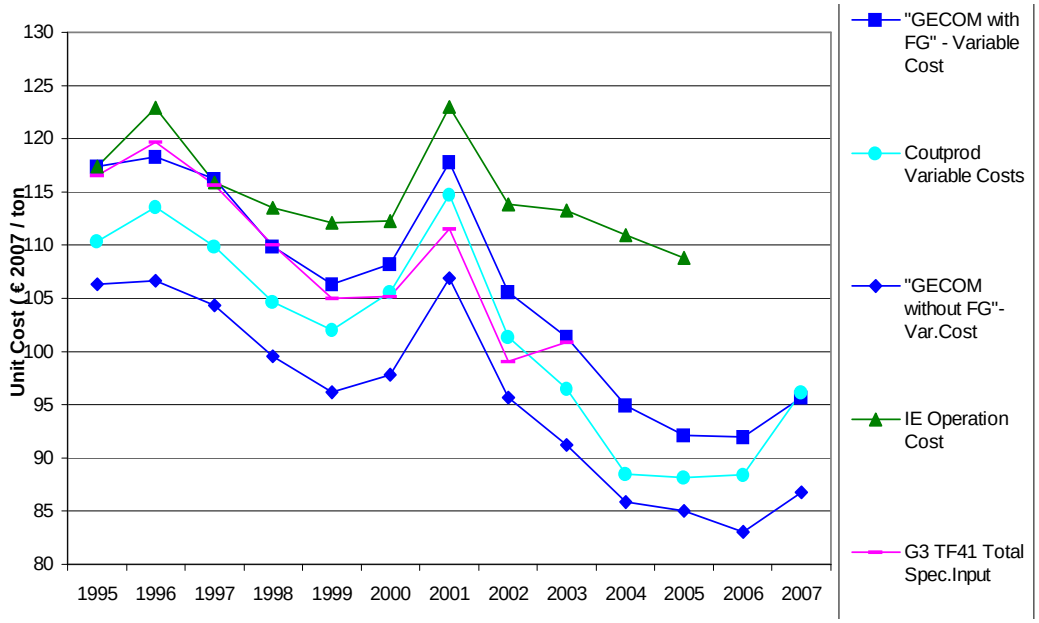
Figure 5-33: Veterinary Care Costs of Cow Milk over the 1995-2007 Period.



Source: EU-FADN - DG AGRI L-3, French FADN-SSP & IE Surveys.

Even if the 'GECOM without FG' Variable Cost estimates are 9.5% lower than the 'GECOM with FG' estimates, they are perfectly correlated (Figure 5-34). The Coutprod Variable Cost estimates are the best correlated series estimates with the 'GECOM with FG' Variable Cost estimates (r=0.98), which is greater by 4.1%. The nearest estimates are the Total Specific Input estimates given by the EU-G3 study on the type of farming specialized in dairy milk production (TF41): they are lower than the 'GECOM with FG' Variable Cost by 1.7% over the 1995-2003 period and correlated at a r=0.92 level. The results issued from the IE technical survey for Operation Cost are higher than the 'GECOM with FG' Variable Cost, by 6.4% and well correlated with (r=0.85).

Figure 5-34: Variable Costs of Cow Milk over the 1995-2007 Period.

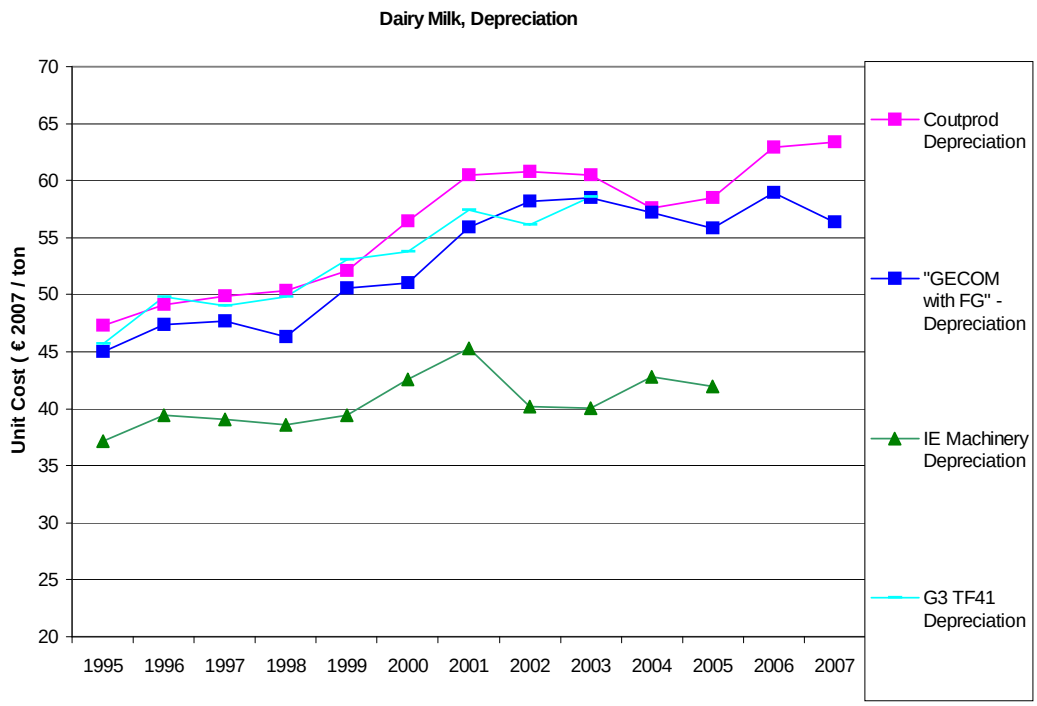


Source: EU-FADN - DG AGRI L-3, French FADN-SSP & IE Surveys.

5.3.5.2 The structure cost estimates of dairy milk

From the IE surveys, the depreciation and the land are the cost items for fixed inputs that can be reasonably compared to the model estimates. Interpreting differences between the IE results and the model estimates, it has to be kept in mind that the depreciation rule into the FADN is a linear one but into the accounting data into the IE surveys are not submitted to such a rule. For the depreciation costs, the 'without FG' GECOM estimates are equivalent to the 'with FG' GECOM estimates (Figure 5-35). The Coutprod Depreciation estimates are 5.9% higher than the 'with FG' GECOM estimates and correlated with, at the r=0.95 level. Over the 1995-2003 period, the G3 estimates for the Depreciation Cost of the specialized type of farming (TF 41) are 2.8% higher than the 'with FG' GECOM estimates and correlated with at the same level. Because they do not take in account building depreciation costs, the IE results for Machinery Depreciation are 22% lower than the 'with FG' GECOM estimates and correlated with to a lesser extend (r=0.64).

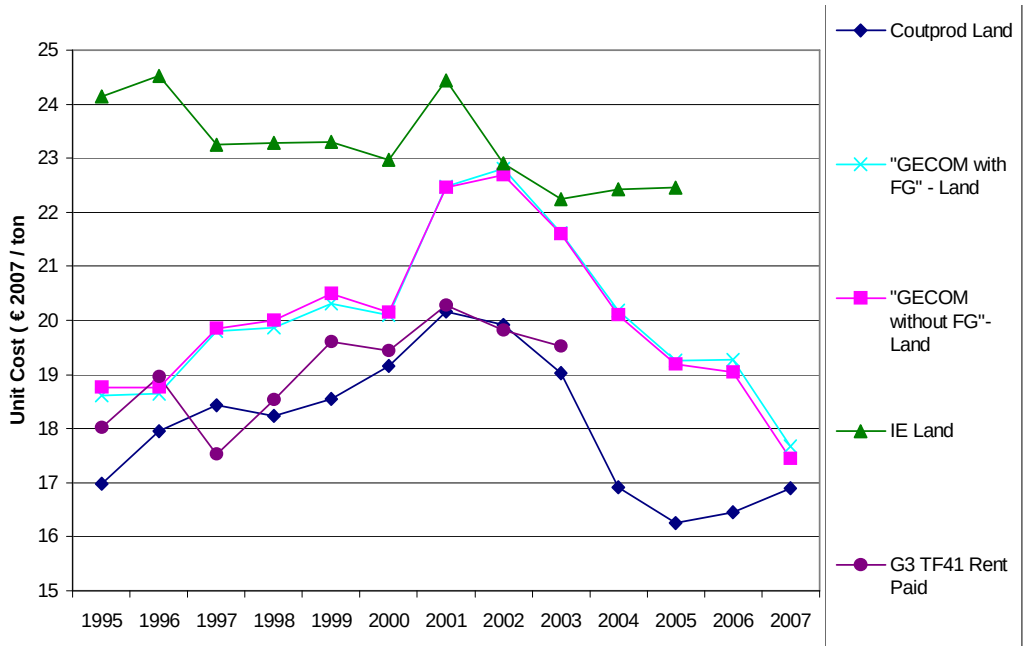
Figure 5-35: Depreciation Costs of Cow Milk over the 1995-2007 Period.



Source: EU-FADN - DG AGRI L-3, French FADN-SSP & IE Surveys.

The 'without FG' GECOM estimates of the Land cost are almost identical to the 'with FG' GECOM estimates (Figure 5-36). The Coutprod Land estimates are 9.8% lower than the 'with FG' GECOM estimates and correlated with at the r=0.81 level. The G3 Rent Cost estimates for the specialized dairy farms are 6.8% lower than the 'with FG' GECOM estimates and correlated with at the r=0.73 level over the 1995-2003 period. However, the Land cost results of the IE technical survey are poorly correlated (r=-0.21) with the 'with FG' GECOM estimates and 14.4% higher in value, over the 1995-2005 period. The between-year variations of the model estimates are far greater than those of the IE technical survey results over the 2000-2007 period and their trend is reverse from the IE technical survey one, over the 1995-2000 period. Hence, the model estimates appear to be not fully consistent with the observed results of IE technical surveys.

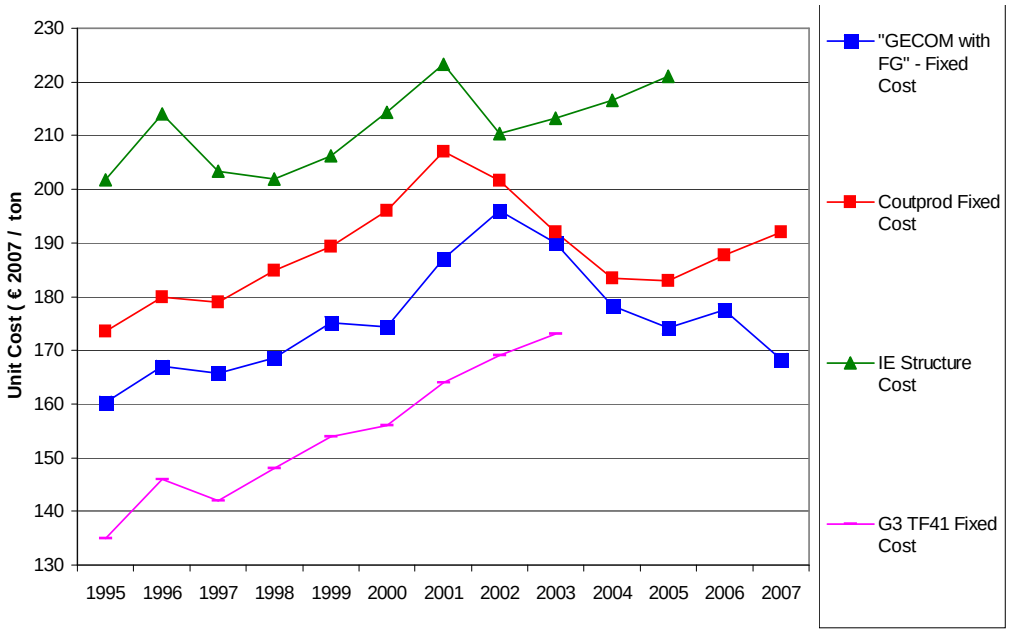
Figure 5-36: Land Costs of Cow Milk over the 1995-2007 Period.



Source: EU-FADN - DG AGRI L-3, French FADN-SSP & IE Surveys.

Summing up all the structure cost (Machinery & Building Up-keeping, Land, Financial Interest, Depreciation, Insurances and Taxes), the Coutprod estimates of Fixed Costs are 9.3% higher than the estimates of the "with FG" GECOM model and well correlated with at the r=0.80 level (Figure 5-37). The G3 estimates of specialized farm holdings (TF41) are the best correlated with at the r=0.96 level over the 1995-2005 period, however they are 10.8% lower than the "with FG" GECOM estimates for fixed costs. The IE technical survey show results 22.4% higher "with FG" GECOM estimates for fixed costs, but moderately correlated with (r=0.49) over the 1995-2005 period.

Figure 5-37: Fixed Costs of Cow Milk over the 1995-2007 Period.

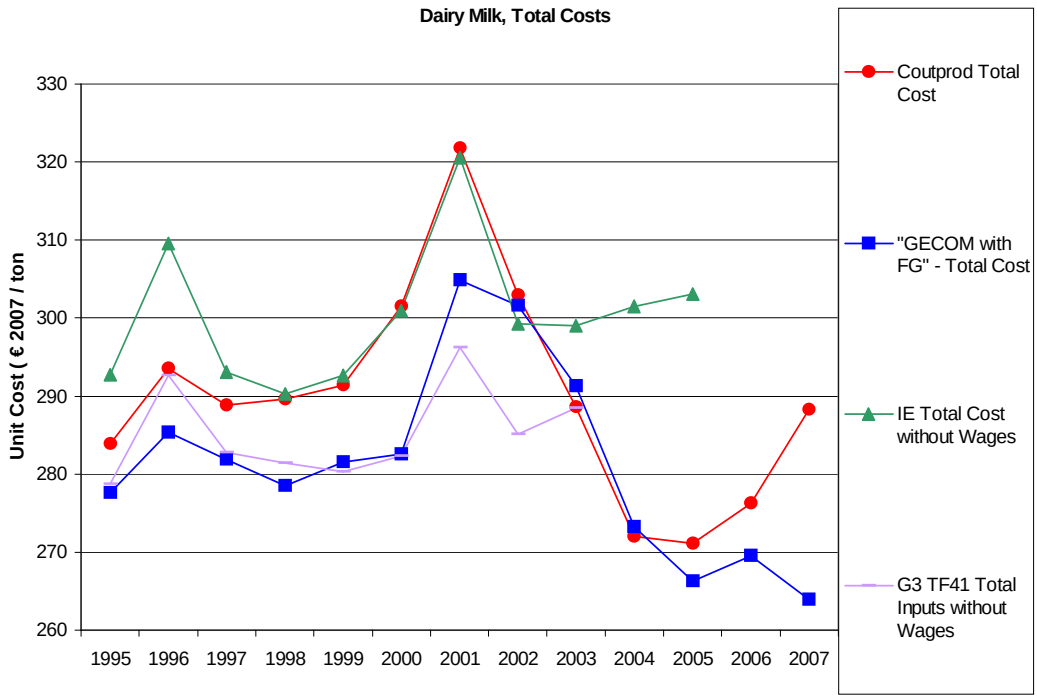


Source: EU-FADN - DG AGRI L-3, French FADN-*SSP* & *IE* Surveys.

5.3.4.3 The total cost and revenue estimates of dairy milk.

For the GECOM and Coutprod estimates, the total cost aggregate is excluding the cost of workforce. Hence, we deduce wages from the IE Total Cost and from the G3 estimates as well before comparison. The Coutprod total cost estimates for dairy milk are 4.2% higher than the corresponding GECOM with FG estimates and correlated with at the r=0.84 level, over the 1995-2007 period (Figure 5-38). The G3 total cost estimates excluding wages for the dairy specialized farm holdings (TF41) are the nearest from the 'GECOM with FG' estimates and correlated with at a lower level (r=0.70), over the 1995-2003 period. Eventually, the IE technical surveys give the results for total cost without wages 6.9% higher than the 'GECOM with FG' estimates, but correlated with at a lower level (r=0.47) over the 1995-2005 period because of a divergent trend from 2003 to 2005.

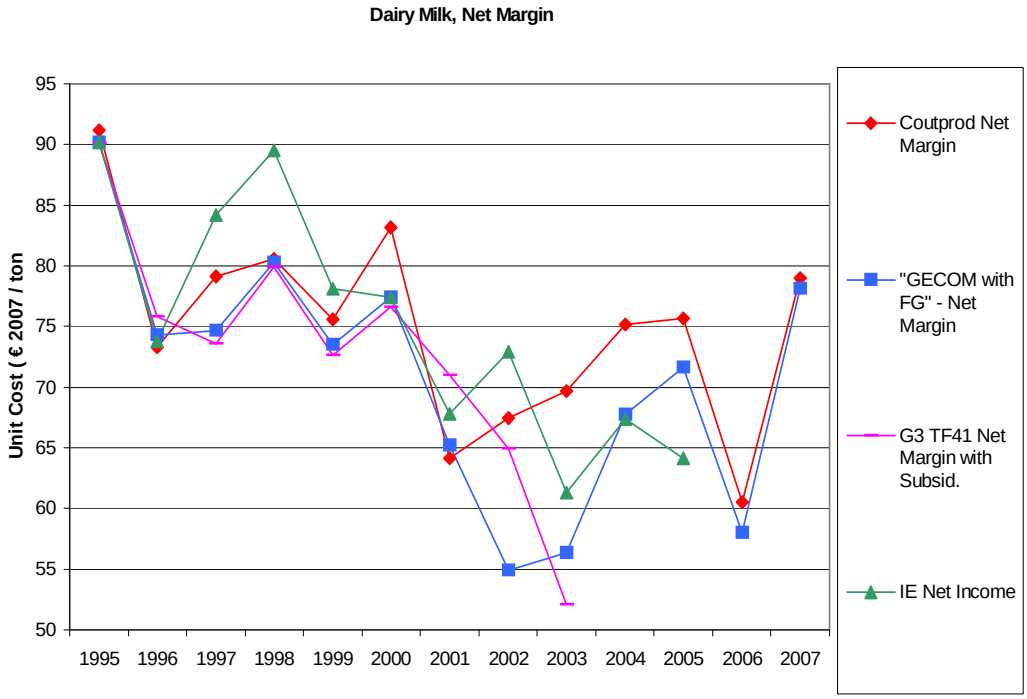
Figure 5-38: Total Costs of Cow Milk over the 1995-2007 Period.



Source: EU-FADN - DG AGRI L-3, French FADN-SSP & IE Surveys.

All the computations of net margin considered for comparison include subsidies received by the dairy milk farm holdings. On the one hand, the GECOM model estimates of the net margin are 5.7% lower than the Coutprod estimates (Figure 5-39) and correlated with at a high level (r=0.89). On the other hand, the nearest estimates are the G3 net margins estimated from the FADN sample of the specialized dairy farm holdings with a 1.5% departure from the 'with FG' GECOM estimates and a correlation coefficient of r=0.93, over the 1995-2003 period. While the results of the IE technical surveys give net income 5.2% higher than the 'with FG' GECOM net margin estimates but correlated with at a lower level (r=0.77).

Figure 5-39: Net Margins of Cow Milk over the 1995-2007 Period.



Source: EU-FADN - DG AGRI L-3, French FADN-SSP & IE Surveys.

6 Results for Bulgarian national FADN

Authors: Dimitre Nikolov, Rumen Popov, Minka Anastasova-Chopeva, Bozhidar Ivanov

Institute of Agricultural Economics, Sofia

Sirak Bahta

von Thünen Institute (vTI), Braunschweig

This chapter describes the results generated by the FACEPA cost of production model, applied to the FADN dataset for Bulgaria. Following a short description of the Bulgarian FADN dataset, estimation results for wheat, cattle and pig production are provided. An attempt is made to determine the changes in the production costs and their five composing elements, to estimate the level of outputs and the revenues and to reveal the financial results for each of these activities. The five cost aggregations are following: variable costs, other variable costs (to avoid one very large variable cost category), more general input costs, depreciation and labour (Table 6-1).

Table 6-1: Cost Items Estimated by the FACEPA Model and Major Aggregation

Cost Aggregation	Individual Cost Item	Description
Variable costs	Purchased Feed	purchased feedstuffs, including concentrated feedstuffs and roughage for ruminants and pigs
	Produced Feed	on farm produced feeds
	Veterinary Costs	other specific animal husbandry cost (
	Seeds	purchased seeds and seedlings
	Fertilizers	fertilizers and soil improvers
	Crop Protection	crop protection products
	Motor Fuel	petroleum products
Other variable costs	Other Energy	goods and services consumed and specific costs as electricity, water and overheads
	Contract Work	including third-party work
	Building Maintenance	current maintenance of buildings
	Machine Maintenance	current maintenance of machinery and equipment
	Other Variable Costs	insurance, taxes other than property taxes, financial charges except interest on property loans
Other inputs	Land Cost	property costs, including farm rents, taxes and interest on loans to purchased land
	Interest	interest on property loans
Depreciation	Depreciation	depreciation of equipment, buildings, plantations and land improvements
Labour	Wages	pay for farm hands
	Family Labour	family compensation

Source: FACEPA Cost of Production Model Documentation

6.1 Data

The Department of Agrostatistics in the Bulgarian Ministry of Agriculture and Food (MAF) is authorized as a liaison agency for the establishment and implementation of

FADN in Bulgaria. The Department determines the way for collection of the data, controls and processes the individual entries and disseminates and publishes the final results in accordance with the EU regulation and national needs. The sample of the FADN in Bulgaria used by the Department is planned to reach up to 2,000 agricultural farms. According to the EU methodology, in the field of survey of FADN are covered farms with market-orientation. Thus, the field of survey in FADN is a subset of all agricultural production units covered by the Agricultural Census held in 2003.

The results from the carried out in 2003, the thorough census of the agricultural households in Bulgaria identifies about 655 000 production units operating throughout country with the average size of the Utilized Agricultural Area about 4.4 ha. In 2007, the conducted survey of the agricultural farm structure shows that their number has reduced by about 25% and average size of the utilized area has risen up to 6.3 ha for 4 years. After an analysis of the farm typology and the gross standard margin of the agricultural farms, there has been decided the field of survey and subset of FADN to encompass all farms with the economic size over 1 economic unit. It represents about one fourth of all operating in the country farms, which compose of 80% out of SGM generated by agricultural producers.

The representative sample of FADN in Bulgaria is planned to attain 2 000 farms distributed evenly regarding their economic size and specialization. The actual implementation of FADN in Bulgaria was set out in 2002 with a pilot survey covering 91 production units. In next years, their number gradually progressed and reaches up to 1916 farms in 2007. In the FACEPA project, the selected FADN dataset covers a 3 year period from 2005 to 2007 due to most reliable and available sources. After accession of Bulgaria in EU during the first three years, 2007-2009, FADN was developed to provide reliable information for the incomes and financial results of the agricultural producers at national level and after 2009, such results must be representative at the regional level. Thus, in the FACEPA project, the regional dimension of the production costs, outputs and incomes are not overviewed. Bulgarian FADN monitors around 25% of the total farms, which produce 80% from the total Standard Gross Margin in the country (Table 6-2).

Table 6-2: Scope and Sample of Bulgarian FADN

Years	**Scope**	**Sample**
2005	118088	946
2006	117939	2000
2007	117793	1916

Source: MAF, Department “Agrostatistics” and own calculations

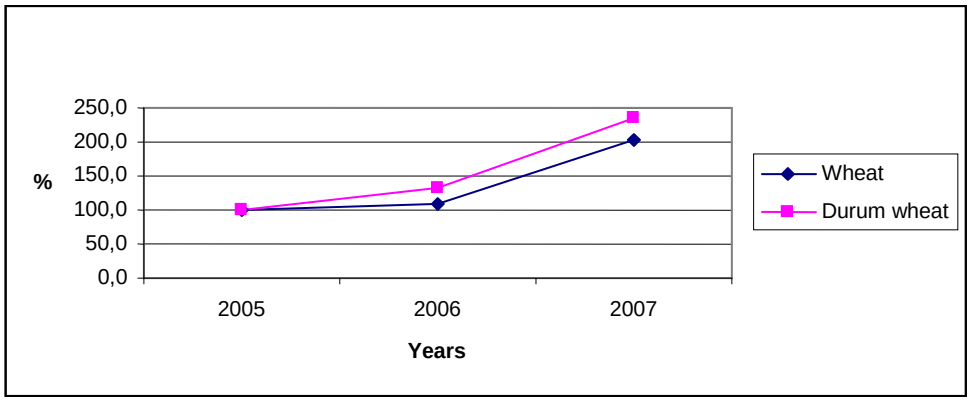
In 2007 the average net income of the farms included in FADN is 5806 Euro. In crop production holdings net income reaches 7783 Euro and in livestock farms it is significantly lower (4132 Euro). The mean net income is highest in farms specialized in growing field crops (8931 Euro), followed by farms with vegetables and mushrooms (5651 Euro). Most low-income farms are growing perennials crops (1933 Euro). Despite unfavourable weather conditions in 2007 net income almost doubled compared to the previous year. This increase was mainly due direct payments received since EU accession. The data show the growing importance of subsidies to Bulgarian agriculture, whose value is rising sharply - from 593 Euro per farm in 2006, to 2836 Euro per holdings in 2007.

6.2 Results

6.2.1 Development of wheat production costs and returns

In a three-year research period, clearly outlined the rapid rise in cost of production of wheat in 2007 over previous two years. The main reasons for this are related to the following facts. Agro-climatic conditions in 2007 were among the worst for Bulgarian agriculture. Particular weather conditions in the winter-spring period had negative effects on growth, especially of winter wheat and barley. Wheat prices during the three-year period 2005-2007 have roughly doubled at the end of 2007 (Figure 6-1).

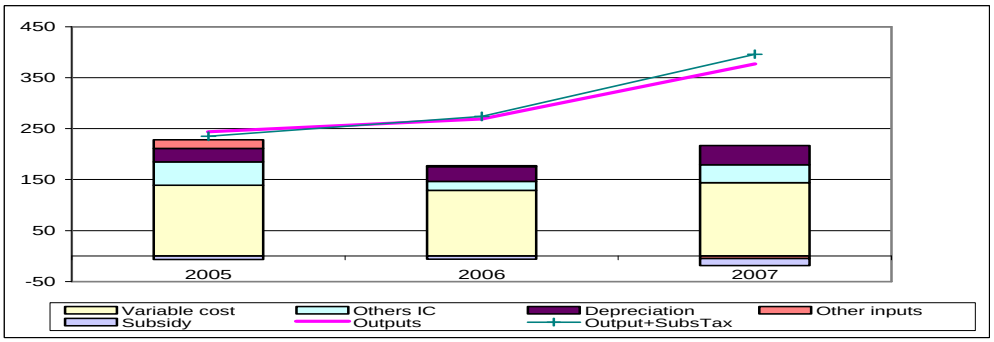
Figure 6-1: Wheat farm gate price indexes



Source: Bulgarian National Statistic Institute (NSI) and own calculations

In 2007, due to dryness, production of cereals marked a decrease of 56 % compared to 2006 due to lower average yields. For example, the average yield of wheat in 2007 with 2.2 ton per ha against 3.4 ton per ha in 2006 (MAF, 2008a). It reduced production of wheat in Bulgaria, has influenced the change of its price to increase, which reached record levels (Figure 6-2).

Figure 6-2: Development of wheat production costs and return, €/t

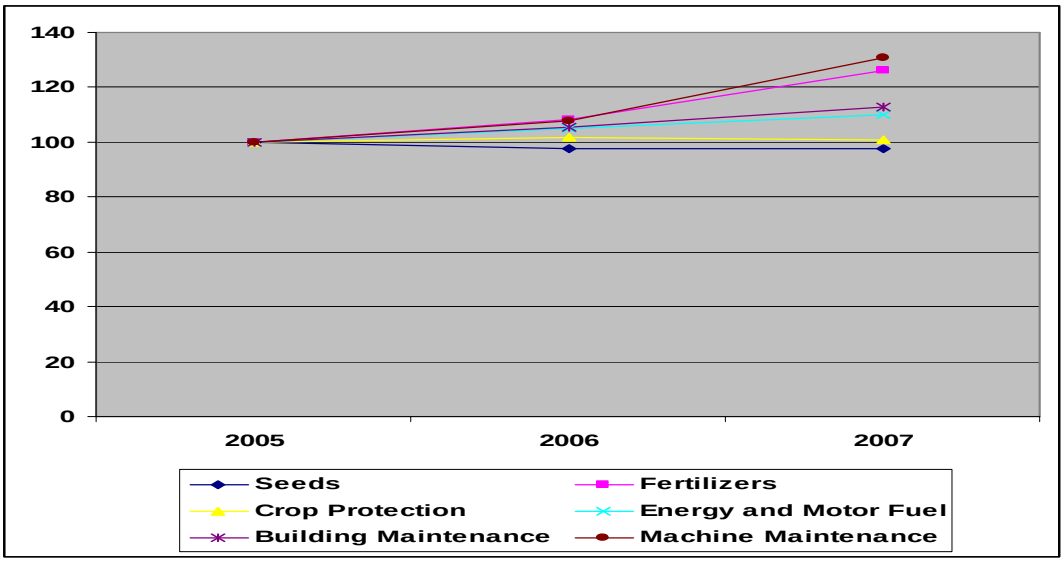


Source: EU-FADN - DG AGRI L-3 and own calculations

The level of the main variable costs in 2007 marks increased by 11.2 percent compared with 2006, while depreciation increased by nearly one third (30.2%). Other variable costs declined strongly in 2006, while in 2007 they again increased and almost reached the level

of 2005. Trends in the change in the level of different groups of costs largely follow the trends of prices of basic variable production cost of wheat (Figure 6-3).

Figure 6-3: Trends of the production costs for wheat production (base 2005 =100%)



Source: EUROSTAT and NSI, Bulgaria, 2009 and own calculations

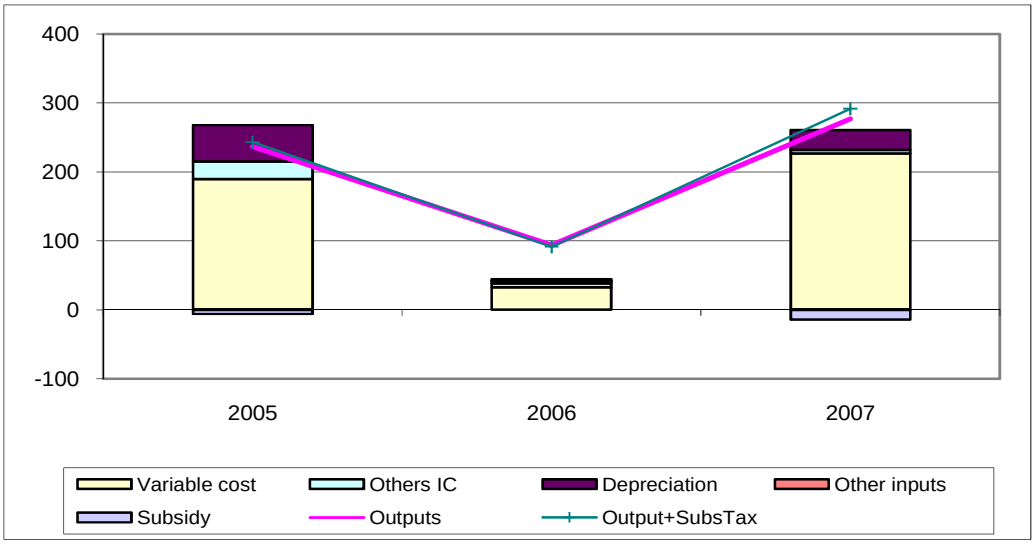
It follows that if a relatively restricted volume and structure of production costs, the main reason for their change in monetary terms is attributable to changes in the level of prices. Significant changes were observed in the other costs in 2006. They significantly decreased compared to 2005 and in 2007.

6.2.2 Development of milk production costs and returns

In Bulgaria, the main dairy livestock includes cows, sheep, buffaloes and goats. Cow milk accounts for 85% of total production, while the second is ranged by sheep milk with around 7% and goat milk with about 7% (MAF, 2007). Bulgaria is a country with very open economy, strongly depending on exports and imports, which on the other hand is unable to influence the prices on the international market (i.e. it is price taker).

The FADN data concerning the production costs and the respective output and return from the dairy farming shows significant fluctuations and volatility over the period 2005 – 2007. As it is seen in Figure 6-4, the output in 2006 is around 33% less out of the average results for the years 2005 and 2007. As for the production costs, their level is 16% less than the costs in other consecutive years 2005 and 2007. The economic and objective explanation of this data discrepancy might not be found. Moreover, a tangible change had happened in 2007, when Bulgaria joined the EU and the inflation increased the prices of dairy products and slowly the farm-gate prices. Thus, the results for 2006 should be considered more or less compatible with this in 2005.

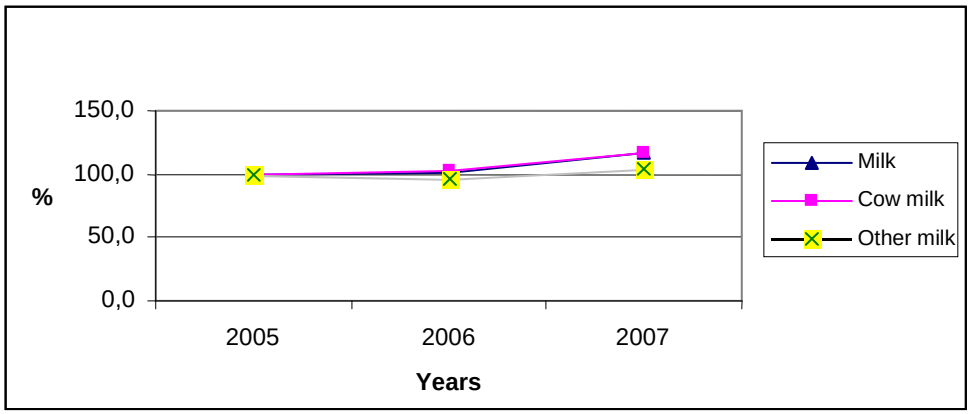
Figure 6-4: Development of milk production costs and return €/ton



Source: EU-FADN - DG AGRI L-3 and own calculations

Regarding the output indicator in 2007 compared with 2005, it is posted an increase by about 17%, which is explicated by the rise of purchase prices in 2007 with 28.5% compared with 2006. The prices of dairy products, like those of all food products, increased with the accession of Bulgaria to the EU. For the whole period 2000 – 2007, the reported increase of the fresh milk reaches 57.9%, which is recorded as the highest increase in the group of dairy products (Figure 6-5).

Figure 6-5: Milk farm gate prices indexes



Source: National Statistic Institute and own calculations

The greatest percentage in the total production costs over the studied period is composed of direct variable costs, as expenditures for feeding veterinary, etc. The highest share of direct variable costs in the total production costs is scored in 2007 with 87%, while in 2005, it is 71%. Depreciation accounts for 20% of total costs in 2005 and 10% in 2007. The depreciation is viewed as a comparatively stable indicator, which must vary not much through the time. The changes twice over two years can be attributed to the writing-off of assets or their devaluation.

The total revenues of the specialized dairy farms in 2007 accounts for a significant increase compared with the revenues in 2005, scoring 40% (Table 6-3). The most considerable increment is reported concerning other revenues about 160% and inflows generated from milk of about 57%. Certain internal changes in the revenue patterns in both years are also identified, as in 2007, the share of inflows from milk mark up for 55% within total revenues, while in 2005, these revenues composed 50%. The increase of total revenues in 2007 compared with 2005 is accompanied with a tangible jump of the production costs. The variable costs risen up by 59% in 2007 juxtaposed with 2005. The most substantial leap in the costs was noticed for livestock feeding, enhanced by 77% in 2007 compared to 2005, and is explained by the universal price increases after accession to the EU.

Table 6-3: Gross margins at Bulgarian dairy farms

Indicators/Years	2005	2007
Number of cows	10	12
Number of sheep	26	36
Yield (kg/cow)	3 593	3 319
Yield (kg/sheep)	83	69
Utilized agricultural area (ha)	6.4	13.4
Values in EUR per 100 kg milk		
Total revenues	**21.78**	**30.66**
- Milk and dairy products	10.98	16.92
- Turnover (calf sales)	8.05	6.93
- Other revenues	2.75	6.81
Total calculated costs	**11.52**	**18.38**
- Feed concentrates	7.06	12.11
- Health care	0.69	0.95
- Other costs	3.78	5.32
Gross margin per 100 kg of milk	**10.25**	**12.28**
Gross margin rate (of return on milk sale)	**0.48**	**0.37**
Gross margin (total revenues less variable costs)	**4 054.90**	**6 442.28**

Source: MAF, Department “Agrostatistics” and field survey and own calculations

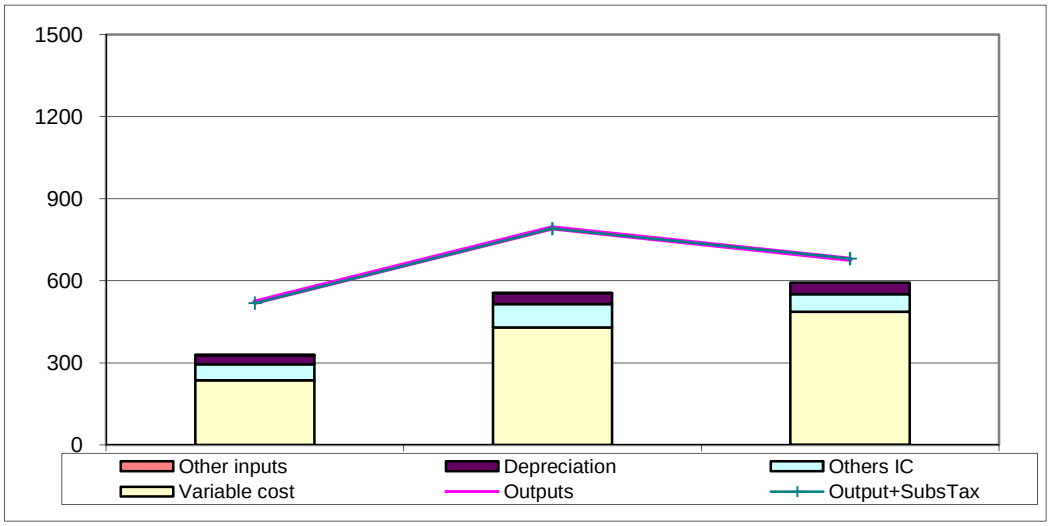
Regarding the results from Figure 6-4 and Table 6-3 can highlight some differences due to the methodology approach. In Figure 6-4, the model of linear input demand has been used for allocation solution of inseparable input costs for each output, while in Table 6-3, the primary data collected from the field survey combined with FADN data were employed to cope with cost allocation problem. However, comparing the total production costs calculated by these two approaches is noticed that deviation is significant reaching up to 138% in 2005 and 41% in 2007, so these costs seem to be overestimated in the linear model. As regards the total revenues and output, in both models are not found significant deflections, as in 2005 by the linear model, the calculated output amounts up to 236.8 Euro/t, whereas in 2005 by another method is equated 217.8 Euro/t. In 2007, the total revenues by survey approach are calculated 11% higher than the linear method. In the same time, the gross margin in dairy farms from Table 6-3 shows an increase in 2007 to 2005 by about 20%, as gross margin rate in 2005 reaches up to 93%, while in 2007, it is 73%. As low as is this rate, as underestimated are milk revenues and gainful are other outputs from dairy livestock.

6.2.3 Development of pig production costs and returns

In 2007 the number of farms raising pigs has decreased by 13.8% compared to the same period of 2006 to 180.7 thousand pigs with an average number of animals 4.9 (at 4.8 in 2006). Farms with 1 to 9 raised pigs decreased by 12.6% and they kept 268 thousand pigs. In the process of consolidation of farms, 62.7 percent of sows are kept mainly in 90 professional farms with over 100 animals, whose number has increased by 45.2% compared with 2006.

A major factor for reduction of pig herds during the year was poor cereal harvest in 2007 which led to a significant increase in cereal prices. Higher feed prices have contributed to increase the cost of manufactured products and thus reduce the efficiency of livestock, including pigs, with the result that most of the pigs were targeted for slaughter. The main factor in forming the cost of pork and products thereof is the price of feed, which occupy a substantial share of the variable cost to feed the animals.

Figure 6-6: Development of production costs and return for pig EUR/livestock unit



Source: EU-FADN - DG AGRI L-3 and own calculations

Unfavorable weather conditions and low cereal harvest in 2007 contributed to the significant rise in prices of feed, which in turn raise the farm gate price. Increase in average prices of animal feed has been registered in all categories of pigs, but most significantly it is in fattening pigs and sows; 35% and 36.3%, reaching respectively 242 Euro / t and 249 Euro / t (Table 6-4).

Table 6-4: Wholesale price of feed

Animals groups	Average 2006	Average 2007	Index 2007/2006
Starter	499	623	125%
Growing up animals	410	522	127%
Fattening pigs	351	474	135
Sows	358	488	136

Source: MAF (2008b), p.17

Despite of the increasing feed prices in 2007, overall prices of pork circulating levels lower than last year. The decline of prices is due to greater domestic demand. The result achieved in twice as large imports of pork during the year compared with 2006 at the same time. The

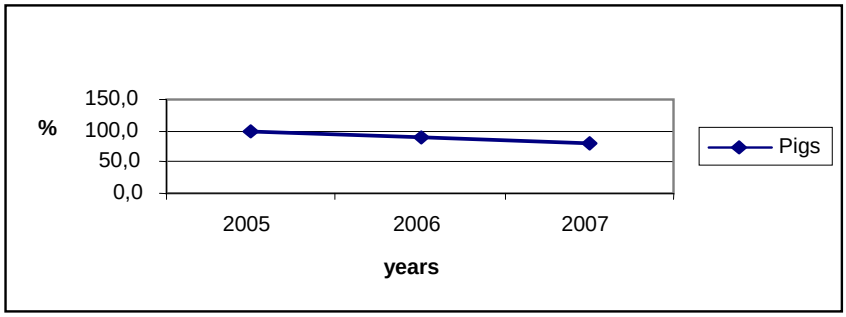
production of pork and its products is very limited, because of the ban on export (due to classical swine fever) in EU countries. In 2007, the largest decrease noted the purchase price of live pigs. The average purchase price of fattened pigs was 0.98 Euro / kg live weight, with 14.7 percent less than 2006 and that of sows declined by 14.5 percent, to 0.78 Euro / kg live weight (Table 6-5 and Figure 6-7).

Table 6-5: Prices of pork meat products

	Average 2006	**Average 2007**	**Index 2007/2006**
Euro / kg live weight:			
Fattening pigs	1,15	0,98	-14.7%
Sows	0,92	0,78	-14.5%
Wholesale price Euro / kg			
Pork skinning	2,62	2,35	-10.4%
Ham	3,49	3,51	-4.4%
Pork neck	3,76	3,84	-2.5%
Retail price Euro / kg			
Ham	3,77	3,60	-4.5%
Pork neck	4,04	3,93	-2.9%

Source: MAF (2008b), p.17

Figure 6-7: Live weight pigs farm gate price indexes



Source: NSI and own calculations

Influenced by the reduction in the farm gate prices the average wholesale and retail pork prices also decreased. The decline ranged between 2.6% and 10.4% for various cuts on an annual basis, the greater the reduction in wholesale prices. After the decline observed during the first 6-7 months of 2007, by year-end prices gradually increase. This increase is due to the appreciation of feed, fuel and electricity, leading to increased production costs, respectively, and output.

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