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A Handbook on the use of FADN Database in Programming Models

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A Handbook on the use of FADN Database in Programming Models

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Extended Summary

The main objective of the current report is to provide a guideline on how the farm accountancy data network (FADN) can be employed in mathematical programming models. The reader of this report is introduced to the FADN database to become familiar with the underlying rules and specific issues.

Chapter 1: The FADN data mining tool

- All extraction rules proposed in the deliverable were also programmed and realized in the software packages language GAMS embedded in the FADN data mining tool. The tool is intended to guide the user in selecting the desired data to be analyzed, to proof the consistency, to view the extracted data in lists or figures, and finally to use the data for further analysis like mathematical programming. A publicly available Java program transforms each original FADN file into a GDX file format, which is the input for the FADN data mining tool.

Chapter 2: Introduction to the FADN accountancy framework

- Since 1990, 274,000 farms contributed in different years to the FADN network. In 1990, 57,615 farms represented a population of 4.15 million farms. It increased due to the enlargement to 78,137 farms and a population of 4.95 million farms.
- Derived from national surveys, FADN is the only source of micro-economic data that is harmonised using bookkeeping principles.
- The FADN sample does not cover all agricultural holdings, but only those which due to their size are considered to be commercial.
- The methodology applied aims to provide representative data at three dimensions: FADN region, economic size (ESU) and type of farming (TF).
- The accounting and recording principals of the FADN are specified under EU regulations, but the data is collected by MS organizations.
- The FADN consists of two parts: The first comprises the accountancy data complemented with non-monetary production data and is organized in a collection of tables as outlined in the document RI/CC 1256 (rev. 7) (2011). The second part comprises standard results (also known as SE variables).
- The first row of the FADN data file (CSV) lists the variable names and the remaining rows are the accountancy values per farm. The variable names are described in RI/CC 1256 (rev. 7) (2011) and RI/CC 882 (rev. 9) (2011).
- The main objective of FADN is to evaluate policy initiatives and decisions in the framework of the Common Agriculture Policy (CAP) with respect to the development of income.

- A number of issues have arisen with FADN and the data derived from it: The main issues are representativeness of the sample in general and with respect to certain data items and sub-samples, and the quality of the sampling process. Specifically, there are questions about the size of the sample and whether it is capable of producing reliable information at a sub-national level. In addition, a big question is how the data are collected and by whom, and whether the methods employed introduce a selection bias.

Chapter 3: Parameterisation of Mathematical Programming models

- At the time this report was completed, no final decision about the structure and level of aggregation of the mathematical programming (MP) model was made.
- We assume that the model should be specified as close as possible to the specification given in the FADN database. The production activity plays a central role as decision variable. It is characterized by producing outputs and using inputs and is restricted by resource constraints such as land or production rights.

Chapter 4: Parameterization of models using FADN

Land use activities

- We first present the extraction rules for crop production activities, to be specific for land use area, output quantities and total production value. All the information is derived from the Table K. All the crop production activities are classified into seven aggregated categories.

Animal production

- We present the extraction rules for herd sizes, livestock production value, animal products and the change of livestock value.
- The information for herd size is derived from Table D. The calculation of total production value from animals is calculated from three positions: For livestock production (animals produced) the information comes from Table E, for animal products (like milk and wool) Table K and for changes of livestock value from Table D.

Input costs

- Costs are entered in monetary terms and are not recorded for specific crop and animal activity which results in relatively simple extraction rules. The information about cost is given in Table F and G.
- The total costs consist of total specific costs, total farm overhead, depreciation and the total external factors.
- Information for gross and net rent is derived from Table F, L and B; information for the value of owned land is derived from Table B and G.

Grants and subsidies

- The Common Agricultural Policy evolved from a system of market support to a system of direct payments. These direct payments were coupled to the production, which biased the economic incentive and distorted markets.
- The main challenge for developing the extraction rules is to link the decoupled payments to the production activities, inputs or products. The decoupled payments of the Single Payment scheme and all payments for rural development are accounted as a payment to the farm.
- The total subsidies excluding own investments consists of total subsidies on crops and livestock, other subsidies, support payments related to Article 68, total support for rural development, subsidies on intermediate consumption and on external factors, as well as decoupled payments.
- The information for grants and subsidies is derived from Table J. The amount of total subsidies increased over the years. From 2004, the amount of decoupled payments increased and at the same time the total coupled subsidies on crops declined, a consequence of the implementation of the MTR. Decoupled payments became the biggest part in the budget of grants and subsidies in the EU-27.

Income

- Gross farm income is the main income category and is calculated from the sum of total output and total subsidies, deducting total intermediate consumption, total farm overhead, taxes and VAT balance.

Comparing standard results

- For the standard results, which are also known as SE variables, the formula for outputs, costs, subsidies and income are given in RI/CC 882 (rev. 9) (2011). The formulas identify the single positions in the FADN tables for every standard result. We recalculate in the FADN data mining tool these standard results as control variables from the relevant positions in the FADN tables and compare these values with the given standard results.
- This exercise is done to verify the developed extraction rules and to obtain an overview regarding the quality and consistency of FADN.
- The comparison of the control standard results with the given standard results for inputs, subsidies and income at EU level revealed that the single bookkeeping positions are very close to the standard results.
- The comparison analyzed at MS level revealed some deviations for total subsidies for Portugal, Sweden, Ireland, and The Netherlands, caused by missing data of the given standard results of “other rural development payments” before 2004.
- We also found some deviations for the calculation of total output for Austria, Portugal and The Netherlands.

Constant sample

- A high number of observations with a constant sample over time are important for different estimation approaches. However, from 57,615 farms in 1990 only 1,419 are recorded over the complete time series until 2008. Changes in the definition of the farm keys in Belgium, parts of Germany, the Netherlands, UK, Italy and Portugal are the reason that no constant sample over a longer period can be observed.

Chapter 5: Conclusion

- Quantities and yields for fodder maize and particularly for pasture are not consistent. To improve the yield data, animal requirements or other statistics should be considered to complement FADN.
- The information in FADN does not allow all information to be linked directly to the animal activities, but has to be distributed over the production activities using the animal shares within the category as an example.
- Inputs are only recorded as total expenses at farm. Production activity specific input costs cannot be observed and have to be estimated.
- One task was to implement the extraction rules into a software tool to proof and validate the content of the FADN database. Because of the time constraints of the project and the requirement that other FADNTOOL partners should be able to work and use the tool later on, we had to build upon already existing and open source software solutions.
- We decided to program all the extraction rules in GAMS, which is a standard software for data manipulation and optimisation problems. Parallel processing was applied to process the extraction rules in an acceptable execution time. All the results are stored in a GDX file format, which can easily be accessed as input by other partners.
- To view the results, we set up the exploitation tool and defined predefined views and tables. The viewer is part of the GAMS Graphical Interface Generator (GGIG). The predefined views are structured similarly to this document; however, they allow data to be analyzed by pivoting, by sorting and by applying descriptive statistics.
- We also added a heat map chart, which, together with a ranking routine, was mainly used to analyse the evolution of farms over time.
- With the work of this deliverable the extracted information for activity levels, total production value, supply, yield and product prices of the crop and animal production activities can be used to feed the farm level models.
- The costs have to be allocated to the crop and animal production activities. Therefore, the input allocation approach (Gocht, 2010) will be used and expanded to EU-wide application.
- The “robust models” for the project will be developed by combining the results of the FADN data converting tool and the input allocation estimates and using the CAPRI farm type layer approach (Gocht and Britz, 2011).

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Acronyms

BuR	Bulgaria and Rumania
CAP	Common Agricultural Policy
CAPRI	Common Agricultural Policy Regional Impact Modelling System
CSV	Comma Separated Values file format
DG AGRI	Directorate-General Agriculture
ESC	Economic Size Class
ESU	Economic Size Unit
EU	European Union
EUR	Euro
EUROSTAT	Statistical Office of the European Communities
EU-02	Bulgaria and Romania
EU-10	Member States that joined the European Union on 1 May 2004
EU-15	Member States of the European Union before 1 May 2004
EU-25	Member States of the European Union before 1 January 2007
EU-27	European Union after the enlargement on 1 January 2007
FADN	Farm Accountancy Data Network
FSS	Farm Structure Survey
GAMS	General Algebraic Modelling System
GDX	Exchange format for GAMS
GGIG	GAMS Graphical Interface Generator
GUI	Graphical User Interface
LU	Livestock Standard Unit
MP	Mathematical Programming
MS	Member State(s)
MTR	Mid-Term-Review
NMS	New Member State(s)
NUTS	Nomenclature of Territorial Units for Statistics
NUTS I	Nomenclature of Territorial Units for Statistics Level 1
NUTS II	Nomenclature of Territorial Units for Statistics Level 2
REGIO	Abbreviation for the regional domain at EUROSTAT
RICA	Réseau d’information comptable agricole
SGM	Standard Gross Margin
TF	Type of farming
UAA	Utilised Agricultural Area

0 Introduction

The current report provides a guideline on how the Farm Accountancy Data Network (FADN) can be used to parameterize mathematical programming models. Compared to other literature in this field (Barkasz et al., 2009; Delame and Butault, 2010; Hansen, 2009), we aim not only to describe but also to evaluate the extraction rules, which define the path from the accountancy tables in FADN to the parameterization of farm models. Therefore, all extraction rules proposed in the deliverable were also programmed and realized in the software packages language GAMS[1] and are provided in the annex. The derived modelling parameters are made visible using the Graphical Interface Generator (Britz, 2010; Britz, 2011). All figures in this report are taken from this software tool. The Deliverable 4.1 is structured as following: Chapter I explains the need for the data mining tool developed for this deliverable. It includes a brief introduction on how the software tool can be applied. Chapter II points out the conceptual approach of FADN and its underlying database. It explains the relation of FADN variables to the corresponding positions in the FADN tables. The description of income calculation follows a discussion about potential problems when building up simulation models based on FADN. A general concept of a mathematical programming model and the necessary parameters are discussed in Chapter III. Chapter IV presents the extraction rules. To detect problems all rules are implemented and applied in the Data Mining Tool. The chapter starts by explaining the extraction rules for crop and animal. Then the rules for costs, grants and subsidies and income are provided. Each section is complemented with maps or charts automatically generated from the tool. Furthermore, we use the formula from the official regulation RI/CC 882 to calculate the standard results. We compared those standard results with given standard results from the FADN database. Detected inconsistencies are also reported. In addition, we present a statistic on to what extent the FADN database can be used to derive a constant sample. The last chapter draws conclusions and discusses further necessary steps to build upon the extraction rules results to a fully parameterized MP model at the farm group level. The results of the extraction rules in the current version of Deliverable 4.1 are based on the FADN database provided 2011 by DG-AGRI under the Agreement Number 265616 for the FADNTOOL project. The database included all variables at single farm record for all available Member States in the years from 1990 to 2008.

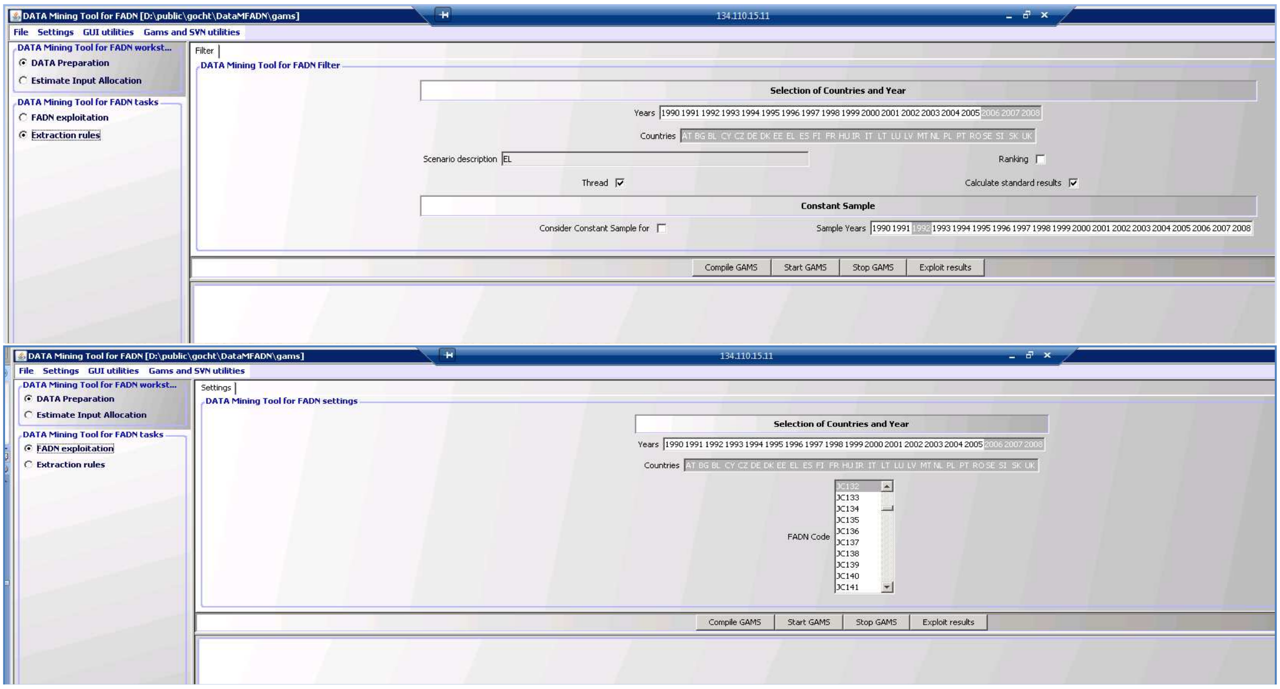
[1] General Algebraic Modeling System http://www.gams.com/

1 The FADN data mining tool

The data of the FADN database is provided in a comma separated values file (CSV) format. Each file comprises the data for a certain country and a certain year. The first row of the file lists the variable names abbreviated by prefix and suffix defined by each FADN Table. The following rows consist of alphanumeric values for every variable if recorded.

A publicly available Java program[2] transforms each file into a GDX file format (Gocht, 2009) which is the input file format for the FADN data mining tool. The FADN Data mining tool is based on the GAMS Graphical Interface Generator (GGIG) (Britz, 2010, Britz, 2011) and applies the developed extraction rules to the FADN database[3]. To make it more developer-friendly, the user can apply the extraction rules to different countries and years depending of their interest as presented in the next figure:

Figure 1: Screenshot of the FADN Data Mining Tool – Task extraction rules and FADN exploitation



Source: FADN data mining tool (FADN, 2011).

2 https://svn1.agp.uni-bonn.de/svn/ft_fadn_csv_gdx/trunk

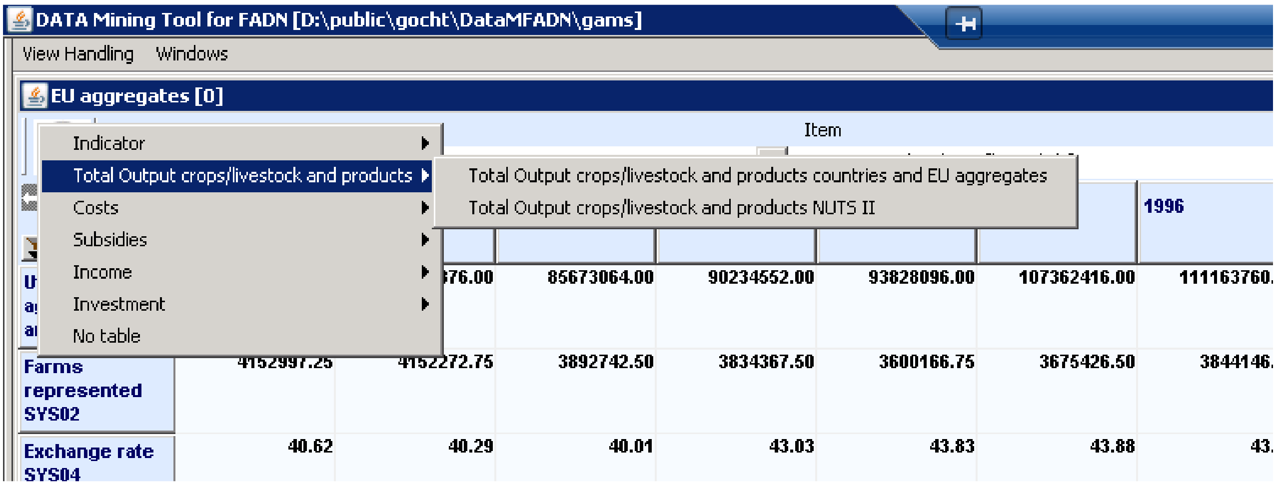
3 The GUI can be downloaded from https://svn1.agp.uni-bonn.de/svn/capri/trunk/GUI. To open the GUI for the Data mining Tool DataMFADN.bat should be used.

The data mining tool starts the program in which the extraction rules are implemented.[4] To provide an overview of the rules and to detect possible problems, the FADN data mining tool also aggregates, in addition to the single farm level, all parameters at different regional levels such as farm type, ESU, NUTS II, MS and EU.

In order to access the original FADN data base for all countries and years for a selection of variables there also consists a FADN exploitation task in the as shown in Figure 1.

The parameter can be accessed for a top down analysis using predefined tables as outlined in Figure 2. It also can show the parameters in the form of an EU-wide map.

Figure 2: Screenshot of the predefined tables



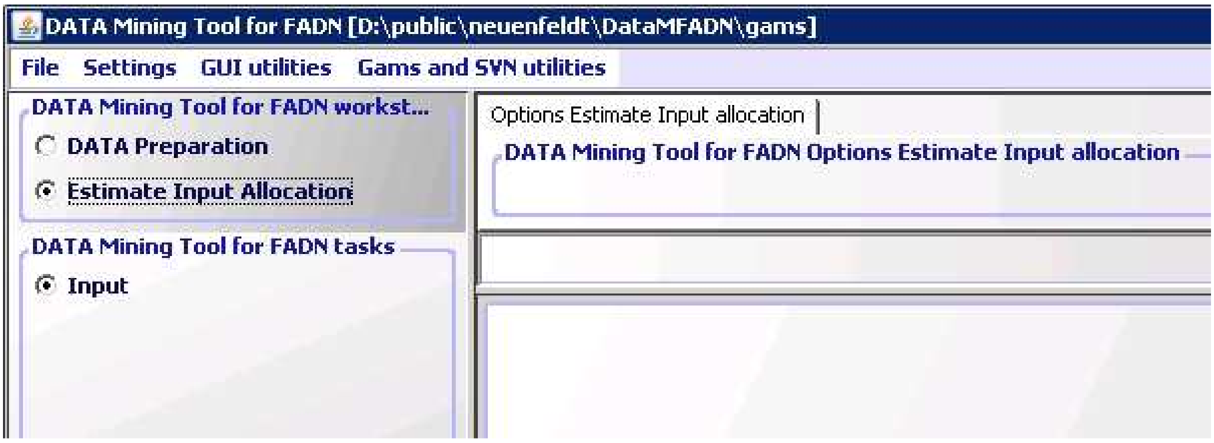
Source: FADN data mining tool (FADN, 2011).

For an analysis at the farm level a heat map was introduced in the tool which can be used to analyze the complete sample farms of a certain indicator over time. To complement the parameters defined from the extraction rules, the data mining tool also gives information on some general indicators such as total utilized agricultural area, farms represented, etc. and all standard results.

Within the FADNTOOL project it is foreseen to extend the FADN data mining tool with work step component which estimates variable input costs (Figure 3). This component takes the result of the extraction rules as input data. Furthermore, it is planned to host the farm simulation engine within the setting.

[4] The GAMS files related to the extraction and aggregation can be found and downloaded from: https://svn1.agp.uni-bonn.de/svn/FADNTOOL/trunk

Figure 3: Screenshot of available optional work steps



Source: FADN data mining tool (FADN, 2011).

In summary, the data mining tool is intended to guide the user in selecting the desired data to be analyzed, in proofing the consistency, in viewing the extracted data in lists or figures and finally in using the data for further analysis like mathematical models.

2 Introduction to the FADN accountancy framework

2.1 Introduction

The Farm Accountancy Data Network of the European Union (FADN or RICA in French, short for “Réseau d’information comptable agricole”) was established in 1965 (Council Regulation 79/65). The aim of the network is to collect accountancy data from farms for the determination of incomes and business analyses of agricultural holdings. Table 1 summarizes some indicators obtained from the FADN database. Since 1990, 274,000 farms contributed to the network in different years. In 1990, 57,615 farms represented a population of 4.15 million farms. These numbers increased due to the enlargement of the EU to 78,137 farms and a population of 4.95 million farms. If one corrects for the effect of the enlargement the total number of represented farms declines, reflecting the ongoing process of structural change. As a result, the average farm size increased from 20 ESU (Economic Size Unit) in 1990 to 30 ESU 2008. This figure fluctuates at the aggregated EU level, due to the inclusion of Austria, Finland, Sweden and East of Germany in 1995, the enlargement in 2004 by the EU-10 and in 2007 by Romania and Bulgaria. It is further influenced by the continuous increase of applied thresholds, defining the minimum size of a farm considered in the sample, which varies according to the agricultural structure from one country to another.

Table 1: Summary FADN database for the EU-27 over selected years

	1990	1993	1996	1999	2002	2005	2008
Farms represented	*4,152,997*	*3,834,367*	*3,844,146*	*3,669,180*	*3,042,444*	*4,136,547*	*4,954,812*
Livestock Units per 100 ha Utilised Agricultural Area (UAA)	103	91	85	86	86	79	78
Sample farms	*57,615*	*56,529*	*58,347*	*58,599*	*58,487*	*76,555*	*78,137*
Average Economic size unit (ESU)	20	23	27	31	38	33	30
UAA in million ha	93	93	111	111	107	139	158
Rented UAA % Share on UAA	47	46	50	50	52	51	53

Source: FADN data mining tool (FADN, 2011).

2.2 The sampling approach

Derived from national surveys, FADN is the only source of micro-economic data that is harmonised using bookkeeping principles across the EU-27. Holdings are selected to take part of the survey on the basis of sampling plans established at the level of each FADN region (see

Appendix) using the information of the population from the Farm Structure Survey (FSS[5]). The FADN sample does not cover all agricultural holdings but only those which, due to their size, are considered to be commercial. The methodology applied aims to provide representative data along three dimensions: FADN region, economic size and type of farming (FT). The size of a farm is measured in Economic Size Units (ESU), which is the total standard gross margin (SGM), as sum of all production activities times the SGM in the region in which the farm is located, divided by a constant value of 1,200 EUR. The SGM for the production activities are provided by EUROSTAT, but calculated by the member states. The SGM reflects the value added per production activity to the economic performance of a farm. It is regionalized and also depends on the less favoured status of a region. The SGM depends on the prices and coupled premiums in a certain year. We should mention that from 2008 onwards, the concept changed to a standard output measure to avoid the impact of premium and price changes over time. Similar to the ESU, the type of farming classifies each farm according to its specialisation, which is expressed as the relative contribution of different production branches to the total SGM. The rules defining the type of farming for a certain farm are defined in CD 85/377/EEC (1985: Annex III, Article 6 and 8).

The accounting and recording principals of the FADN are specified under EU regulations, but the data is collected by MS organizations. The accountancy data relate to a single agricultural holding for a period of 12 consecutive months. Data on the farm return exclusively concerns the agricultural holding. These data refer to activities of the holding itself, including forestry and farm tourism, if they are managed as part of the holding. Non-farming activities of the holder and his family are not included (pensions, private bank accounts, properties external to the agricultural holding, personal taxation, private insurances, inheritances, etc).

All data relating to the 'profit and loss account' should correspond to the production in the accounting year. Costs recorded are those used in the year’s production, even if the inputs were not purchased during the year. For non-monetary inputs costs equal the difference between initial and closing value of the respective inputs stock. Values are to be expressed excluding VAT and without any grants and/or subsidies.

Each year, an average of 1,000 data items is collected per farm. In each MS, a Liaison Agency is responsible for the collection of the FADN data through an annual sample survey and for the transmission of the data into the required format. These data transmitted to FADN are controlled and verified using different tests and procedures. In most MS, basic data for the FADN are collected through a (non-random) sample survey. Therefore, it is necessary to extrapolate data from the sample to produce information concerning the field of observation.

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[5] The FSS reports data on production activities by region and type farm type, based on a sub-survey each third year and a complete survey each tenth year. The Member States collect the information from individual agricultural holdings and forward the data to EUROSTAT.

2.3 The FADN variable names

The FADN database as provided consists of two parts. The first part comprises the accountancy data complemented with non-momentary production data and is organized in a collection of tables as outlined in the document RI/CC 1256 (rev. 7) (2011). Each of it comprises rows, named 'headings', and columns. Serial numbers indicated with a '#' in all formulas are assigned to individual data locations inside a Table.[6] The second part of the FADN database comprises standard results (also known as SE variables) calculated and partially enhanced with estimated values from the tables section. The definition of the standard variables and its calculation are given in the document RI/CC 882 (various revisions). Table 2 gives an overview of the information provided in the FADN Tables A to N and SE. Many tables are interlinked. For instance Table J and K are linked because some grants and subsidies (Table J) are paid for certain products defined in Table K. Detailed information is given in the next chapters where we explain the extraction.

Table 2: Overview of the information provided by the FADN Tables[7]

Table	Information provided in the Table	Table	Information provided in the Table
A	General information	I	VAT
B	Structure and yields	J	Grants and subsidies
C	Labour detail	K	Production
D	Livestock numbers and valuation	L	Quotas and other rights
E	Livestock purchases and sales	M	Compensatory payments
F	Costs	N	Details of purchase and sales of livestock
G	Capital	SE	Income and financial indicators not mentioned elsewhere
H	Debts detail		

1) From 2000 in The Netherlands a change of the accounting year implied a change on the variables pertained to stock and change of stock and the values in 2000 were estimated predicated on 1999 data.

Source: FADN.

The FADN data file consists of the variable names in the first row and the alphanumeric values in the following rows. The variable names correspond to FADN Tables as outlined in RI/CC 1256 (rev. 7) (2011) and RI/CC 882 (rev. 9) (2011). Figure 4 illustrates the composition of the four different ways to create the FADN variable name. In general, a variable name consists of letters and numbers. The first example in the figure has a letter from A to N (red colour) in front of the variable name which refers to the FADN table A-N. One to three digits (green colour)

[6] The corresponding codes references delivered with the data replace partially the column serials with more or less intuitive abbreviations. As example in Table K (Production) the area under production is refereed to Column (4) in the documentation, whereas, in the data deliverable this column refers to 'AA'. A list for the existing column abbreviations and its description is given in Table A1 in the Annex.

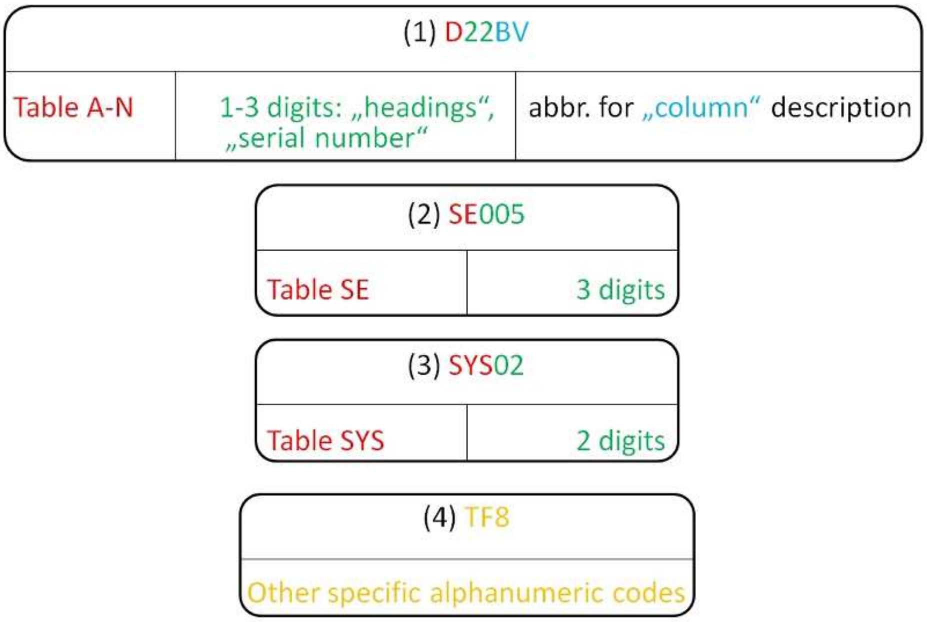
[7] From 2000 in The Netherlands a change of the accounting year implied a change on the variables pertained to stock and change of stock and the values in 2000 were estimated predicated on 1999 data.

corresponding to the “heading” or the “serial number” within the table. The last part of the variable name uses abbreviations for column description (blue colour). All the possible abbreviations are summarized in Table A1 in the Annex. All these variable names have in common, that the first part is linked to a certain FADN Table. Any further specific and exceptional rules on how the variable names of the FADN tables A to N are composed can be found in DG AGRI/L3 (2008). A more detailed explanation of each variable of the FADN tables can be found in RI/CC 1256 (rev. 7) (2011).

The second example describes a variable name which belongs to the standard results which has two parts. The first part (red colour) shows affiliation to the table of the standard results (SE) and the second part (green colour) consists of three digits. The third example shows a system variable. The first part (red colour) is always SYS and the second part (green colour) has two digits. Further description of both kinds of variables can be found in the document RI/CC 882 (rev. 9) (2011). The fourth example is a classification variable and has a specific alphanumeric variable name regarding the definition of classification.

As an example, the variable name D22BV is the opening valuation value of equines. Information for this variable can be found in RI/CC 1256 (rev. 7) (2011) in Table D heading 22 and column BV. A complete overview for all tables can be found in DG AGRI/L3 (2008).

Figure 4: Graphical description of the composition of four different kinds of variable names

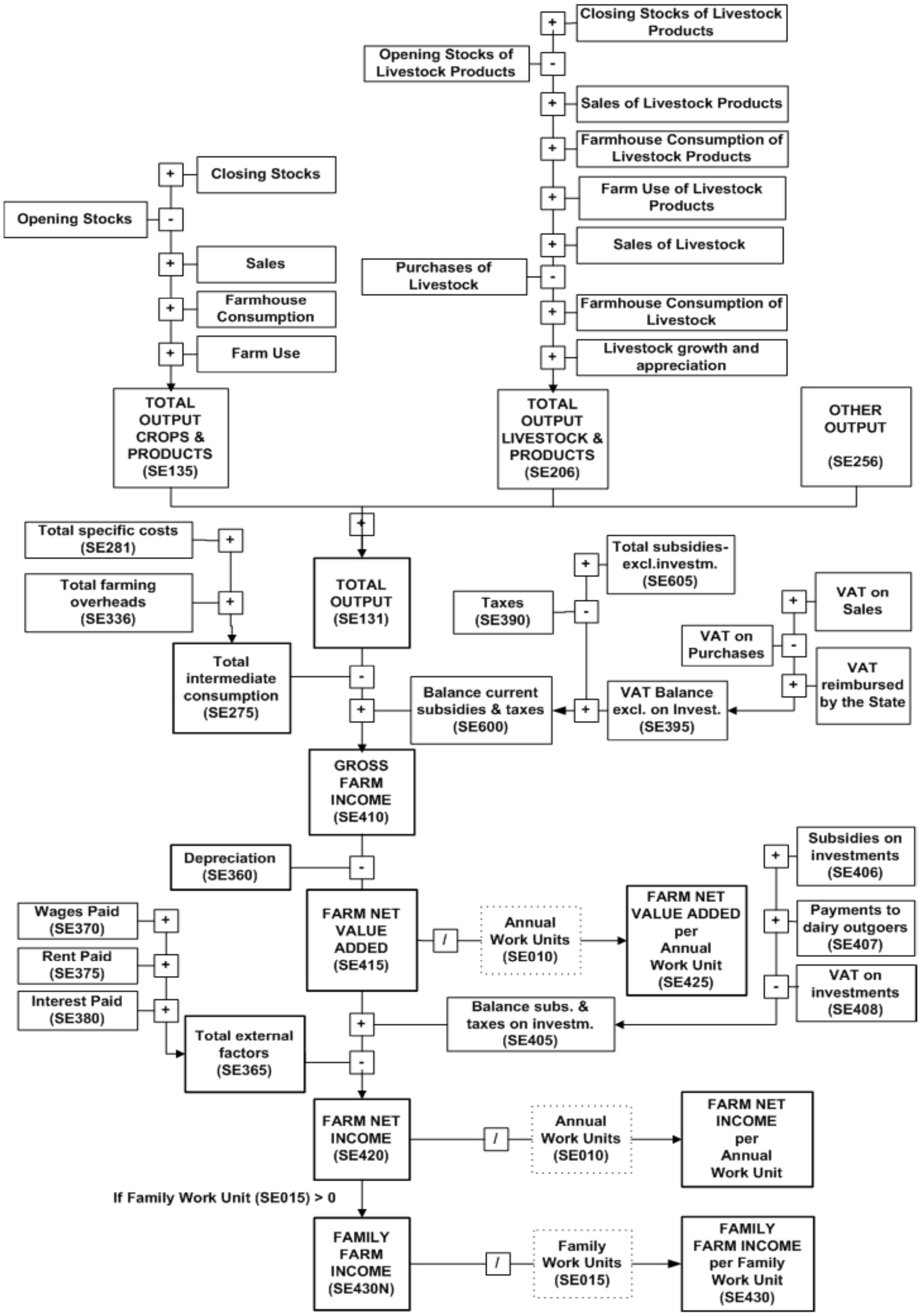


Source: DG AGRI/L3 (2008), own composition.

2.4 Income calculation

The main objective of FADN is to evaluate policy initiatives and decisions in the framework of the Common Agriculture Policy (CAP) with respect to the development of income. A schematic calculation of farm income indicators is given in the official document which defines the variables used in FADN standard results. We represent the calculation of income in Figure 5. The schema starts with the calculation of the total output in monetary terms for crops, livestock and other outputs. The output for crops is recorded in Table K, in which we can also find non-monetary values such as the area used (AA) and total production (QQ). The total production value (TP) is calculated as given in Figure 5 using sales (SA) + Farm use (FU) + Farm consumption (FC) + closing valuation (CV) - opening valuation (BV). The calculation of total output of livestock and products is calculated from three positions i) livestock production, given in Table E; ii) estimation of change in livestock valuation for animals which are in the holding for more than one year, given in Table D; and iii) animal products like milk and eggs, recorded in Table K. Other outputs are given also in Table K. Total output of crops, livestock and other outputs are also part of the standard variables as indicated in Figure 5 with the codes SE135, SE206, and SE256. Total inputs are defined in four classifications: i) Specific costs; ii) Overheads; iii) Depreciation; vi) Total external factors. Costs are linked to the agricultural activity of the holder and related to the output of the accounting year. Included are amounts relating to inputs produced on the holding (farm use) like seeds and seedlings and feed for grazing stock and granivores, but not manure. Farm taxes and other dues are not included in the total for costs but are taken into account in the balance for subsidies and taxes. The personal taxes of the holder are not to be recorded in the FADN accounts. Total specific costs are crop-specific inputs (seeds and seedlings, fertilizers, crop protection products, other specific crop costs), livestock specific inputs (feed for grazing stock and granivores, other specific livestock costs) and specific forestry costs. These cost positions are recorded in Table F. Overhead is also given in Table F. Depreciation is given in Table G and comprises agricultural land, buildings and rights, as well as forest land including standing timber and machinery and equipment. External factors cover wages and social security costs, rent paid and interest and financial charges, recorded in Table F. Total outputs plus total subsidies (SE605) (recorded in Table J) and minus total specific costs, overhead cost, and minus other taxes from Table F, plus VAT balance from Table I result in gross farm income, are also recorded as (SE410). The farm net value minus the depreciations yields the farm net value added (SE415). If the cost for wages, interest, and rents, summarized as total external factors, are subtracted from the farm net value added and the taxes and subsidies in investments are considered, the farm net income is obtained. The different income indicators can be expressed in per annual working unit, given the information about family working units.

Figure 5: Output, Balance of subsidies and taxes, Income



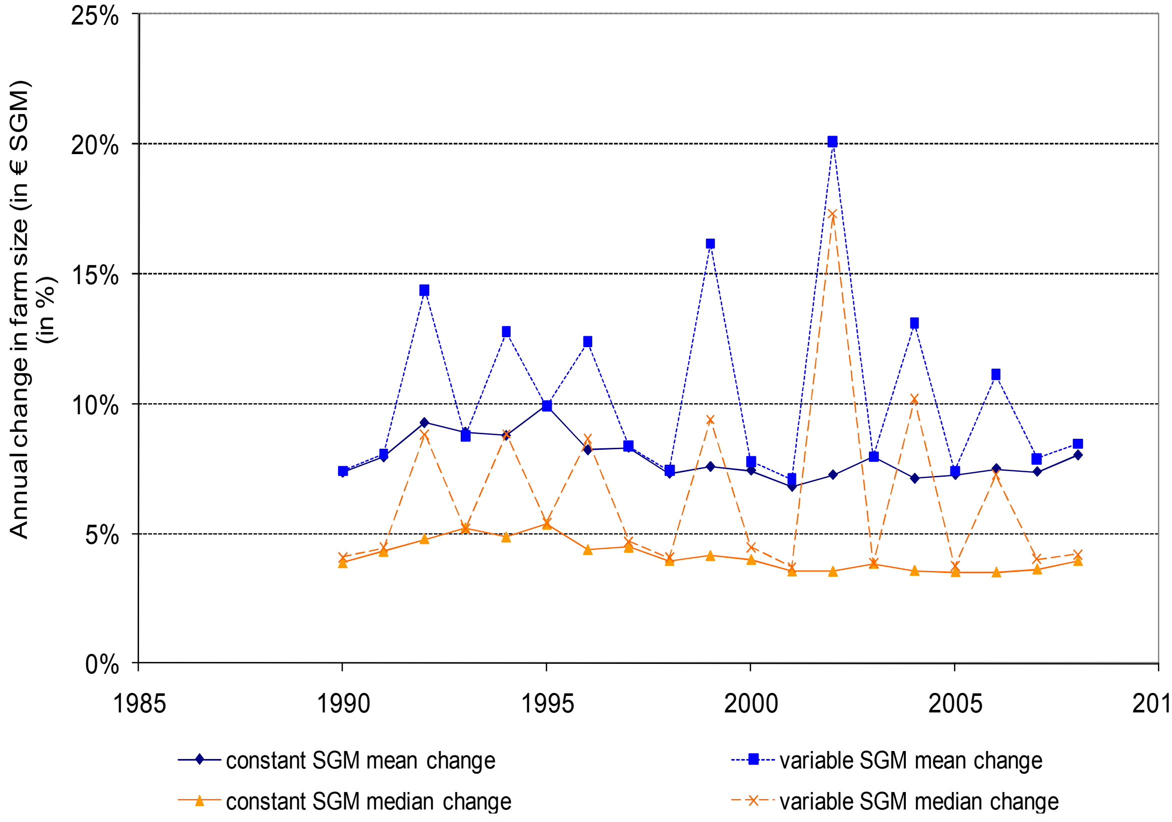
Source: RI/CC 882 (rev. 9) (2011).

2.5 Known problems with FADN

A number of issues have arisen with FADN and the data derived from it have implications for the extent to which it can be relied upon. The main issues are representativeness of the sample in general and with respect to certain data items and sub-samples and the quality of the sampling process. Specifically, there are questions about the size of the sample and whether it is capable of producing reliable information at a sub-national level. In addition, a big question is how the data are collected and by whom, and whether the methods employed introduce a selection bias. As an example, the monetary accounts in Germany are important for the tax statement of the farm. However, the non-monetary information like area development and herd sizes has to be added from other sources. A comparative analysis in Germany found that FADN compared to FSS has a lower variance of cropping area and herd size development over time, although the same sample was considered (Gocht et al., 2012). An explanation is that the information is not always updated by the accountant (or farmer) but last year's values are carried forward to the maximum extent possible. FADN describes the current income situation instead of the development over the time. New codes, code-aggregations or regional re-definition are introduced without correcting this for the past. As example, a re-definition of the regional codes (code A1, A2, A3) leads to a new farm identity and all together to the loss of the farm history. This, in turn, reduces the number and coverage of the constant sample for estimation.

If the type of farming and ESU is used as variable in the economic model the impact of variable SGM has to be taken into account, which can lead to a new classification of ESU or FT from one year to the next without any change in the farm account. In Germany, the SGM is calculated for each NUTS II region and updated annually. In the FADN database, the activities are weighted with a three year's average SGM to determine a farm’s farm type. This procedure dampens in particular the impact of short term price fluctuations. Unfortunately, this average SGM is not a moving average but is kept constant for two or three years. The impact can be seen in Figure 6 taken from Gocht et al. (2012). Using variable SGMs introduces additional dynamics regarding the structure which are not mirrored by a change in the physical assets. When the SGM was updated, the recorded changes were between 30 % and 300 % larger compared to years without an update. The updating influences the observed dynamics regarding both the changes in farm size (Figure 6) and specialization. A possible remedy would be the application of constant SGMs. However, this would mean one would have to recalculate the FT and ESU for the complete FADN sample and if the sample should afterwards be representative, the FSS population must also be re-calculated to define the grid for calculating the new farm representation weights. Although, FADN has a substantial amount of accounting data and information about inputs and outputs from each farm, some important information are not collected, such as crop and animal specific inputs, yields for pastures and manure handling, and have to be derived using additional estimations and/or accountancy techniques to fed the economic models.

Figure 6: Comparison of the mean and median annual change in the farm size over time if the farm's activities are weighted with constant or variable SGM



Source: Own calculation based on the German FADN-farms in the period 1995-2007. Only farms that remained at least two consecutive years in the sample.

3 Parameterisation of Mathematical Programming models

At the moment, no decision about the finial structure and level of aggregation for the mathematical programming (MP) model is taken. However, we can summarize some main objectives for the development. The model should cover all land use activities in FADN which use arable land, including fodder production such as maize silage, root fodder and other fodder on arable land as well as fallowed land and set-aside. It should also cover grassland, permanent crops, fruits and vegetables. Furthermore, the various livestock production activities should be differentiated. The model should reflect the agricultural production process as detailed as it can be derived, to allow e. g. a detailed representation of policy support for a certain category of crop or animal.

The production activity plays a central role as decision variable. It is characterized by producing outputs and using inputs and is restricted by resource constraints such as land or production rights. The interaction between the different production activities is taken into account by the definition of outputs and inputs. As example, fodder or young animals are inputs for raising production activities but also outputs of other activities. This information describes the interaction of the agricultural production process. Production factors as land or labour constrain the possible production combination. After input/output relations and constraints are set, the model should recover the observed production structure, also known as calibration, and simulate the supply response given a certain vector of exogenous input and output prices or other shocks.

In a MP model, the objective function defines the target value. Maximizing this value, using a solve-algorithm, leads to an optimal combination of the production activities subject to the given resource constraints. In its general form this can be described by the following model: $Max\ Z = p'x - c'x\ subject\ to\ Ax \leq b \quad [\lambda]\ \text{and}\ x \geq 0$, where Z is the objective function value, p is $(N \times 1)$ vector of output prices, x is an $(N \times 1)$ vector of production activity levels, c is a $(N \times 1)$ vector of accounting cost per unit of activity, A is a $(M \times N)$ matrix of coefficients in resource constraints and b is $(M \times 1)$ vector of available resource quantities. λ is a $(M \times 1)$ vector of dual variables associated with resource constraints. The solution space is bounded by the resource constraints b and the activity levels x must be non-negative.

Generally, the solution to this problem does not reproduce the observed mix of production activities as the number of known resource constraints is below the number of observed activities. This results in overspecialization. As a consequence, the number of non-zero activities in a linear programming framework is bounded by the number of resource constraints. Methods in the tradition of positive mathematical programming (PMP) can be applied to overcome the overspecialization and non-reproduction of observed activities, (Heckelei, 2002, Heckelei and Wolf 2003). The objective function is extended by a non linear quadratic cost function, which results in an objective function in the form $Z = p'x - d'x - \frac{1}{2}x'Qx$. The parameters d and Q of the cost function have to be derived such that the first order condition of the problem holds. This results in a non-linear objective function which reproduces the observed production activities. In the literature several approaches are given to specify the parameter of the cost function, which calibrate the model (Heckelei, 2002). Also a strand of literature exists which estimates the parameters to specify the resulting supply behaviour (Jansson and Heckelei, 2011).

The specification of the model and, hence, the decision on the considered production activities, input/output coefficient, prices, restriction depends on the foreseen simulation experiments and on the databases available for the specification. We assume that the model should be specified as close as possible to the specification given in the FADN database. A detailed knowledge of the accounting rules in FADN is therefore important to identify possible pitfalls and use the full potentials of the accounting system.

4 Parameterisation of models using FADN

The chapter discusses the extraction rules for the mathematical programming models. We start with the rules for crops and animal production, hectare and herd sizes, yields, production value, prices for accounted products. We continue with the extraction rules for input cost categories, grants and subsidies as well as income.

All data problems encountered during the extraction process are documented in the following. We also present a comparison between the values of the given standard results and our control variables obtained by the extraction rules, before we present some important information about the relevance of a constant sample for the estimation approach.

4.1 Land use activities - extraction rules

From Table K we can derive the average yield calculated as the total production (QQ) divided by the area (AA). A price approximation can be calculated by dividing the total production value (TP) with total production (QQ). RI/CC 1256 (REV. 7) (2011) states, that area (AA) is measured in area, but the FADN database measured this in hectare (ha), except for mushrooms which is given in square meters. This also holds for the unit of total production (QQ) which is not recorded in quintals, but in tonnes, except for wine grapes (without table grapes) which is recorded in hectolitres and eggs which is recorded in thousand pieces.

Table 3summarizes the extraction rules for land use production activities and its aggregation from the headings/sub-headings in FADN. The first column names the crop activity, followed by the GAMS abbreviation used in the FADN data mining tool in column two. The last three columns describe the extraction rules on how the area (AA), supply (output quantities, QQ) and production value (TP) of each land use activity is calculated. The total production (TP) is calculated by adding up sales (SA), farmhouse consumption (FC), closing valuation (CV) and farm use (FU) and deducting opening valuation (BV). For a better result presentation, the production activities are classified into seven categories. The summary statistics for the land use activities and its development for selected years are given in Table 4 using the extraction rules from Table 3.

Table 3: Extraction rules for all land use activities for area, output quantities, total production value from Table K in FADN

Production activity	GAMS Abbr. prod. activity	Extraction rule for area in ha (AA)	Extraction rule for output output quantities (QQ) in tons	Extraction rule for total production value (TP) in EUR
ACER		**Cereals**		
Soft wheat	SWHE	120AA	120QQ	120TP
Durum wheat	DWHE	121AA	121QQ	121TP
Rye and meslin	RYEM	122AA	122QQ	122TP
Barley	BARL	123AA	123QQ	123TP
Oats	OATS	124AA	124QQ	124TP
Grain maize	MAIZ	126AA	126QQ	126TP
Paddy rice	PARI	127AA	127QQ	127TP
Other cereals	OCER	125AA+128AA	125QQ+128QQ	125TP+128TP
AOIL		**Oilseeds**		
Rape	RAPE	331AA	331QQ	331TP
Sunflower	SUNF	332AA	332QQ	332TP
Soya	SOYA	333AA	333QQ	333TP
Other oils	OOIL	334AA	334QQ	334TP
AOAC		**Other arable crops**		
Pulses	PULS	129AA	129QQ	129TP
Potatoes	POTA	130AA	130QQ	130TP
Sugar beet	SUGB	131AA	131QQ	131TP
Flax and hemp	TEXT	347AA+364AA	347QQ+364QQ	347TP+364TP
Tobacco	TOBA	134AA	134QQ	134TP
Other industrial	OIND	133AA+135AA-347AA	133QQ+135QQ-347QQ	133TP+135TP-347TP
Other crops	OCRO	142AA+143AA+ 148AA+156AA+158AA+159AA	139QQ+142QQ+143QQ+ 146QQ+148QQ+156QQ+ 158QQ+159QQ+160QQ+ 161QQ+284QQ	139TP+142TP+143TP+ 146TP+148TP+156TP+ 158TP+159TP+160TP+ 161TP+284TP
APER		**Vegetables and Permanent crops**		
Tomatoes	TOMA	337AA	337QQ	337TP
Other vegetables	OVEG	136AA+137AA+138AA -337AA-341AA	136QQ+137QQ+138QQ -337QQ-341QQ	136TP+137TP+138TP -337TP-341TP
Apples/peaches	APPL	349AA	349QQ	349TP
Other fruits	OFRU	350AA+353AA +351AA+352AA+341AA	152QQ-349QQ+341QQ	152TP-349TP+341TP
Citrus Fruits	CITR	354AA+355AA +356AA357AA	153QQ	153TP
Table grapes	TAGR	285AA	285QQ	285TP
Olives for oil	OLIV	282AA+283AA	282QQ+283QQ	282TP+283TP
Table olives	TABO	281AA	281QQ	281TP
Table wine	TWIN	155AA-285AA	155QQ-285QQ	155TP-285TP
Nurseries	NURS	157AA	157QQ	157TP
Flowers	FLOW	If 140AA+141AA >0 then 140AA+141AA else 342AA+343AA+344AA	If 140QQ+141QQ >0 then 140QQ+141QQ else 342QQ+343QQ+344QQ	If 140TP+141TP >0 then 140TP+141TP else 342TP+343TP+344TP
AFOD		**Fodder activities**		
Fodder maize	MAIF	326AA	326QQ	326TP
Fodder root crops	ROOF	144AA	144QQ	144TP
Pasture	GRAS	150AA+151AA	150QQ+151QQ	150TP+151TP
Fodder other on arable land	OFAR	147AA+327AA+328AA	147QQ+327QQ+328QQ	147TP+327TP+328TP
ASET		**Set aside and fallow land**		
Set-aside	SETA	146OUAA		
Non food set aside	NONF	NFCAA		
Fallow land	FALL	146AFAA		

Source: Own composition.

4.2 Results and problems for land use activities

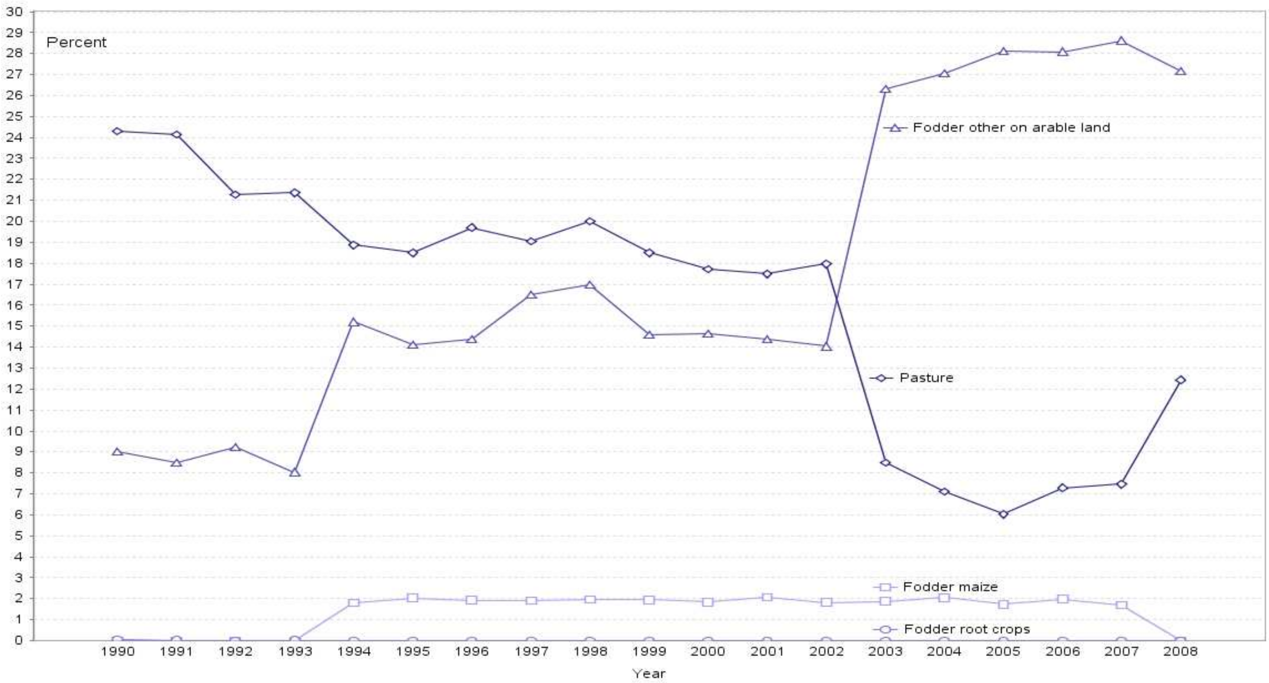
Table 4 outlines the production level of different crop activities in million hectares and the number of observed farms which are active in each category for the EU-15 and EU-12 countries.

Table 4: Production level of different crop activities in EU-15, EU-12 in different years

Production activity	EU-15						EU-12					
	Area in Million hectare			Observations in 1.000			Area in Million hectare			Observations in 1.000		
	1990	2000	2008	1990	2000	2008	2004	2006	2008	2004	2006	2008
UAA	91	119	121				26	28	44			
Arable land	63	86	87				22	22	35			
Pasture	29	33	34	23	25	23	3	5	7	5	12	13
Cereals	29.2	35.6	38.8	68.8	68.6	64.6	13.6	13.8	22.3	47.0	44.8	50.9
Oilseeds	4.2	*5.3*	*5.7*	9.9	*11.5*	*10.2*	2.0	2.5	4.8	5.6	6.1	8.3
Oth. a. crops	8.7	13.0	10.0	28.5	41.0	30.5	2.3	2.1	2.6	18.0	18.9	17.2
Veg. + perm.	8.8	9.7	10.0	44.9	38.1	32.9	0.9	1.0	1.4	7.7	8.2	10.3
Fodder activities	35.9	*47.3*	*50.8*	37.3	*54.9*	*53.4*	6.9	8.1	11.4	18.6	25.0	27.0
Set aside fallow	4.0	3.9	3.5	6.7	8.9	8.7	0.7	0.3	0.3	1.7	1.8	1.2

Source: FADN data mining tool (FADN, 2011).

Figure 7: Development of fodder production activity and pasture in % of UAA in Italy between 1990 and 2008

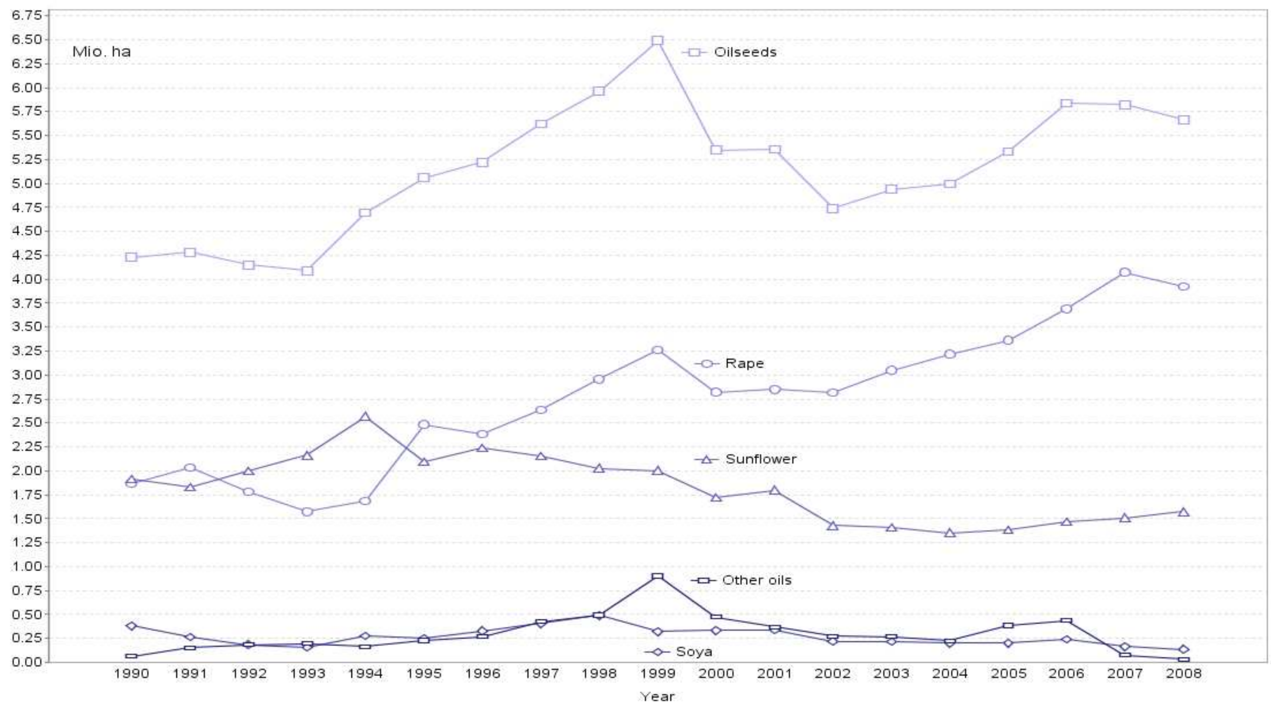


Source: FADN data mining tool (FADN, 2011).

The production level activities are weighted using SYS02 which is the number of farms represented in the sample. Finland, Sweden, and Austria joined the EU-15 Aggregate in 1995 and Bulgaria and Romania (BuR) were included in the EU-12 Aggregate in 2007. The strong increase in fodder activities and number of observations in EU-15 have three main reasons. First, there is no data for fodder maize in 1990-1992 (except for The Netherlands in 1992). Second, fodder on other arable land increased rapidly. Third, pasture was rebooked in Italy in 2002. The latter can be seen from the Figure 7, where fodder on other arable land is rising from 2002 to 2003 whereas pasture is declining in the same period.

The increase of oilseeds in EU-15 is driven by rape seed whereas sunflower decreased slightly over time and soya and other oils are of minor importance for the oilseeds aggregate (see Figure 8).

Figure 8: Development of land use for oilseeds and the sub-categories rape, sunflower, soya and other oils in EU-15 between 1990 and 2008

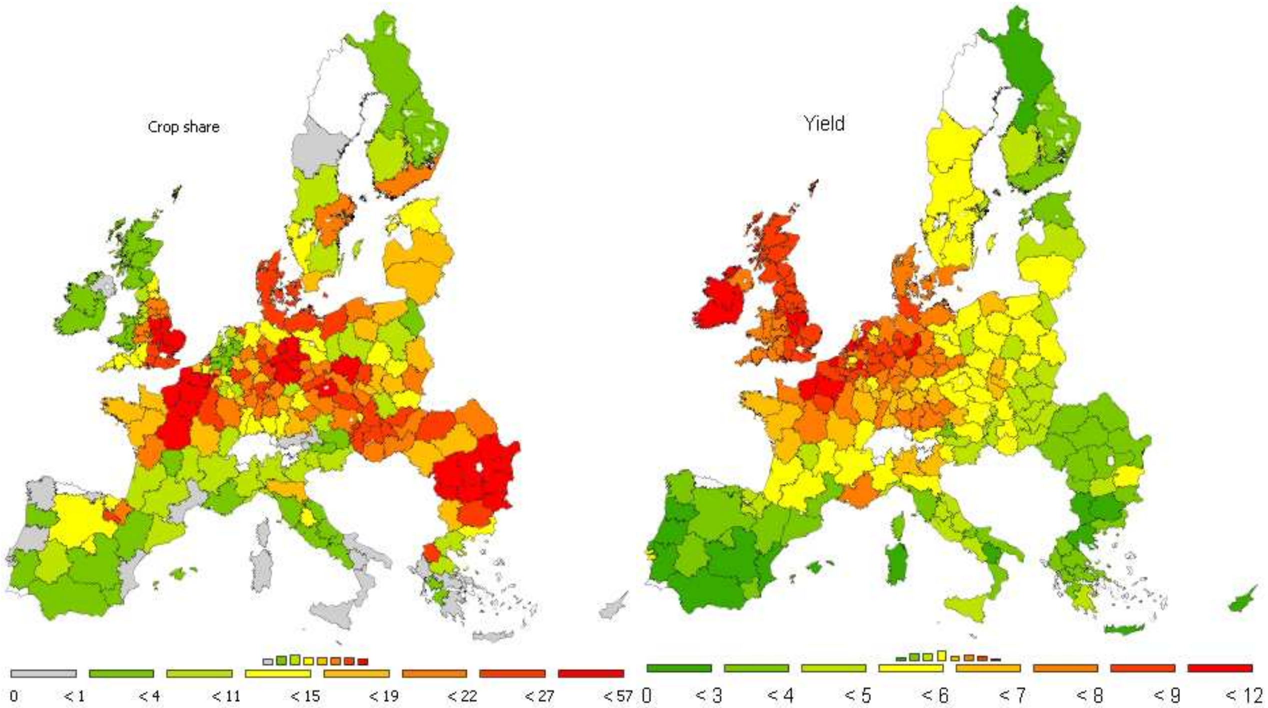


Source: FADN data mining tool (FADN, 2011).

Furthermore, oilseed production activities rose till 1999, declined afterwards and recovered after 2002 but never reached the level of 1999. In general, in the EU-12 countries the admittance of BuR led to an increase in almost all activities. However, some activities declined and this can be caused by refinements or improvements of the sampling plan. As in the EU-15, rape seed also affected the high rise in oilseeds in the EU-12. Although in average the production activities increased, the number of involved farms did not increase.

The following two figures show the crop share, yield, supply[8] and price of soft wheat in 2008 at NUTS II level for the EU-27. Figure 9 displays the relative share of soft wheat on UAA and the yield of soft wheat in tons. We find the highest share of soft wheat on UAA in Bulgaria and Romania, in Hungary, the regions around Paris, central Germany and Denmark and Eastern England. The lowest values for the share of soft wheat have the regions at the Mediterranean Sea and Northern Scandinavia. The highest yield of soft wheat is concentrated on the British Isles and on a line from Northern France to Northern and Eastern Germany whereas in the southern countries of Europe and the Northeast of Scandinavia the yield is comparatively low.

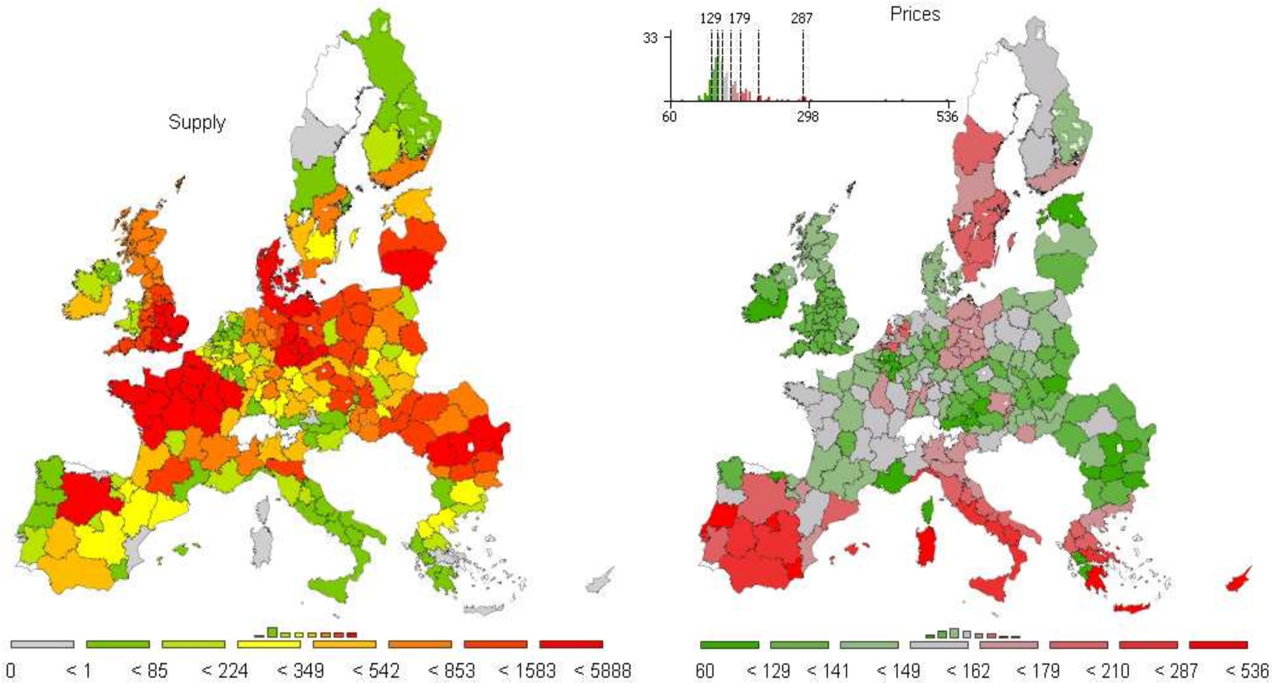
Figure 9: Soft wheat: share on UAA in % (left) and yield in tons (right) for EU-27 at NUTS II level in 2008



Source: FADN data mining tool (FADN, 2011).

[8] Supply is also dependent on the size of the NUTS II region and therefore hardly capable for efficiency or productivity interpretations.

Figure 10: Soft wheat: supply in 1.000 tons (left) and prices in EUR per ton (right) for EU-27 at NUTS II level in 2008



Source: FADN data mining tool (FADN, 2011).

Figure 10 shows the supply in thousand tons and the price in EUR per ton of soft wheat. Central and Northern France, Eastern Germany, Denmark, Eastern and Southern England, Spain (Castilla-Leon) Romania, and Lithuania supply the largest amounts of soft wheat. Scandinavia, the Southern European countries, and the Benelux supply the least. The price of one ton of soft wheat is the highest in the southern countries of Europe and in Sweden whereas the price is lower in Romania, Bulgaria, Poland, Central Europe (except for Eastern Germany and Northern Italy), and on the British Isles. It is apparent that in some regions high prices coincide with low yield (especially Southern Europe) and vice versa (British Isles).

4.3 Animal production - extraction rules

In Table 5 the extraction rules of gathering the average herd size of all animal production activities are listed and categorized into cattle, pig, goats and sheep as well as other animals. The first three columns provide the name of the activity, the abbreviation used in the data mining tool and the table of the FADN definitions. The fourth column shows the extraction rules with heading for each activity and column abbreviation for the average herd size.

Table 5: Extraction rules for herd sizes for all animal activities from Table D in FADN

Production activity	GAMS Abbr. animal prod. activity	FADN Table	Extraction rule for production level (LEVL) average herd size
ACAT			**Cattle**
Dairy Cows	DCOW	D	30AV
Heifers breeding	HEIR	D	28AV+(1-WEGT)*26AV [1)]
Raising male calves	CAMR	D	0.5*24AV
Raising female calves	CAFR	D	0.5*24AV
Other Cows	SCOW	D	32AV
Heifers fattening	HEIF	D	29AV+WEGT*26AV
Male adult cattle	BULF	D	25AV+27AV
Fattening male calves	CAMF	D	0.5*23AV
Fattening female calves	CAFF	D	0.5*23AV
APIG			**Pig**
Pig fattening	PIGF	D	45AV+46AV
Pig breeding	SOWS	D	44AV
ASAG			**Goats and sheep**
Milk Ewes and goat	SHGM	D	38AV+40AV
Sheep and goat fattening	SHGF	D	39AV+41AV
AOAN			**Other animals**
Laying hens	HENS	D	48AV/1000
Poultry fattening	POUF	D	(47AV+49AV)/1000
Other animals	OANI	D	50AV

1) WEGT = Weighting factor to calculate the correct numbers for heifers breeding or fattening.

Source: FADN, own composition.

The calculation of total production from animals is calculated from three positions: from the livestock production (Table E), from the animal products (Table K) and from the estimation of change in livestock valuation (Table D).

4.3.1 The livestock production (Total production livestock value)

Table 6 shows the extraction rules for livestock value of different categories of animal production activities. The first three columns show the name of the production activity, the abbreviation used in the data mining tool and the corresponding FADN Table. The fourth column lists the variable name(s) of livestock production value of each category of animal production activity. Livestock production value (NO = net output) is calculated by adding up sales (SA) and farmhouse consumption (FC), deducting purchases (PU).

Table 6: Extraction rules for Livestock production value from Table E in FADN

Production activity	GAMS Abbr. animal aggreated production activities	FADN Table	Extraction rule for livestock production value in EUR
Cattle	PCAT	E	52NO
Pig	PPIG	E	56NO
Goats and sheep	PSAG	E	54NO + 55NO
Other	POTH	E	51NO + 57NO + 58NO

Source: FADN, own composition.

4.3.2 Animal products (Total production value)

Table 7 presents the extraction rules for total animal product output and total animal output production value. The first three columns are organized as described previously. Columns four and five specify how output quantity and output production value are calculated from the corresponding FADN Tables indicated by heading for each animal activity and column abbreviation for output (QQ) and production value (TP). The total production value is calculated by adding up sales (SA), farmhouse consumption (FC), closing valuation (CV) and farm use (FU) and subtracting opening valuation (BV).

Table 7: Extraction rules for animal product output and total product output value from Table K in FADN

Animal output	GAMS Abbr. animal products	FADN Table	Extraction rule for output quantities (GROF) in tons	Extraction rule for output production value (EAAP) in EUR
Milk	COMI	K	162QQ	162TP
Sheep’s and goat’s milk	SGMI	K	164QQ+165QQ	164TP+165TP
Hens’ eggs	EGGS	K	169QQ	169TP
Other animal products	OANI	K	170QQ + 166QQ 163QQ+167QQ+168QQ	170TP + 166TP + 163TP+167TP+168TP

Source: FADN, own composition.

4.3.3 Change of livestock value

Table 8 depicts the rules on how the changes of the livestock values of different livestock categories can be extracted. This is calculated by adding up the difference between closing and opening valuation (column four) and/or the adjusted variation estimation (column five). The former is called gross stock change and is given by a certain variable (DxxDG[9]) and the latter is

[9] The two letters “xx” stand for the headings (22…50) in FADN Table D.

called the stock change after revaluation and takes the regional price index into consideration as well as the closing and opening valuation and is given by the variable DxxDR.

Table 8: Extraction rule for the change of livestock value different livestock categories from Table D in FADN

Livestock category	GAMS Abbr. animal activity aggregates	FADN Table	Net variation (CV-BV) = (closing valuation - opening valuation)	Adjusted variation (LVVAL)
Equines	AOAN	D	-	One category only (22DR)
Cattle	ACAT	D	Calves for fattening (23DG), Other cattle < 1 year (24DG), Cull dairy cows (31DG)	All other categories (25DR .. 30DR and 32DR)
Goats	ASAG ASAG	D	Other goats (39DG)	Breeding goats (38DR)
Sheep		D	Other sheep (41DG)	Ewes (40DR)
Pigs	APIG	D	Piglets (43DG), Pigs for fattening (45DG); Other pigs (46DG)	Breeding sows (44DR)
Poultry	AOAN	D	All categories (47DG...49DG)	-
Other animals	AOAN	D	Beehives (33DG), Rabbits (34DG), Other animals (50DG)	-

Source: RI/CC 882 (rev. 9) (2011), own composition.

4.4 Results and problems for animal activities

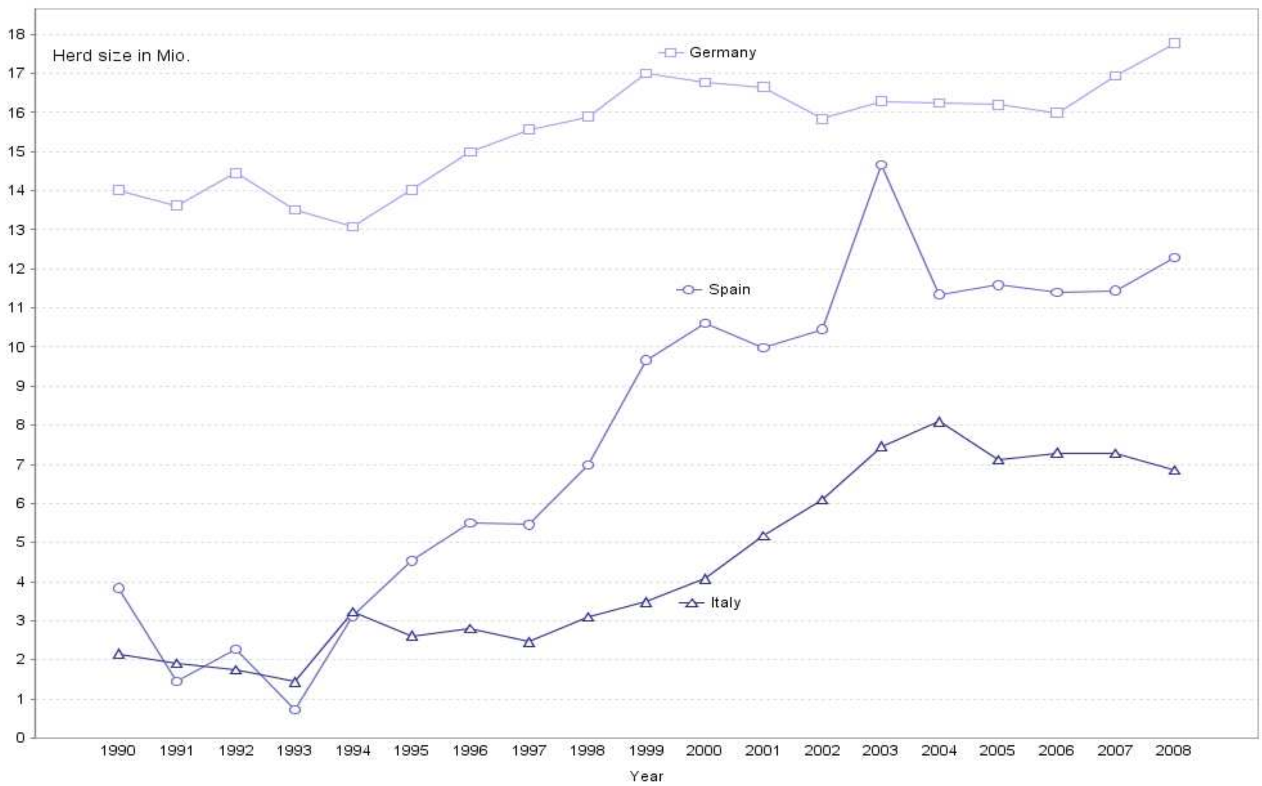
A summary statistics for the animal production activities and its development for selected years are given in Table 9. The respective herd sizes in million heads and number of farms are provided for the different animal production activities. In the EU-15 countries, the number of farms of each category became smaller while the herd sizes increased or remained constant.

Table 9: Herd sizes of different animal activities in EU-15, EU-12 in different years

Production activity	EU-15						EU-12					
	Herd size in Million			Observations in 1.000			Area in Million hectare			Herd size in Million		
	1990	2000	2008	1990	2000	2008	2004	2006	2008	2004	2006	2008
Livestock Unit	93.1	105.1	106.3				15.8	15.9	22.7			
Cattle	74.7	76.9	75.3 #	130.7	122.0	109.0	9.3	9.9	14.1	55.3	55.6	60.5
Pig	*60.6*	*83.0*	*83.0* #	13.8	11.9	10.0	17.0	17.6	18.8	18.7	17.7	17.0
Goat and Sheep	96.8	101.0	103.0 #	16.6	15.3	13.5	*3.9*	*3.7*	*19.9*	1.5	1.7	2.7
Others	1.0	1.3	1.8 #	5.6	5.9	5.1	0.5	0.4	0.8	3.1	2.9	3.7

Source: FADN data mining tool (FADN, 2011).

Figure 11: Main drivers of increase of pig activities through pig fattening in EU-15 between 1990 and 2008

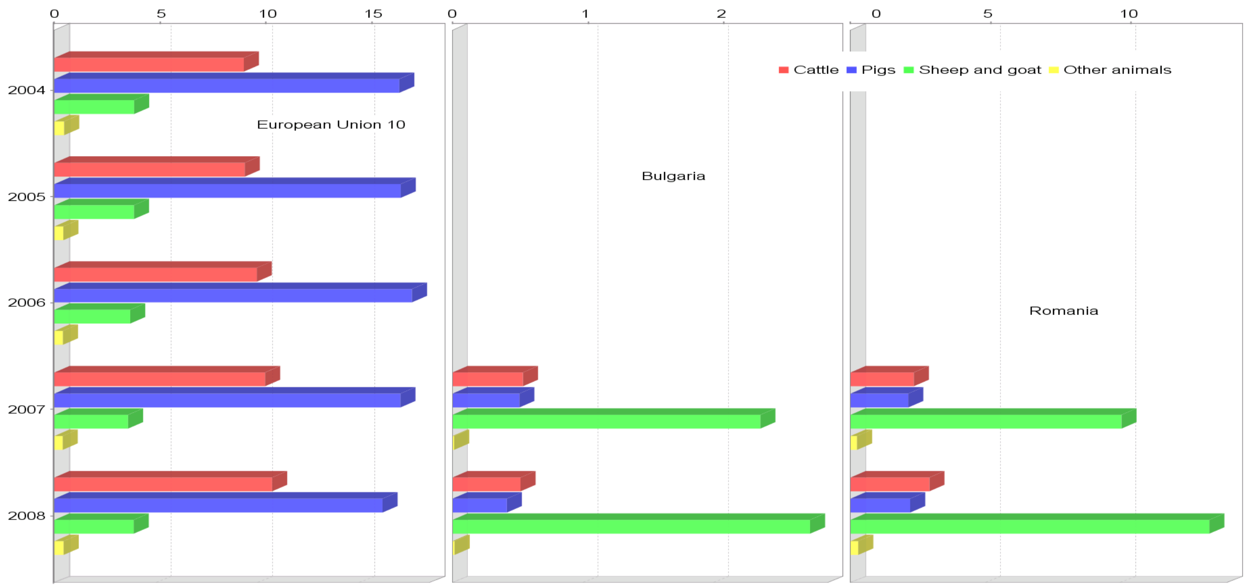


Source: FADN data mining tool (FADN, 2011).

The greatest growth in herd size is identified for the pig categories. This is due to higher pig fattening activities in Germany, Spain and Italy. Figure 11 depicts this development. It is difficult to compare the results because EUROSTAT does not provide any herd statistics before 2002, however, one can observe that FADN pig statistic underestimates the reality, which probably results from the exclusion of commercial farm in the FADN sample.

The increase of the herd sizes in the EU-12 from 2004 to 2008 is caused by the entrance of BuR in EU-12. Goat and sheep activities and number of farms increased considerably. This is shown in Figure 12 where herd sizes of goats and sheep remain relatively constant for the EU-10 and increase for BuR. Interestingly, the absolute number of farms in each category stays constant on average (except for goat and sheep).

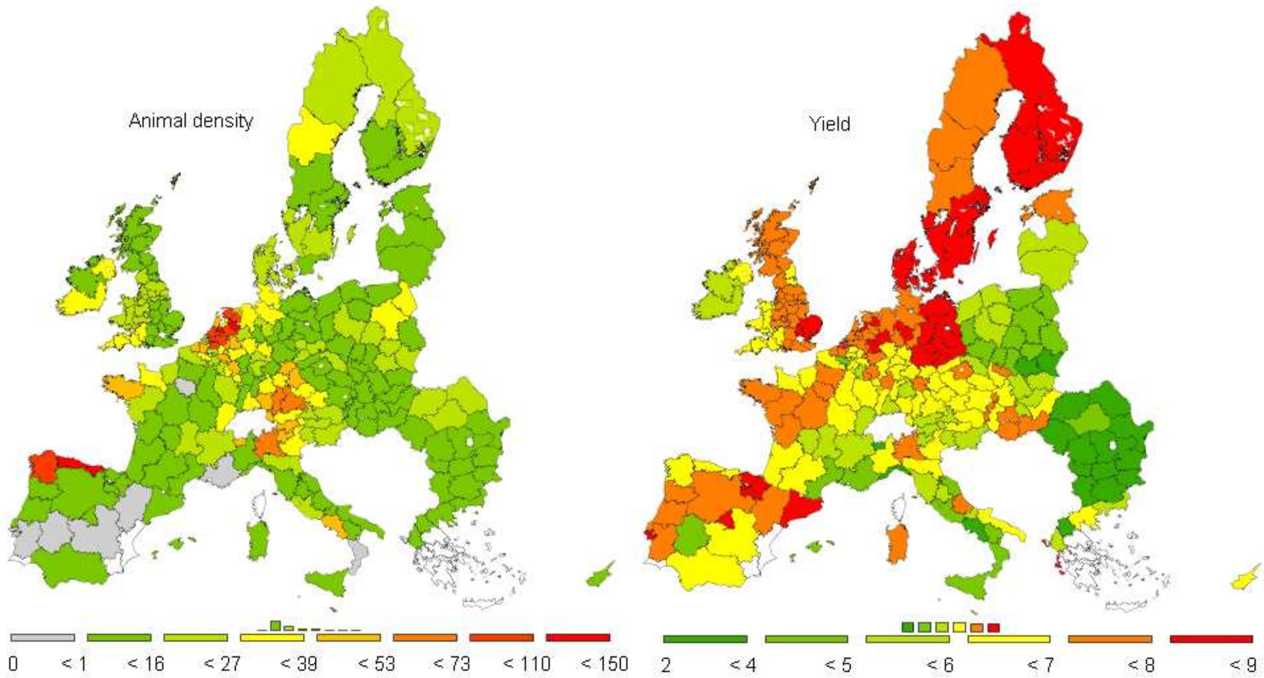
Figure 12: Development of Goat and Sheep herd sizes in Millions caused by inclusion of BuR in EU-10 between 2004 and 2008



Source: FADN data mining tool (FADN 2011).

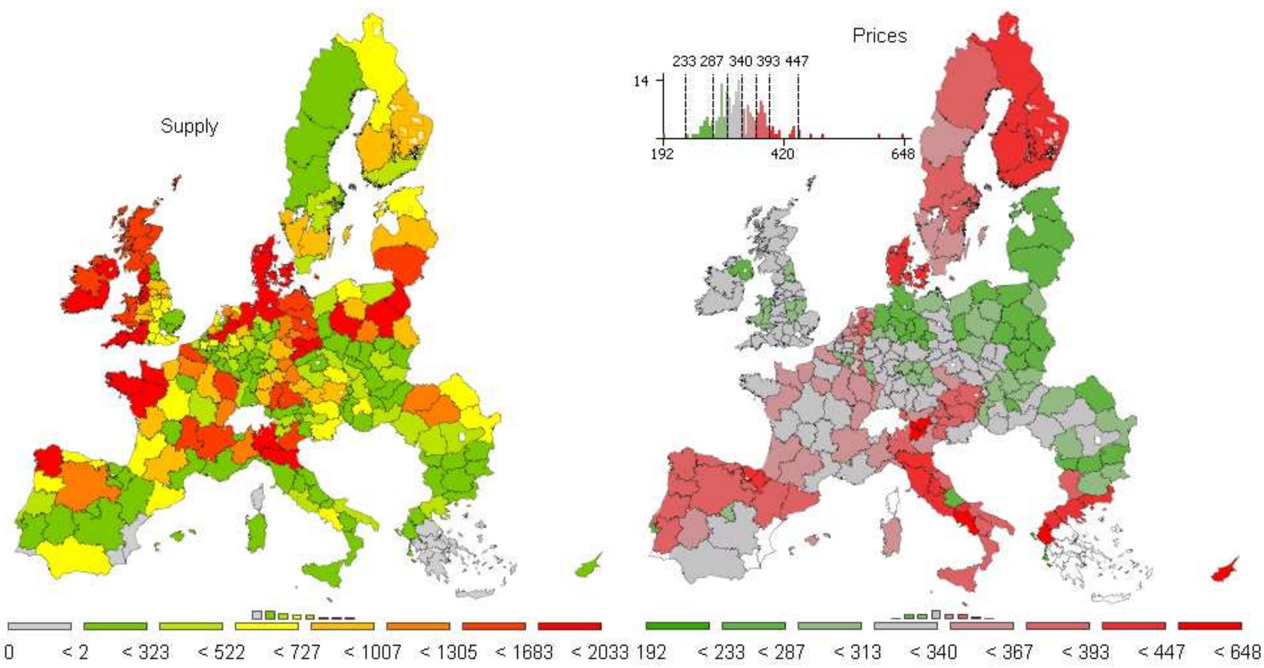
The following two figures present the EU-27 map at NUTS II region level in 2008. dairy cow density per 100 hectare and yield of dairy milk (COMI, see Table 7) in tons is shown in Figure 13. The yield is calculated by dividing animal production output by herd size. In most regions there are between 1 and 27 cows per 100 hectare. The highest animal densities can be found in Malta, at the Spanish north coast and in The Netherlands. The yield of dairy milk is the lowest in East European countries and the highest in Central, Northern, Western and Southern Western Europe.

Figure 13: Animal density (dairy cows (in heads) per 100 hectare) (left) and yields in tons of dairy milk (right) for EU-27 at NUTS II level in 2008



Source: FADN data mining tool (FADN, 2011).

Figure 14: Milk: supply in 1.000 tons (left) and prices in EUR per ton (right) in EU-27 at NUTS II level in 2008



Source: FADN data mining tool (FADN, 2011).

Figure 14 depicts the supply[10] in 1,000 tons and the price for dairy milk in EUR. The highest supply of dairy milk can be found in the Northern parts of Spain, the Po Valley, Eastern and Northern Germany, the western parts of the British Isles, some regions in Poland, and Brittany in France. The supply is the lowest in Southern Europe, Northern Scandinavia, in the Czech Republic and in Western Germany. According to FADN data the price of dairy milk is particular high in Italy, Finland, Denmark, Greece, Portugal and Northern Spain. The lowest prices can be found in Eastern Europe and in the centre of Northern Germany

4.5 Input costs – extraction rules

Inputs are entered in monetary terms and recorded as total expenses at farm for twenty different input categories. Input costs are not recorded specifically for crops or animals which results in relatively simple extraction rules.

Table 10 proposes an aggregation for the input categories in FADN, which is also used in the data mining tool to introduce sub-headings. Column One names the different categories and sub-categories of costs, Column Two lists the abbreviation used in the data mining tool, Column Three lists the related FADN tables of each cost category, and Column Four shows the extraction rules. The information is gained from FADN Tables F and G. The total costs (CTOT) consist of total specific costs (CSPE), total farm overhead (COVE), depreciation (CDEP) and the total external factors (CEXT).

[10] Supply is also dependent on the size of the NUTS II region and therefore hardly capable for efficiency or productivity interpretations

Table 10: Extraction rules for input costs from Table F and G in FADN

	GAMS Abbr. for total farm cost categories	FADN Table	Extraction rule for each cost category
Total costs	**CTOT**	**F+G**	**Sum(CSPE,COVE,CDEP,CEXT)**
Total specific costs	**CSPE**	**F**	**Sum(F64...F77)**
Concentrated feedingstuffs for grazing stock	CSPE_F64	F	F64
Coarse fodder for grazing stock	CSPE_F65	F	F65
Feedingstuffs for pigs	CSPE_F66	F	F66
Feeding stuffs for poultry and other small animals	CSPE_F67	F	F67
Feeding stuffs for grazing stock	CSPE_F68	F	F68
Feeding stuffs for pigs produced on farm	CSPE_F69	F	F69
Feeding stuffs for poultry and other small animals produced on farm	CSPE_F70	F	F70
Other specific livestock costs	CSPE_F71	F	F71
Seeds and seedlings purchased	CSPE_F72	F	F72
Seeds and seedlings produced and used on the farm	CSPE_F73	F	F73
Fertilisers and soil improvers	CSPE_F74	F	F74
Crop protection products	CSPE_F75	F	F75
Other specific crop costs	CSPE_F76	F	F76
Specific forestry costs	CSPE_F77	F	F77
Total Farm Overhead	**COVE**	**F**	**Sum(F60...F63,F78...F82,F84,F87)**
Contract work	COVE_F60	F	F60
Current upkeep of machinery and equipment	COVE_F61	F	F61
Motor fuels and lubricants	COVE_F62	F	F62
Car expenses	COVE_F63	F	F63
Upkeep of land improvements and buildings	COVE_F78	F	F78
Electricity	COVE_F79	F	F79
Heating fuels	COVE_F80	F	F80
Water	COVE_F81	F	F81
Insurance	COVE_F82	F	F82
Other farming overheads	COVE_F84	F	F84
Insurance for farm buildings	COVE_F87	F	F87
Depreciation	**CDEP**		**Sum(G94DP,G101DP,G100DP)**
Depreciation for agricultural land, building and rights	CDEP_LBR	G	G94DP
Depreciation for machinery and equipment	CDEP_MAC	G	G101DP
Depreciation for forestry and timber [1)]	CDEP_FOR	G	G100DP
Total external factors	**CEXT**		**Sum(F89,F59,F86)**
Interest and financial charges	CEXT_INT	F	F89
Wages and social security	CEXT_WAG	F	F59
Rent paid	CEXT_REN	F	F85
.. of which is paid for land	CEXT_RFL	F	F86

1) It has to be noted, that “depreciation for forestry and timber” is not included in the FADN data set.

Source: FADN data mining tool (FADN 2011).

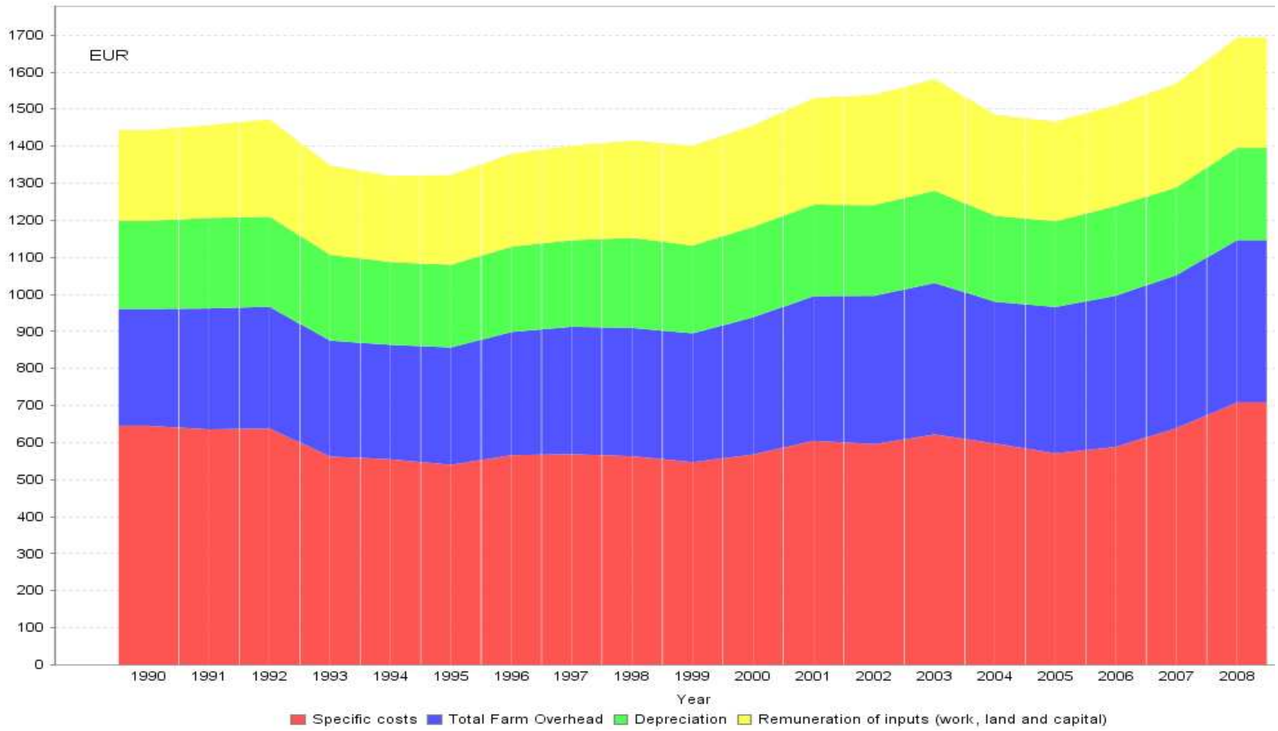
4.6 Results and problems for input costs

The following figures show the development of all the cost categories that are shown in Table 10 for the EU-27 per hectare of UAA between the years of 1990 and 2008. Figure 15 shows the development of total costs, whereas Figure 16, Figure 17 and Figure 18 give more detailed information on the development of total specific costs, total farm overhead as well as depreciation and total external factors.

Figure 15 depicts the development of the cost categories of total specific costs, total farm overhead, depreciation and total external factors in the EU-27 in EUR per hectare of UAA between 1990 and 2008. The total cost increased from about 1,445 EUR per hectare of UAA in 1990 to about 1,692 EUR per hectare of UAA in 2008.

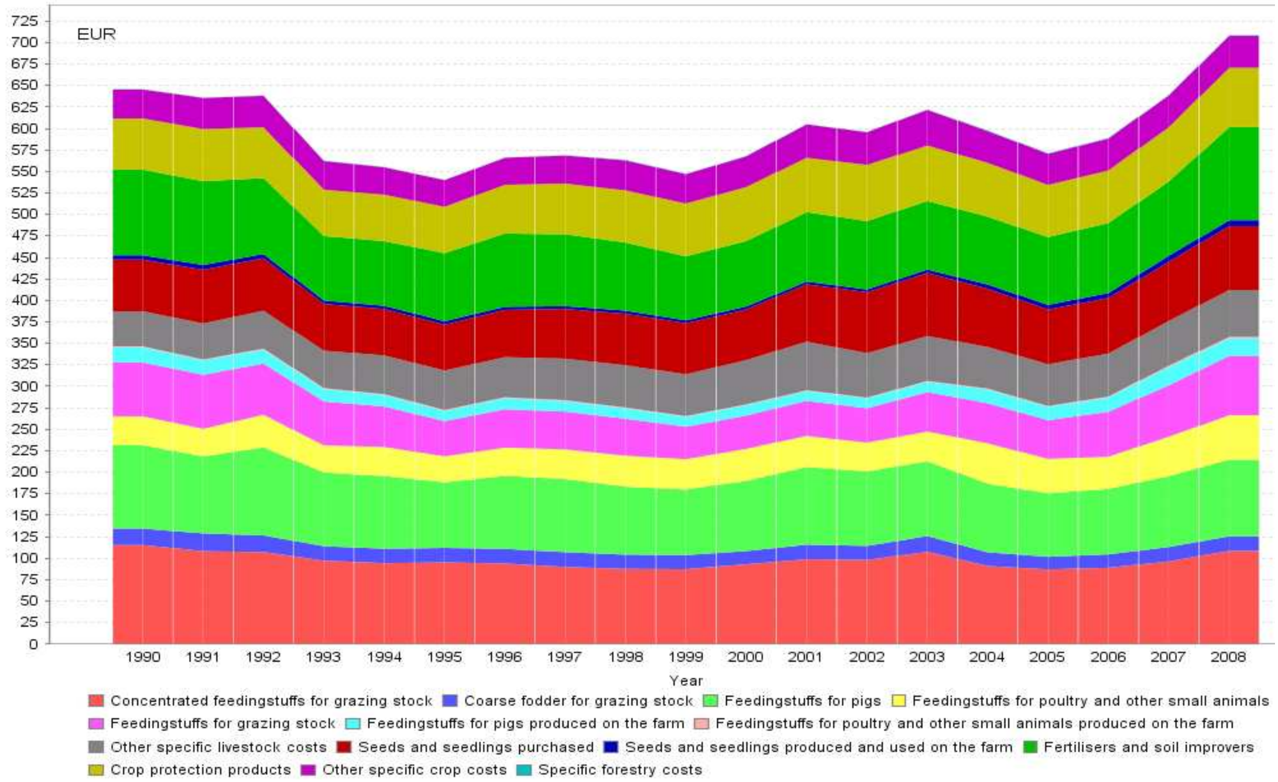
Figure 16 shows the development of sub-categories of specific costs for the EU-27 in EUR per hectare of UAA between 1990 and 2008. The first cost category "concentrated feedingstuffs for grazing stock" is located at the bottom of the graphic, whereas the last cost category "specific forestry costs" is located at the top of the graphic. The total amount of total specific costs is decreasing in the time span of 1992 to 1999 from about 640 EUR per hectare of UAA to roughly 547 EUR per hectare of UAA and increasing afterwards up to about 708 EUR per hectare of UAA. The picture also shows that the relative share of each subcategory of total specific costs does not change very much.

Figure 15: Development of the main cost categories in EUR per hectare in the EU-27 between 1990 and 2008



Source: FADN data mining tool (FADN, 2011).

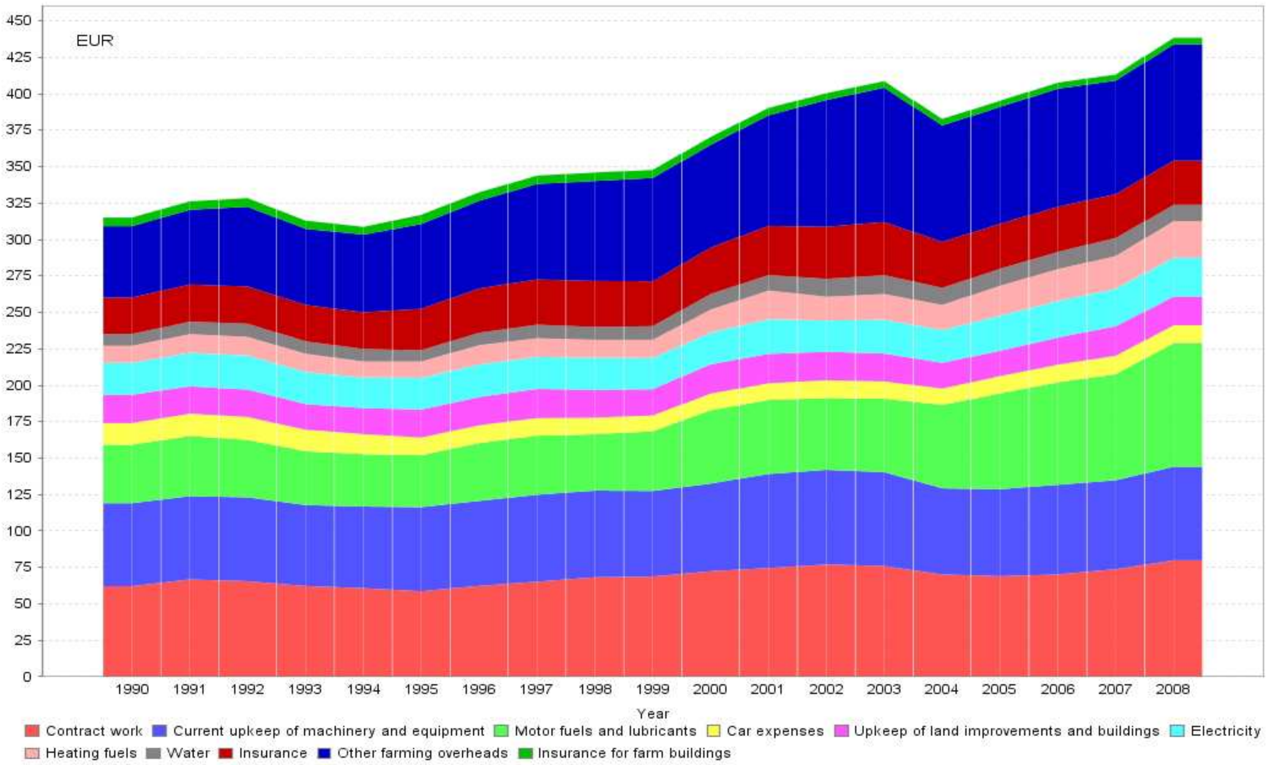
Figure 16: Development of the subcategories of total specific costs in EUR per hectare of UAA in the EU-27 between 1990 and 2008



Source: FADN data mining tool (FADN, 2011).

Figure 17 depicts the development of the subcategories of total farm overhead in the EU-27 in EUR per hectare of UAA between 1990 and 2008. The picture shows that total farm overhead increased from about 316 EUR per hectare of UAA in 1990 to about 438 EUR per hectare of UAA in 2008. Motor fuels and lubricants and other farming overheads have, in absolute terms, the most substantial part of the increase of total farm overhead.

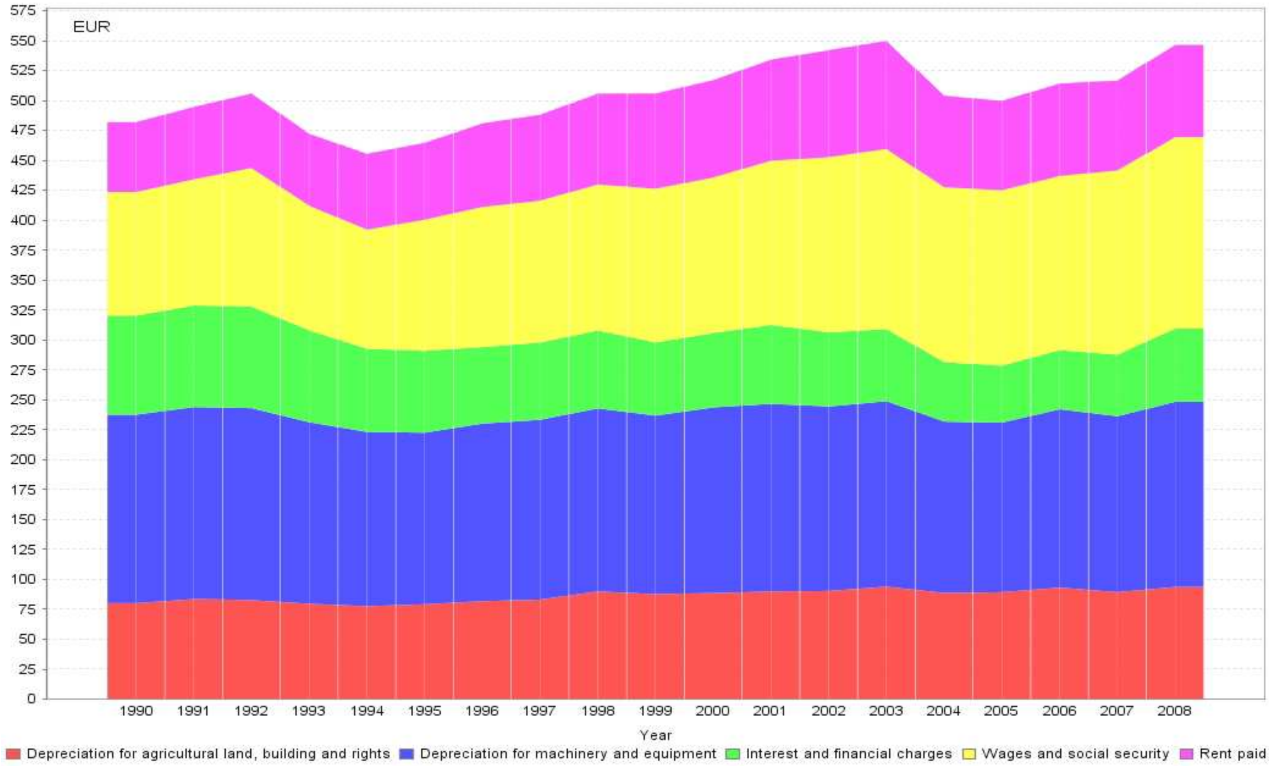
Figure 17: Development of the subcategories of total farm overhead in EUR per hectare of UAA in the EU-27 between 1990 and 2008



Source: FADN data mining tool (FADN, 2011).

Figure 18 draws the development of the subcategories of depreciation (red and blue colour) and total external factors in the EU-27 in EUR per hectare of UAA between 1990 and 2008. The value for depreciation for forestry and timber (G100DP) is not given due to missing data in the FADN data set used for the analysis. Depreciation for agricultural land, buildings and rights as well as for machinery and equipment does not change very much and lies between 223 and 250 EUR per hectare of UAA for the years from 1990 to 2008. The subcategories of total external factors are much more volatile. On the one hand, interest and financial charges decrease from about 83 EUR per hectare of UAA in 1990 to roughly 61 EUR per hectare of UAA in 2008. On the other hand, wages and social security as well as rent paid increases substantially. From 1990 to 2008 wages and social security increases from about 103 EUR per hectare of UAA to roughly 160 EUR per hectare of UAA and rent paid increases from about 59 EUR per hectare of UAA to 77 EUR per hectare of UAA.

Figure 18: Development of the subcategories of depreciation and total external factors in EUR per hectare of UAA in the EU-27 between 1990 and 2008



Source: FADN data mining tool (FADN, 2011).

As described in RI/CC 1256 (rev. 7) (2011), rent paid for land (F86) is part of total rent paid (F85). In consequence, rent paid for land must be lower or equal to total rent paid. This does not hold for the EU-27 in the years from 1990 to 2001. Afterwards, the value of rent paid for land declines rapidly from 2001 and finally becomes zero in the years from 2005 to 2008. Both facts indicate that these bookkeeping positions are not consistent with the current definition or that F86 is used for other information. Guastella et al. (2012: p. 19) state in information from DG AGRI that F86 has been available since the 2009 version of the FADN data files and therefore F86 is may not, as defined in RI/CC 1256 (rev. 7) (2011), be applicable for our purpose.

4.7 Land rent and land value – extraction rules

Crucial information for modelling is the amount of rent paid for land as well as the value of owned land. Therefore, in the remainder of this chapter we take a closer look at the farms' rented and owned land. Deliverable 6.1 “Land Price Data in the FADN Database” Guastella et al. (2012) provides a comprehensive elaboration of this topic. To obtain the value of land in EUR per hectare, we distinguish between rented and owned land.

Table 11 defines the extraction rules for gross rent and net rent as well as the value of owned land. Furthermore in Column Three it shows which abbreviation is used in the data mining tool and in Column Four which FADN Table provides the desired information. The gross rent is captured by FADN Table F heading 85 (F85: rent paid) if SE030 (utilised agricultural area rented by the holder under a tenancy agreement) is greater than zero. The net rent is gross rent minus the sum of the total amount of payments for rented or leased quotas not attached to land (recorded in FADN Table L). The gross rent and net rent has to be divided by SE030 to obtain the rent per hectare. The value of the owned land can be extracted from FADN Table G. It is equal to the closing valuation of agricultural land (G95CV), if both the UAA is in owner occupation (B48) and the opening valuation of agricultural land (G95BV) is greater than zero. Dividing the value of owned land by the owned area yields the value of owned land per hectare.

Table 11: The identification of rented and owned land in EUR or EUR per ha

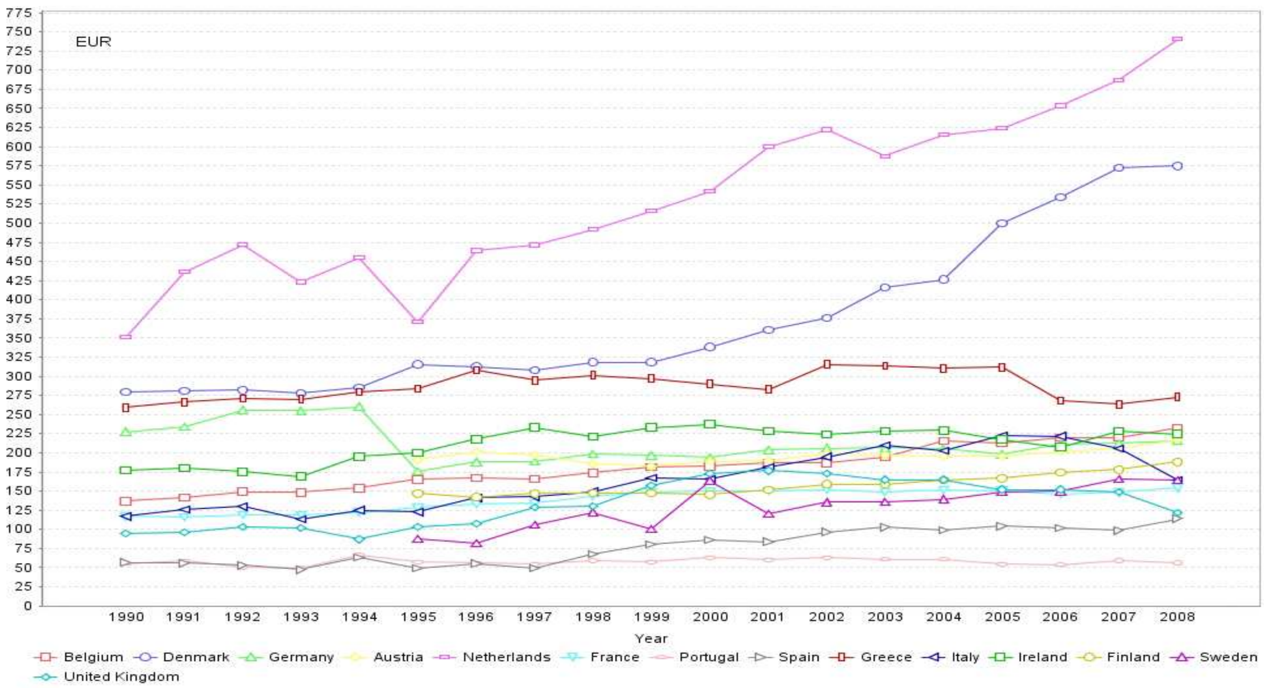
Value of land		Abbr.	FADN Table	Extraction rule for rented and owned land calculation
Gross Rent	**a**	**GROSSRENT**	**F,SE**	**(F85 and SE030) > 0 àF85**
Gross Rent per hectare of UAA			SE	a/SE030
Net Rent	**b**	**NETRENT**	**L**	**a – L(401G,402G,404G,421G..423G,441G,442G,470G,499G)**
Net Rent per hectare of UAA			SE	b/SE030
Value of owned Land	**c**	**OWNED**	**B,G**	**(B48 and G95BV) > 0 à G95CV**
Value of owned Land per hectare of UAA				c/B48

Source: Guastella et al. (2012), own composition.

4.8 Results and problems for land rent and land value

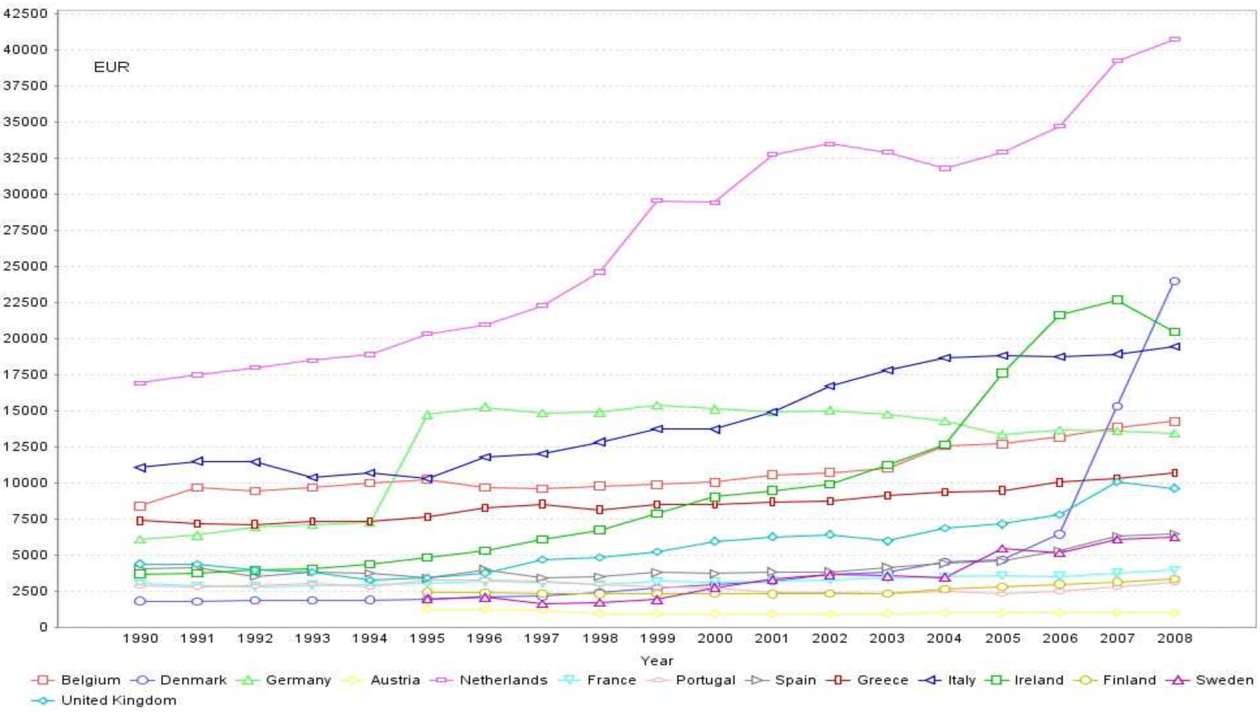
Figure 19 and Figure 20 depict the net rent paid per UAA hectare and value of owned land per UAA hectare for the EU-15. The Netherlands have the highest values for net rent paid and value of owned land. Net rent paid per UAA hectare increased from about 350 EUR in 1990 to roughly 750 EUR in 2008 and the value of owned land per UAA hectare increased from circa 17,000 EUR in 1990 to almost 41,000 EUR in 2008. Denmark also shows strongly increasing values for net rent paid per hectare of UAA. In the other countries the increases are smaller and the levels obtained in 2008 significantly lower. Except for the Netherlands, all the other countries of the EU-15 aggregate started with values of owned land between 2,000 and 12,000 EUR per UAA hectare and ended up in 2008 with values between roughly 1,000 and 24,000. This differs markedly from the Netherlands' values. Denmark shows a strong increase of the value of owned land per UAA hectare from roughly 4,700 EUR in 2005 to roughly 24,000 EUR in 2008. The picture also shows that the there is a structural break for net rent paid and value of owned land paid per UAA hectare from 1994 to 1995 in Germany due to the inclusion of East Germany.

Figure 19: Net rent paid in EUR per hectare of UAA for the EU-15 countries between 1990 and 2008



Source: FADN data mining tool (FADN, 2011)

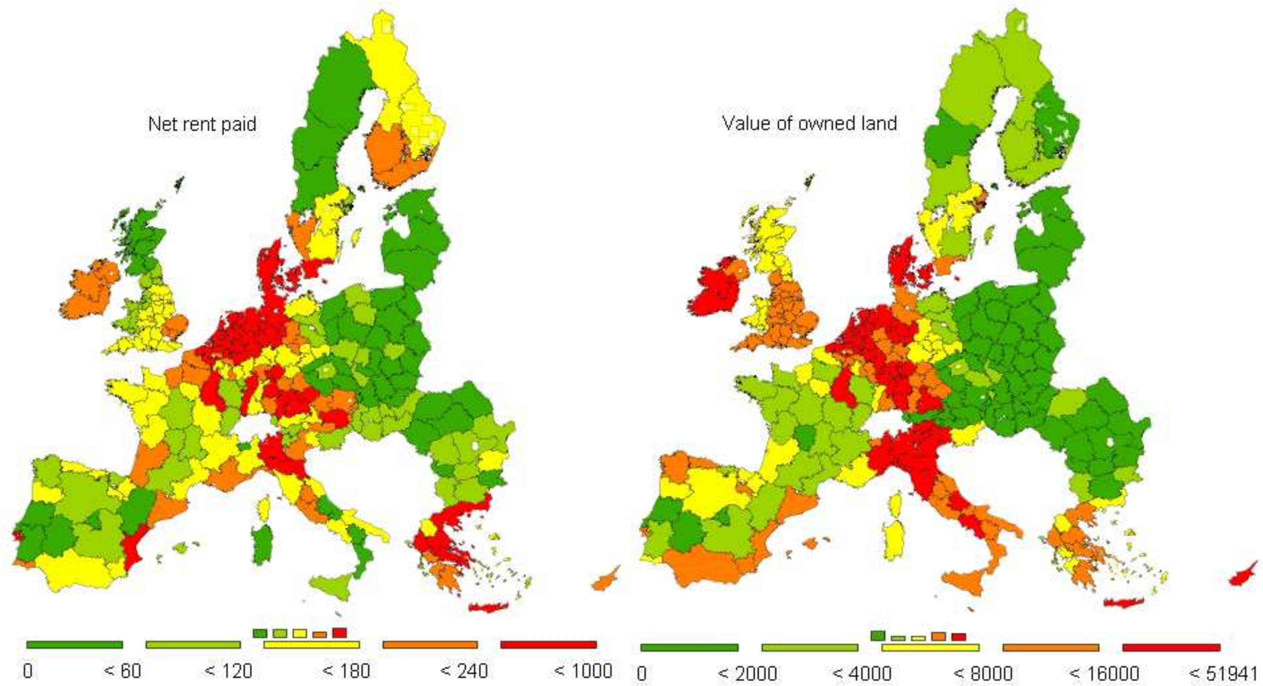
Figure 20: Value of owned land in EUR per hectare of UAA for the EU-15 countries between 1990 and 2008



Source: FADN data mining tool (FADN, 2011).

Figure 21 shows two maps. The left map depicts net rent paid per hectare of UAA and the right map shows the value of owned land per hectare of UAA for every NUTS II region for the EU-27 in 2008. In both maps the NUTS II regions are coloured from green (lowest quintile) over yellow to red (highest quintile). The lowest values of net rent paid per hectare of UAA are observed in East Europe, Sweden, Scotland and large parts of the Iberian Peninsula. In contrast, the highest values of net rent paid per hectare of UAA can be found on the strip from Southern Finland over Denmark, Northern and Western Germany to The Benelux and Northern France; from Southern Germany over Austria to the Po Valley and in Greece and Eastern Spain. The highest values for owned land per hectare of UAA are reached on the strips extending from Denmark over Northern and Western Germany, as also from the Benelux to Southern Germany; in Northern and Central Italy, as well as Ireland, whereas the lowest values of owned land can be found in Eastern Europe. This figure also shows that in most cases the regions with higher values of owned land per hectare of UAA also have higher values for net rent paid per hectare of UAA.

Figure 21: Net rent paid in EUR per hectare of UAA and value of owned land in EUR per hectare of UAA for the EU-27 at NUTS II level in 2008



Source: FADN data mining tool (FADN, 2011).

4.9 Grants and subsidies – extraction rules

The Common Agricultural Policy evolved from a system of market support to a system of direct payments. These direct payments were coupled to the production, which biased the economic incentive and distorted markets. In the year 2004 the MTR reform package and in the year 2006 the Health-Check introduced the decoupling of these direct payments. However, not all MS implemented the decoupling of payments in the same manner. Some MS only decoupled partially, while some completely decoupled the payments. Furthermore, the distribution of the decoupled money to the farmer also differed. Some MS, such as Germany and England, introduced the decoupled money as a regional flat rate for all farmers with equal per hectare rate. Some MS opted for the so-called historical model, in which the decoupled money remained by the farm. This diversity resulted in a complex accounting scheme in FADN. The main challenge for developing the extraction rules in this chapter is to link the decoupled payments to the production activities, inputs or products. The decoupled payments of the Single Payment scheme and all payments for rural development are accounted as a payment to the farm.

The structure and grouping of payments schemes in Table 12 and related extraction rules follow the calculation of the standard results (RI/CC 882 (rev. 9), 2011). The categories and sub-categories of grants and subsidies are given in Column One and the last column refers to the extraction rules. The third column lists the abbreviation of each category of grants and subsidies used in the FADN data mining tool. The categories comprise total subsidies excluding on investments, total subsidies on crops and livestock, other subsidies, support payments related to Article 68 of Council Regulation (EC) No 73/2009, total support for rural development, subsidies on intermediate consumption and on external factors, as well as decoupled payments.

Table 12: Extraction rules for grants and subsidies from Table J and M in FADN

Categories of grants and subsidies		GAMS Abbr. for subsidy positions	FADN Table	Extraction rule for each category of grants and subsidies
Total subsidies excluding on investments		**SUBTOT**	**J+M**	**Sum(a+b+c+d+e+f+g+h)**
Total subsidies on crops	**a**	**SUBCRO**	**J+M**	
Compensatory payments per area		SUBCRO_COP	J+M	<2000: JC600(2); 2000-: M(602CP...614CP)+M618CP+M(622CP...629CP)+ M(632CP...634CP)+M638CP+M655CP
Set aside premiums		SUBCRO_SETA	J+M	1989-1999: JC146; 2000-: M650CP
Other crops subsidies		SUBCRO_OTHER	J	JC(120...145)+JC146(>2000) +JC(147...161)+JC185+ JC(281...284)+JC(296...301)+JC(326...357)+JC(360...374)+JC952
Total subsidies on livestock	**b**	**SUBLIV**	**J+M**	
Subsidies dairying		SUBLIV_DAIR	J+M	JC30+JC162+JC163+M770CP-L401F
Subsidies other cattle		SUBLIV_OTCA	J+M	JC(23...29)+JC(31...32)+JC52+JC307+M700CP
Subsidies sheep and goats		SUBLIV_SHGO	J	JC(38...41)+JC(54...55)+JC(164...168)+JC308
Other livestock subsidies		SUBLIV_OTHER	J	JC22+JC(33...34)+JC(43...51)+JC(56...58)+ JC(169...171)+JC(309...311)+JC313+JC951
Support payments Article 68	**c**	**SUBART**	**J**	**JC956**
Other subsidies	**d**	**SUBOTH**	**J**	**JC172+JC(177...178)+JC(180...182)+JC950+JC998+JC999**
Total support for rural development	**e**	**SUBRUR**	**J**	**e1+e2+e3+JC(173...176)+JC179**
Environmental subsidies	e1	SUBRUR_ENV	J	JC800+JC810
Agri-environment and animal welfare payments		SUBRUR_ENV_AEAWP	J	JC800
Natura 2000 payments		SUBRUR_ENV_N2000		JC810
LFA subsidies	e2	SUBRUR_LFA	J	JC820
Other rural development payments	e3	SUBRUR_OTHER	J	JC830+JC835+JC840+JC900+JC910+JC953
Support provided for meeting standards		SUBRUR_OTHER_MEETSUP		JC830
Support for the costs of using advisory services		SUBRUR_OTHER_COSTADVISORY		JC835
Support for the partici-pation of farmers in food quality schemes		SUBRUR_OTHER_PARTQUAL		JC840
Support granted for the first afforestation of agricultural land		SUBRUR_OTHER_AFFORES		JC900
Other support to forestry		SUBRUR_OTHER_OTHFOR		JC910
Grants and subsidies to rural development not included in the codes presented above		SUBRUR_OTHER_OTHER		JC953
Subsidies on inter-mediate consumption	**f**	**SUBCON**	**J**	**JC(60...82)+JC84+JC87**
Subsidies on external factors	**g**	**SUBFAC**	**J**	**JC59+JC85+JC89**
Decoupled payments	**h**	**SUBDEC**	**J**	**JC670+JC680+JC955**
Single farm payment		SUBDEC_SFP	J	JC670
Single area payment		SUBDEC_SAP	J	JC680
Additional aid		SUBDEC_ADAI	J	JC955

Source: FADN data mining tool (FADN, 2011).

The extraction rules use the headings of the FADN table D, K, F, M and E to relate the coupled support to the production activity in the accounts. Table 13 gives an overview of how these relate to the corresponding FADN Tables. For instance, the accounting position JC30 is the amount of subsidies paid for the production activity recorded in the heading "30" in the FADN Table D. In general, the subsidies on livestock (JC22...JC50) refer to the accounting position for the headings of livestock in Table D (D22...D50) excluding cattle subsidies in code JC700. The relationship between the accounting position of Table J and corresponding FADN Table is also applicable in a similar way for the other extraction rules.

Table 13: Overview of the relation of grants and subsidies to corresponding headings of FADN Table D, K, E, F and M

Category of grants and subsidies and FADN codes	Corresponding FADN Table and headings or subheadings	Notes
Livestock (JC22...JC50)	Table D (D22...D50)	Excluding cattle subsidies (JC700/M700)
Crop products (JC120...JC161)	Table K (K120...K161)	
Animal products (JC162...JC171,JC307...JC311)	Table K (K162...K171,K307...K311)	
Livestock purchases (JC51,JC52,JC54…JC58)	Table E (E51,E52,E54...E58)	
Costs (JC59...JC82,JC84,JC85,JC87,JC89)	Table F (F59...F82,F84,F85,F87,F89)	
Premiums for protein crop (JC600) Single payment scheme (JC670) Single area payment scheme (JC680) Premiums for beef and veal (JC700)	Table M (M600,M670,M680,M700)	

Source: FADN, own composition.

Table 14 depicts this relationship in more detail. The table reads as follows: The compensatory payments per area are recorded as a total payment per farm in the FADN account "JC600" before the year 1999. We distribute this amount to each crop activity using the relative shares of each crop in the farm. From 2000 onwards, the compensatory payments are recorded in more detail. For the oilseeds and cereals activity aggregate the sum of the compensatory payments are distributed to each crop activity using the relative share of that crop activity group.[11] For the oilseeds activities any additional payments for the oilseeds activity group (JC132), which are not covered by each activity, are distributed to each oilseeds activity using the relative share of that activity to the oilseeds activity group. This exercise was also done for the crop activities apples/peaches and other fruits (JC152) as well as table olives and olives for oils (JC154).

[11] The subsidies for other crops are not yet consistently allocated to the activities or categories of activities of crop production. Therefore the sum of subsidies, which is calculated correctly, of other crops allocated to each crop activity must be smaller than the value of other crops subsidies calculated as stated in Table 12. For the subsidies for other cattle, sheep and goats as well as other livestock a few subsidy payments are allocated to the corresponding aggregate of animal activities, because they cannot directly be allocated to a certain activity (see italic accentuation in Table 14).

Table 14: Total subsidies on crops and livestock and corresponding crop and animal production activities

Total subsidies on crops	GAMS Abbr. for for subsidy positions	Activities or categories of activities of crop production	Extraction rule for each category of subsidy and production activity
Compensatory payments per area	SUBCRO_COP	All crop activities (<2000)	JC600
		Certain crop activities (2000-):	
		Oilseeds	M(603CP,623CP,655CP)
		Cereals	M(602CP,605CP,606CP,608CP,618CP,622CP, 625CP,626CP,628CP,638CP)
		Pasture	M611CP
		Pulses	M(604CP,614CP,624CP,634CP)
		Fodder maize	M(607CP,627CP)
		Flax and hemp	M(612CP,613CP,632CP,633CP)
		Other crops	M(609CP,610CP,629CP)
Set aside premiums	SUBCRO_SETA	Set aside [1)]	1989-1999: JC146; 2000-: M650CP
Other crops subsidies	SUBCRO_OTHER	Cereals:	
		Soft wheat	JC120
		Durum wheat	JC121
		Rye and Meslin	JC122
		Barley	JC123
		Oats	JC124
		Grain Maize	JC126
		Paddy rice	JC127
		Other cereals	JC125+JC128
		Oilseeds:	
		Rape	JC331
		Sunflower	JC332
		Soya	JC333
		Other oils	JC334
		Other arable crops:	
		Pulses	JC129+JC330+JC360+JC361
		Potatoes	JC130
		Sugar beet	JC131
		Flax and hemp	JC347+JC364
		Tobacco	JC134+JC(365...372)
		Other industrial	JC133+JC135+JC(345,346,348,373,374)
		Other crops	JC(139,142,143,146(>1999),148,149,156,158, 159,160,161,185,284,296...301,952)
		Vegetables and permanent crops:	
		Tomatoes	JC337
		Other Vegetables	JC136+JC137+JC138+JC(335,336,338...340)
		Apples/peaches	JC349
		Other fruits	JC(350...353)+JC341
		Citrus fruits	JC153+JC(354...357)
		Table grapes	JC285
		Olives for oil	JC282+JC283
		Table olives	JC281
		Wine	JC155+JC(286,288,289,291...295,304)
		Nurseries	JC157
		Flowers	JC140+JC141+JC(342...344)
		Fodder activities:	
		Fodder maize	JC326
		Fodder roots crops	JC144
		Pasture	JC150+JC151
		Fodder on other arable land	JC147+JC145+JC(327..329)

1) JC146/M650CP is only attributed to the activity set aside (SETA) which has the FADN code K146OU (see Table 3).

Table 15: Total subsidies on crops and livestock and corresponding crop and animal production activities **– continuation**

Total subsidies on livestock	GAMS Abbr. for for subsidy positions	Activities or Categories of activities of animal production	Extraction rule for each category of subsidy and production activity
Subsidies dairying	SUBLIV_DAIR	Dairy cows (sub-category of cattle)	JC30+JC162+JC163+M770CP
Subsidies other cattle	SUBLIV_OTCA	Cattle	JC52+JC307+JC31+M700CP
		Other cows	JC32
		Male adult cattle	JC25+JC27
		Heifers fattening	JC29+WEGT*JC26 [2)]
		Heifers breeding	JC28+WEGT*JC26
		Fattening male calves	0.5*JC23
		Fattening female calves	0.5*JC23
		Raising male calves	0.5*JC24
		Raising female calves	0.5*JC24
Subsidies sheep and goats	SUBLIV_SHGO	Goats and sheep	JC54+JC55+JC166+JC308
		Milk ewes and goat	JC38+JC40+JC164+JC165+JC167+JC168
		Sheep and goat fattening	JC39+JC41
Other livestock subsidies	SUBLIV_OTHER	Other animals	JC56+JC309
		Pig fattening	JC45+JC46
		Pig breeding	JC44
		Laying hens	JC48+JC169
		Poultry fattening	JC47+JC49+JC310
		Other animals	JC50+JC22+JC33+JC34+JC43+JC51+JC57 +JC58+JC170+JC171+JC311+JC313+JC951

2) WEGT = Weighting factor to calculate the correct numbers for heifers breeding or fattening.

Source: FADN data mining tool (FADN, 2011).

4.10 Results and problems for grants and subsidies

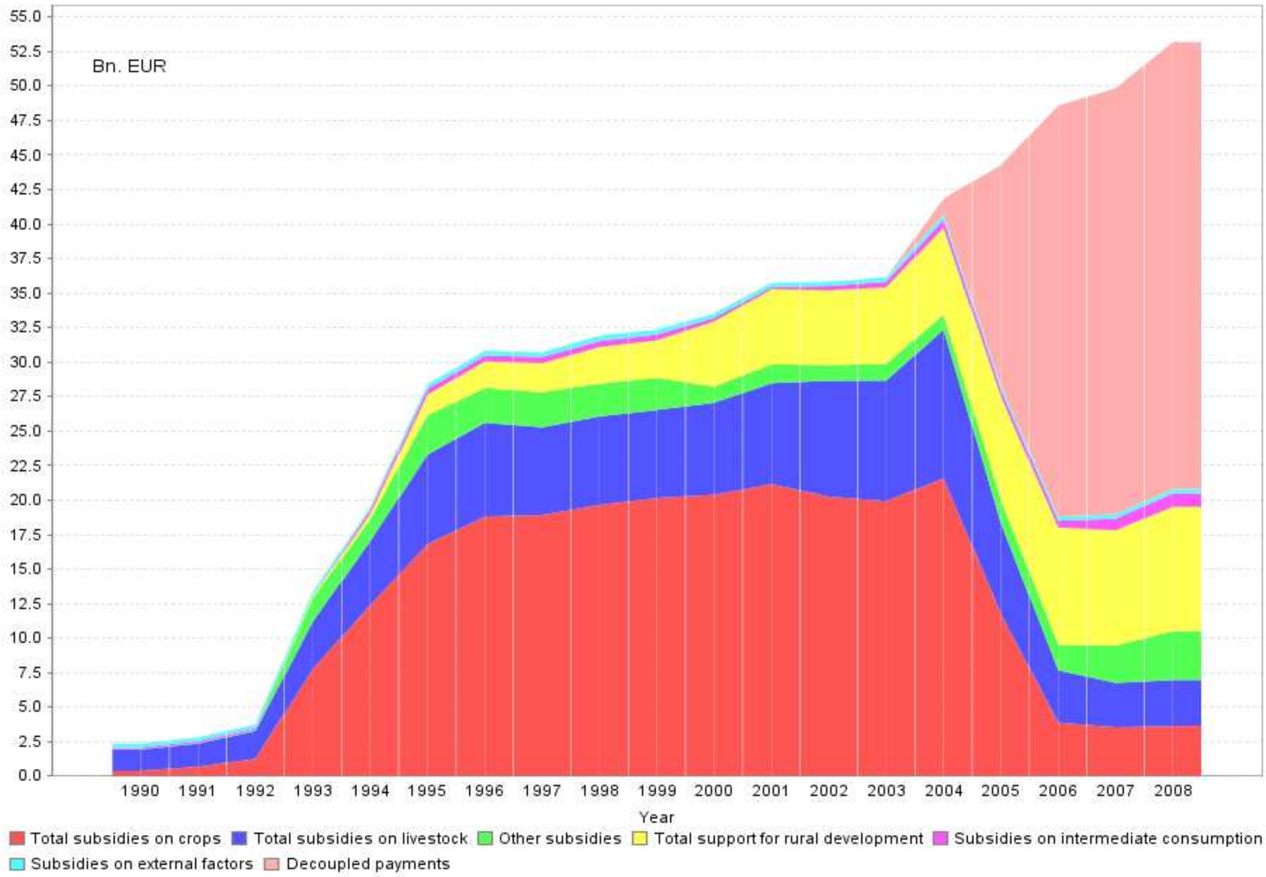
The following problem occurred when applying the extraction rules for grants and subsidies:

No values can be found for the all accounting positions for subsidies paid for article 68 (JC956, JC921-JC928) in the current FADN database. This is also true for the standard result aid for article 68 (SE650).

Although the position JC955 and JC956 are used in the formula for calculating the standard results for additional aid (SE640) and Aid for article 68 (SE650) in RI/CC 882 (rev. 9) (2011) in the latest official document RI/CC 1256 (rev. 7) (2011) these accounting positions cannot be found. It seems that some small inconsistencies exist between the latest official documents.[12]

[12] All relevant revisions for the RI/CC 1256 and RI/CC 882 can be found in http://circa.europa.eu/Public/irc/agri/rica/library?l=/information_documentatio/basic_definitions&vm=detailed&sb=Title

Figure 22: Development of different subsidy categories in EUR of the EU-27 between 1990 and 2008

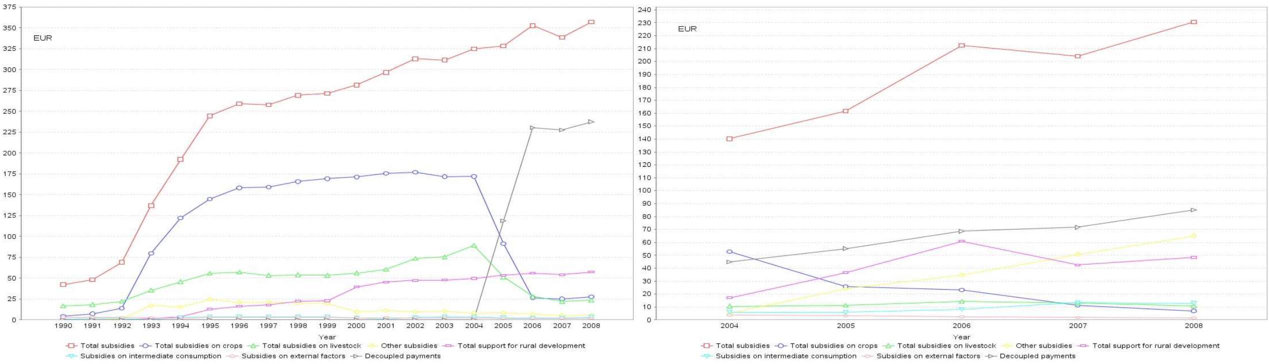


Source: FADN data mining tool (FADN, 2011).

Figure 22 shows the development of all subsidy categories gathered from Table J and M for the EU-27 member states from 1990 to 2008. The amount of total subsidies increased over the years. From 2004, the amount of decoupled payments increased and at the same time the total coupled subsidies on crops declined, a consequence of the implementation of the MTR. Decoupled payments became the biggest part in the budget of grants and subsidies in the EU-27. Similarly, total subsidies on livestock increased until 2004 and decreased afterwards. The total subsidies on rural development (Pillar II) increased, whereas subsidies on external factors and subsidies on intermediate consumption are rather small.

Figure 23 relates the subsidies to the UAA aggregated for the EU-15 and the EU-12. For the EU-15 member states the total subsides per hectare on average increased from about 42 EUR in 1990 to about 357 EUR in 2008, whereas in the EU-12 the average value of total subsidies per hectare was about 230 EUR in 2008. As shown above, the decoupled payments became the most important source of subsidies. Decoupled payments per hectare in the EU-15 account on average for 240 EUR in 2008. For the EU-15, this is almost twice the sum of the other subsidies. Decoupled payments per hectare are also the biggest part of subsidies in the EU-12, but they are less important. Other subsidies per hectare play a much more important role in the EU-12 compared to the EU-15.

Figure 23: Different categories of subsidies in EUR per hectare for the EU-15 between 1990 and 2008



Source: FADN data mining tool (FADN, 2011).

4.11 Income – extraction rules

Table 16 relates to Figure 5 and comprises the different income categories and how they are calculated. The first column lists the name of the income category respectively the variables that are used to calculate a specific income category. Column Two presents the abbreviation used in the FADN data mining tool and Column Three contains the corresponding FADN Tables for a specific income category. The last column gives some further information to some indicators when necessary.

Gross farm income (GROSSINC) is the main income category and is calculated from the sum of total output (TOUT) and total subsidies (SUBTOT), deducting total intermediate consumption (total specific costs (CSPE) and total farm overhead (COVE)), taxes (TAXES) and VAT balance (VATBALANCE). Total output comprises the total production value of crops and crops products (see Table 3, Column Five), the total production value of livestock and livestock products (see Table 6, Column Four; Table 7 and Table 8) as well as the production value of other output.[13] Total specific costs and total farm overheads and their position in the FADN Tables are listed in Table 10. Farm net value added (FARMNETVA) can be obtained by deducting depreciation (CDEP) (see Table 10) from gross farm income. Farm net income (FARMNETINC) is determined by farm net value added plus balance of current subsidies and taxes on investments (BALCURSUBTAX) and deducting total external factors (CEXT) (see Table 10). In case the farm is a family farm, the farm net income is also called family farm income. Finally, both income categories "farm net value

[13] Other output comprises production values of forestry and other products not belonging to crop or animal activities like farm tourism. The total production value of headings (149; 172...181) of FADN Table K are belonging to other output.

added" and "farm net income" are related to the annual work unit and the family work unit. The extraction rule for annual work units adds the accounting positions C01AW to C07AW, C09AW and C10AW as well as C08HR/C08NB and C11HR/C11NB.[14] The family work units are derived by C01AW to C07AW and C08HR/C08NB.

Table 16: Income categories in EUR

Categories of income	GAMS Abbr. for the income categories	FADN Table	Notes
Gross farm income =	**GROSSINC**		
+ Total output	TOUT	E,D,K	Total output of crops and products, livestock and products, other output
- Total intermediate consumption	CSPE + COVE	F	Total specific costs + total farm overhead
+ Total subsidies excl. on investments	SUBTOT	J	
- VAT balance excl. on investments	VATBALANCE	I	
- Taxes	TAXES	F, J	
Farm net value added =	**FARMNETVA**		
+ Gross farm income			
- Depreciation	CDEP	G	
Farm net income =	**FARMNETINC**		
+ Farm net value added			
+ Balance current subsidies and taxes on investments	BALCURSUBTAX	G, I, J	Subsidies on investments + Payments to dairy outgoers – VAT on investments
- Total external factors	CEXT	F	Wages, rent and interest paid
Family farm income	**FAMILYFARMINC**		If family work unit is greater than 0

Source: FADN, own composition.

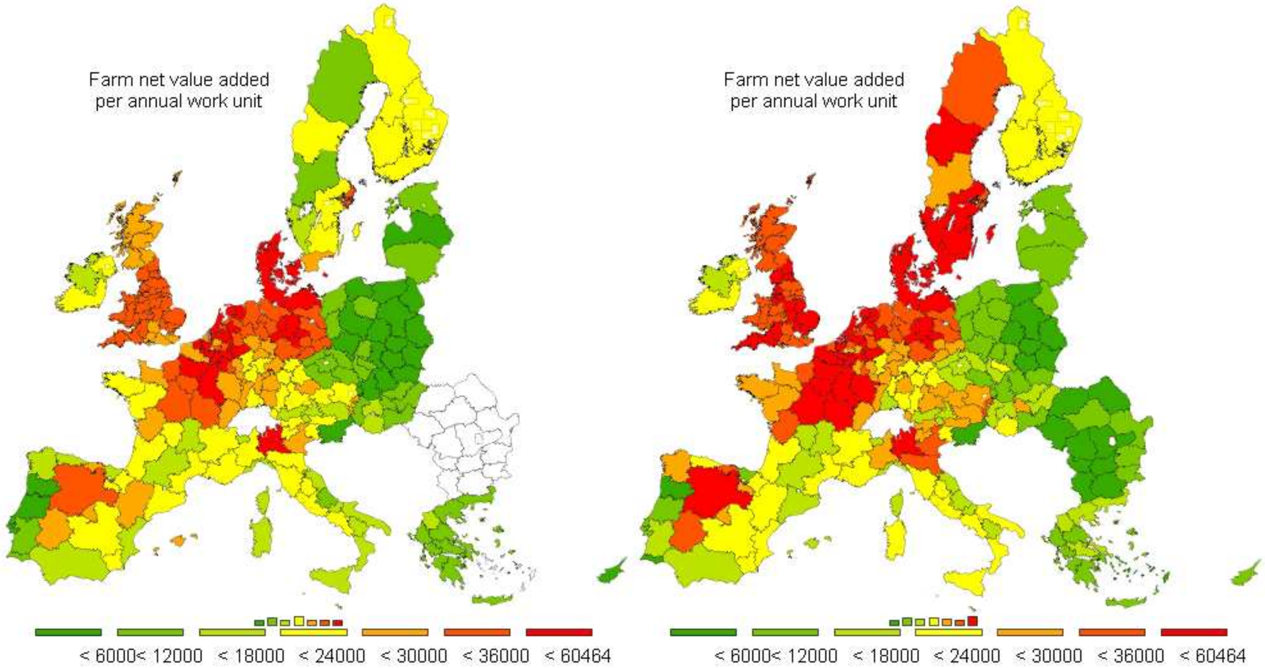
4.12 Results and problems for income

Figure 24 maps the distribution of farm net value added per annual work unit for all NUTS II regions in the EU-27 for 2004 and 2008. The regions are divided into 7 classes. From 2004 to 2008 the values of net value added per annual work unit rose and therefore in 2008 more NUTS II regions are located in the sixth and seventh class. In 2004, Ireland, Eastern, Northern and Southern Europe are generally characterized by middle or low farm net value added per annual work unit. The highest net value added per annual work unit can be found in Central Europe, United Kingdom, some parts of Scandinavia, Spain and Italy. In 2008 the general picture does not change significantly. The biggest difference compared to 2004 can be found in Sweden for

[14] The formula to derive annual work units and family work units in RI/CC 882 (rev.9) (2011: 11) both needs a regional or national average calculation for casual unpaid and paid labour. This step was not necessary given that the FADN data set included already the information necessary to calculate C08AW = C08HR/C08NB and C11AW = C11HR/C11NB.

regions that did not belong to the sixth and seventh class with highest net value added per annual work unit in 2004.

Figure 24: Farm net value added per annual work unit in EUR for the EU-27 NUTS II regions in 2004 (left) and in 2008 (right)



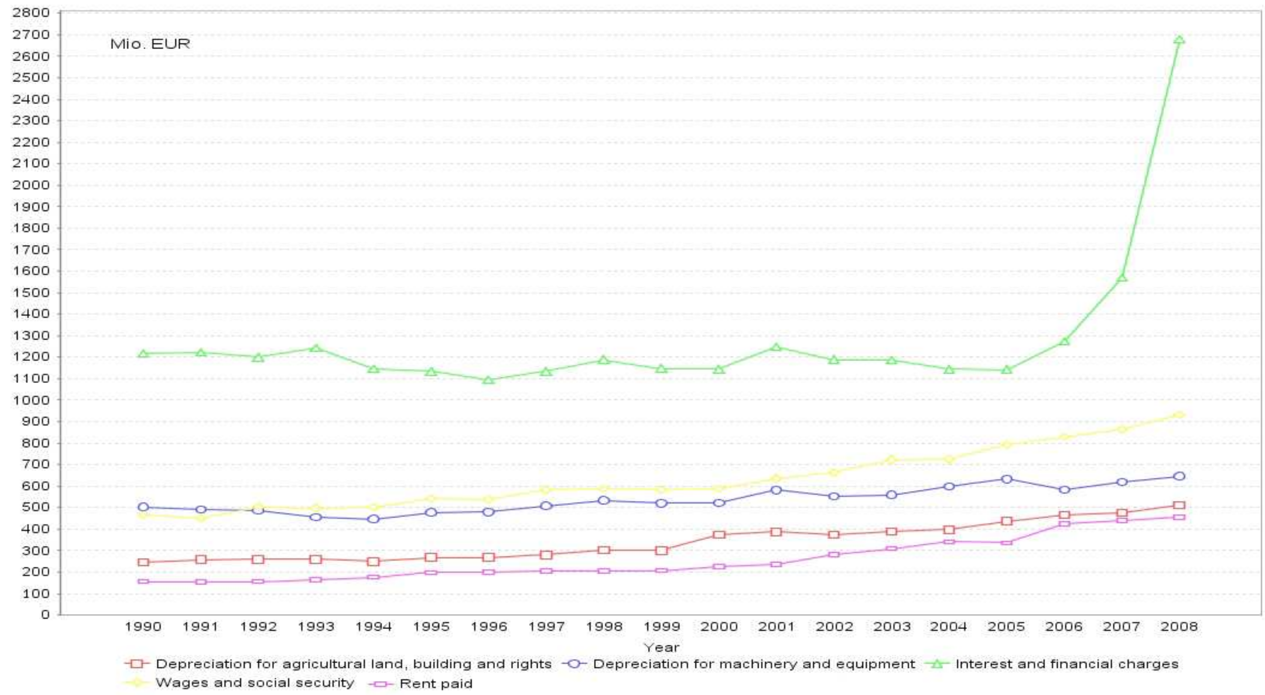
Source: FADN data mining tool (FADN, 2011).

Figure 25 shows farm net income in EUR per annual work unit for the EU-15. Belgium has the highest values, whereas in most years the lowest values are observed in Portugal. The strong decline of Denmark's farm net income per annual work unit in 2008 is remarkable. In Table 16 one can see that the farm net income is dependent on farm net value added (and thus depreciation), balance of subsidies and taxes on investments and total external factors. Depreciation and total external factors are the most important values influencing farm net income. Therefore, Figure 26 depicts the absolute values of the sub-categories of depreciation and total external factors in Denmark.

Figure 25: Farm net income in EUR per annual work unit for the EU-15 countries between 1990 and 2008

Source: FADN data mining tool (FADN, 2011).

Figure 26: Cost categories in EUR influencing farm net income of Denmark between 1990 and 2008



Source: FADN data mining tool (FADN, 2011).

Interest and financial charges increased by roughly 70 % in 2008 This is approximately equal to an absolute increase of about 21,000 EUR per annual work unit[15] and thus explains the severe decline of Danish farm net income per annual work unit in 2008. Experts from Denmark explained this development with the increased selection bias towards farms which received investment aid.

4.13 Comparing standard results

In this section of the report the control and given standard results are compared. For the standard results, which are also known as SE variables, the formulas for outputs, costs, subsidies and income are given in RI/CC 882 (rev. 9) (2011). The formulas identify the single positions in the FADN tables for every standard result. We recalculate these standard results as control variables from the relevant positions in the FADN tables and compare these values with the given standard results. This exercise is done to verify the developed extraction rules and to obtain an overview regarding the quality and consistency aspects of the data in the FADN tables. In this chapter we focus on costs, grants and subsidies as well as income regarding quality and consistency, given that larger deviations were observed in these positions.

In the **cost positions** there are no relevant percentage differences between the control and given standard results of total cost at EU or MS level. But we observed that depreciation of forestry and timber (G100DP) is not recorded. Consequently, there are some minor percentage differences for the control standard results of depreciation (G94DP+G100DP+G101DP) compared to the given standard result (SE360). But it has to be noted, that this difference for the member states or even some EU aggregates is so small, that remarkable differences between the control standard results of total costs and the corresponding given standard result variable (SE270) do not occur.

Now we examine possible differences between the control and given standard results for **grants and subsidies**. Before 2004 the SE variable "other rural development payments" (SE623) is only recorded in some countries. This causes the deviation between the control and the given standard results depicting the total support for rural development (SE624) before 2004 and is the main source for the difference between the control and given standard results for total subsidies (SE605).

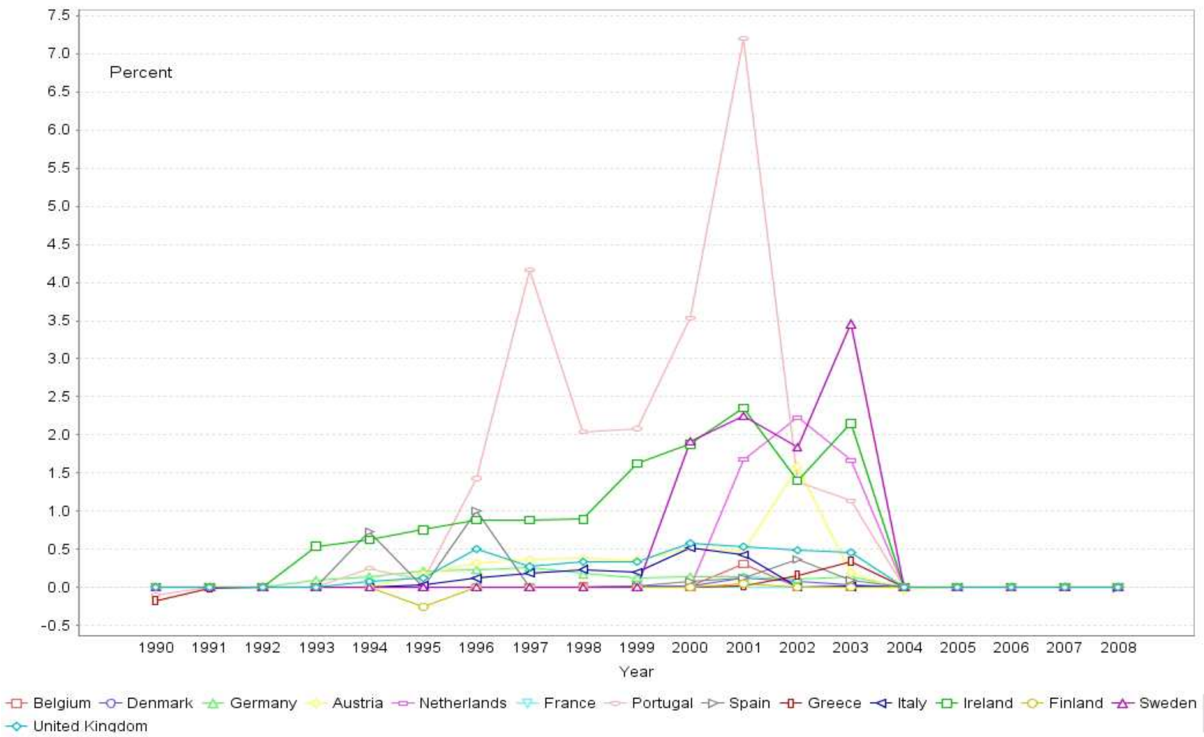
Figure 27 shows the percentage difference between the control and given standard results for total subsidies in all MS in EU-15. For the years from 2004 to 2008 the EU-15 countries do not show substantial deviations between the control and given standard results for total subsidies. Before 2004, the following problems appeared: Portugal and to a lower extent, Ireland, Sweden and the Netherlands have deviations above 1 % in total subsidies (SE605) for certain years. All other countries have small or no deviations.

[15] In 2008 interest and financial charges per annual working unit is about 52,000 EUR and in 2007 about 31,000 EUR.

Inspecting the subcategories, the deviations occur mainly for subsidies paid for rural development (SE623). However, we can observe some small deviations for Finland in 1995 in the subcategory total subsidies on livestock (0.6 %) and in 2001 in total subsidies on crops (0.18 %).

We did not present this analysis for MS in EU-12 given that no significant deviations are observed.

Figure 27: Percentage difference between control and given standard result of total subsidies for the EU-15 between 1990 and 2008



Source: FADN data mining tool (FADN, 2011).

Analysing the deviations for Portugal and Sweden at NUTS II regions (Table 17) gives the observation that the control variable is always equal or greater than the standard result. For some NUTS II regions in Portugal we observe deviations in all years. In Sweden all NUTS II regions have differences, but not for all years. Experts from DG-AGRI confirmed but could not explain these deviations.

Table 17: Percentage difference between control and given standard result of total support for rural development for the NUTS II regions of Portugal and Sweden for certain years

Country	NUTS II region	Years								
		1995	1996	1997	1998	1999	2000	2001	2002	2003
Portugal	Acores	0	0	0	0	0	0	0	0	0
	Alentejo	32	120	79	59	22	37	38	16	14
	Algarve	0	3	5	81	65	136	631	0	12
	Centro	3	6	44	5	6	3	5	3	2
	Lisboa	0	0	0	0	0	0	0	0	0
	Madeira	0	0	0	0	0	0	0	0	0
	Norte	0	0	3	6	6	6	2	4	1
Sweden	Mellersta norrland	0	0	0	0	0	5	4	9	2
	Norra mellansverige	0	0	0	0	0	7	10	9	9
	Östra mellansverige	0	0	0	0	0	4	4	6	27
	Övre norrland	0	0	0	0	0	22	7	9	2
	Småland med öarna	0	0	0	0	0	8	8	4	5
	Stockholm	0	0	0	0	0	11	1	0	13
	Sydsverige	0	0	0	0	0	7	8	3	17
	Västsverige	0	0	0	0	0	6	8	5	13

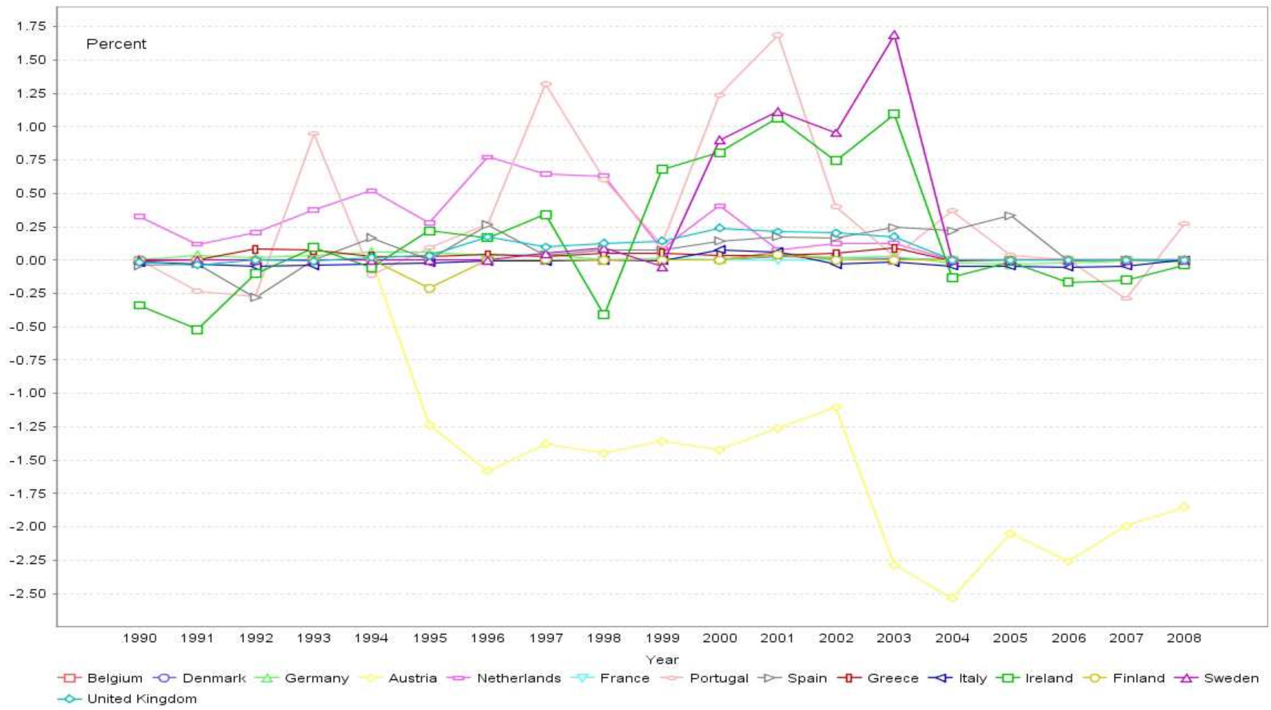
Source: FADN data mining tool (FADN, 2011).

The FADN data mining tool allows us to trace back such effects down to the single FADN accounting records. As an example, in Portugal 27 farm accounts out of 1,706 farms were responsible for the deviation in 2001. In Sweden 592 out of 915 farms caused the deviation.

In addition, we found that the formula of calculating the standard result for subsidies dairying (SE616) seems not to take into account the accounting position L401F (milk quotas – taxes). If this is included in the formula as given in RI/CC 882 (2011) then the control standard results deviates systematically from the given standard result.

Finally we are going to compare the control and given standard results for **income** and **total output**. We first investigate gross farm income (SE410). Figure 28 depicts the percentage differences for the MS in EU-15. For Austria, The Netherlands, Ireland, Portugal and Sweden the deviations are caused either by total output (SE131) deviations as given in Figure 29 and/or by a deviation of total subsidy (SE605) as presented above in Figure 27. As seen in the case of Portugal and Ireland, both deviations can cancel each other out. For the MS in EU-12 we observe negative percentage differences for total output and, hence, for gross farm income only in Slovenia (not presented).

Figure 28: Percentage difference between control and given standard result of gross farm income for the EU-15 between 1990 and 2008



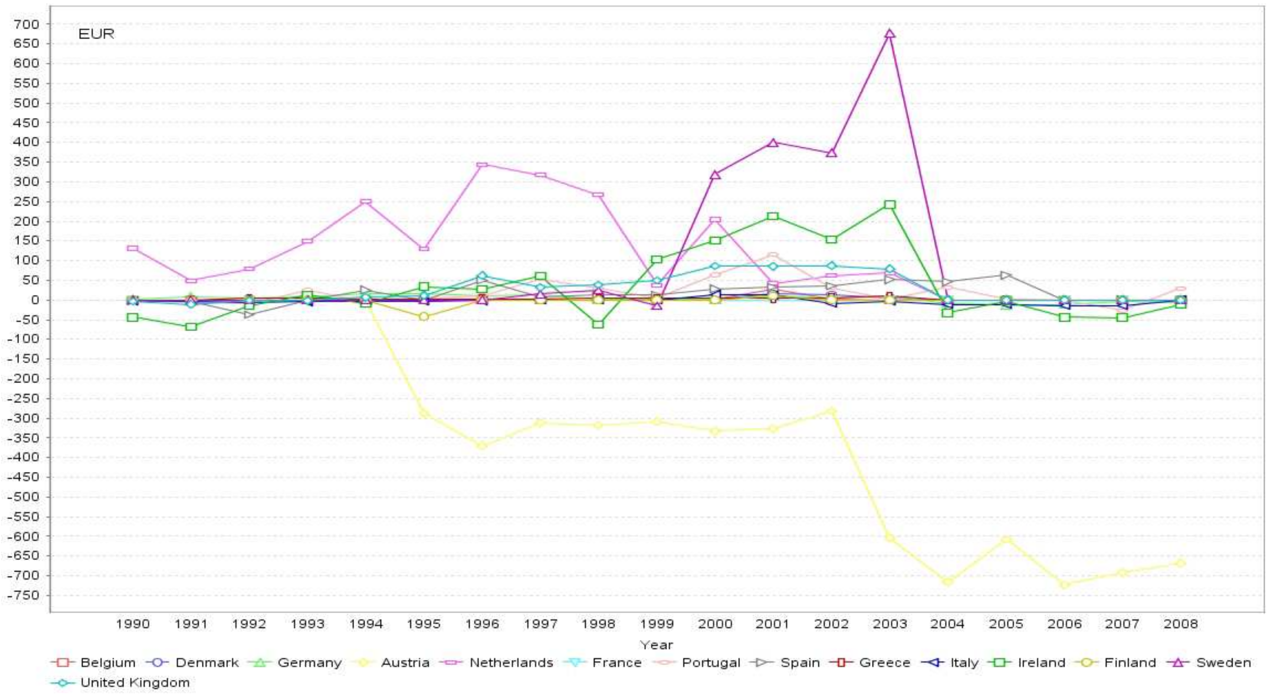
Source: FADN data mining tool (FADN, 2011).

Figure 29: Percentage difference between control and given standard result of total output for the EU-15 between 1990 and 2008

Source: FADN data mining tool (FADN, 2011).

The deviation of net value added per annual working unit is presented in Figure 30 as defined in Table 16. The figure reveals again that in Sweden the deviations mainly are caused by the differences in subsidies and hence rural development payments, and for Austria the deviations result from deviations of total output and can amount up to +/-700 EUR per annual working unit. This seems to be relatively high. However, the total income in these countries is one of the highest in the EU.

Figure 30: Absolute difference between control and given standard results of farm net value added per annual work unit in EUR for the EU-15 between 1990 and 2008



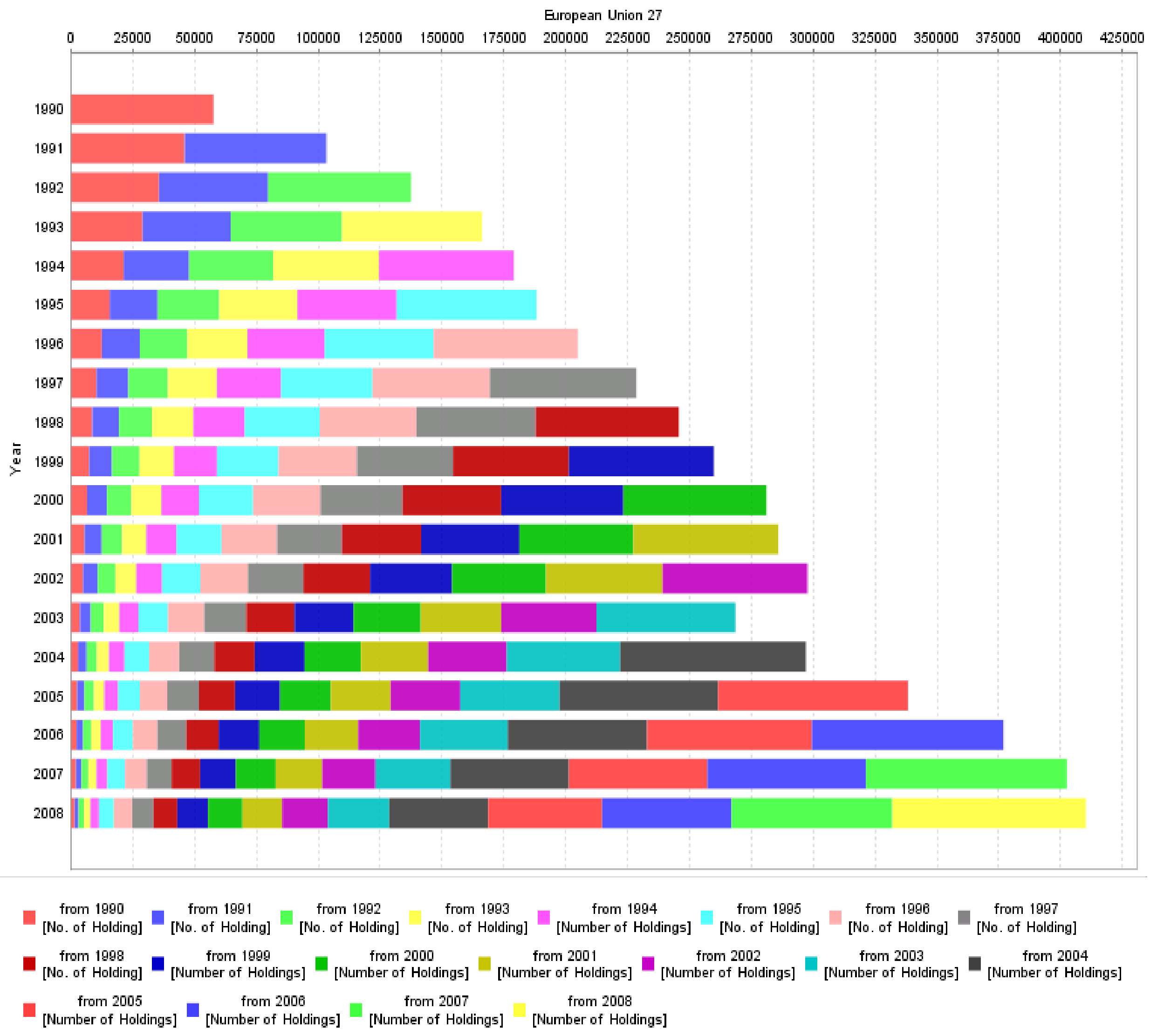
Source: FADN data mining tool (FADN, 2011).

4.14 Constant Sample

A high number of observations with a constant sample of farms (sometimes also called identical farms) over time are extremely important for different estimation approaches. Figure 31 represents summary statistics on the number of farms which remain in the sample over time, aggregated at EU-27. The figure reads as follows. The vertical axis sorts the data according to the analyzed year of the FADN sample from 1990 till 2008. Sampled farms are coloured according to the year of their first occurrence. The farms keep this colour for all consecutive years they remain in the sample. The horizontal axis displays the number of farms. The values are stacked to get a better representation; therefore the cumulated values cannot be interpreted directly, but can indicate structural breaks. The first red bars and their corresponding share in 1990 declines until 2008. Only a small share of the farms can be observed over a period of 19 years. From 57,615 farms in 1990 only 1,419 are recorded over the complete time series until 2008. Changes in the definition of the farm keys in Belgium, parts of Germany, the Netherlands, UK, Italy and Portugal are the reason that no constant sample can be observed over a longer period.

The blue bars sum up all farms surveyed 1991 for their first time. At the EU-27 aggregated level we observe that in 2003 a structural break occurred. This can be further investigated looking at the disaggregated picture at MS level in Figure 32.

Figure 31: Evaluation of the number of FADN farms across the EU-27 differentiated by the year of first observation

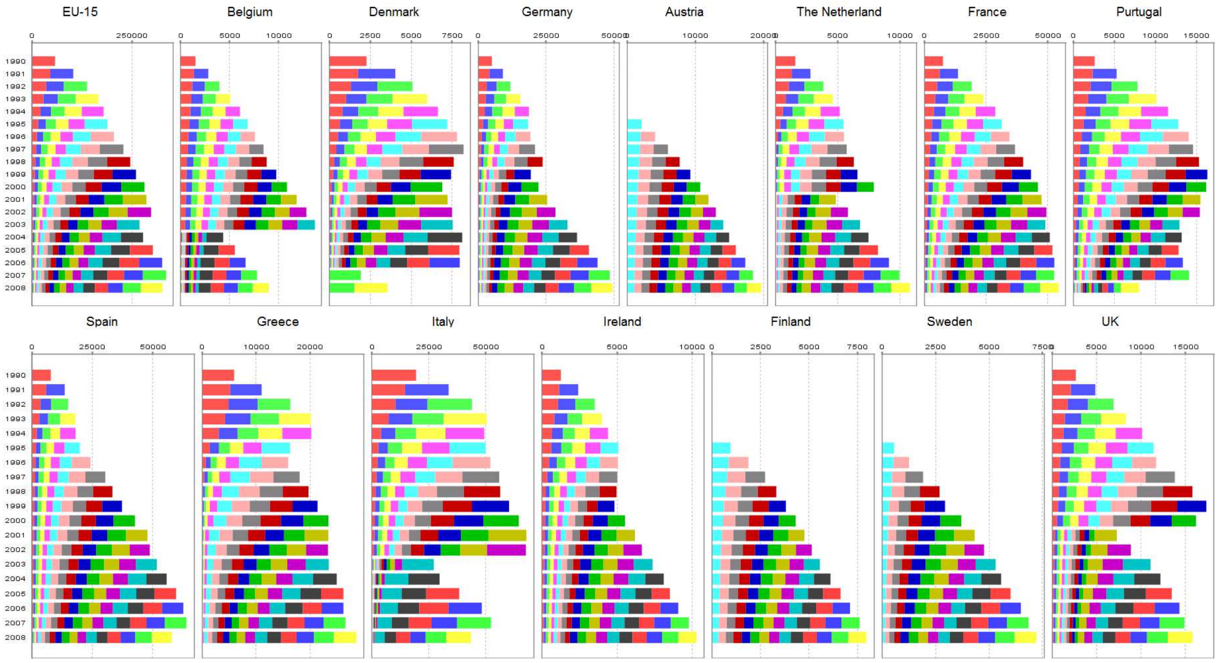


Source: FADN data mining tool (FADN, 2011).

Figure 32 presents the similar graphical representation at MS Level. Several structural breaks can be observed: In Belgium a completely new sample is considered in FADN due to the new FADN regional classification from 2003. Denmark also starts with a complete new farm sample from 2006 onwards. In Germany the additional consideration of East Germany in 1995 is apparent.

Portugal shows a structural break in 2008. Also in Italy the constant sample seems to end in the year 2002. Due to the high number of farms in Italy this causes the break in Figure 31.

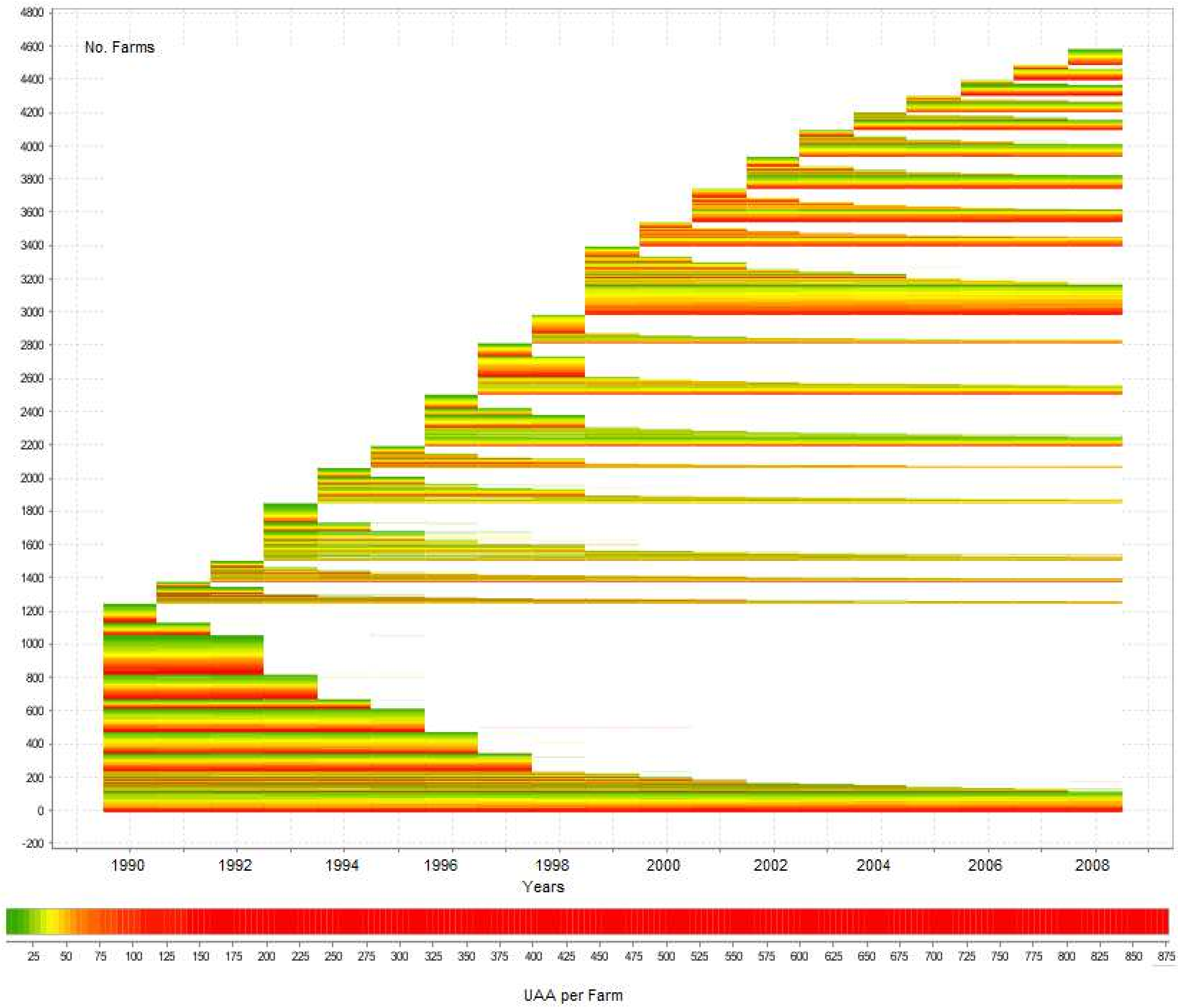
Figure 32: Evaluation of the constant sample over time in EU-15



Source: FADN data mining tool (FADN, 2011).

The Figure 33 provides a graphical overview (heat map) on the evaluation of farms over time. It shows the development of the UAA of all Irish FADN farms.

Figure 33: Representation of the development of the constant sample in Ireland sorted by years, number of years in FADN and UAA of the sample farm

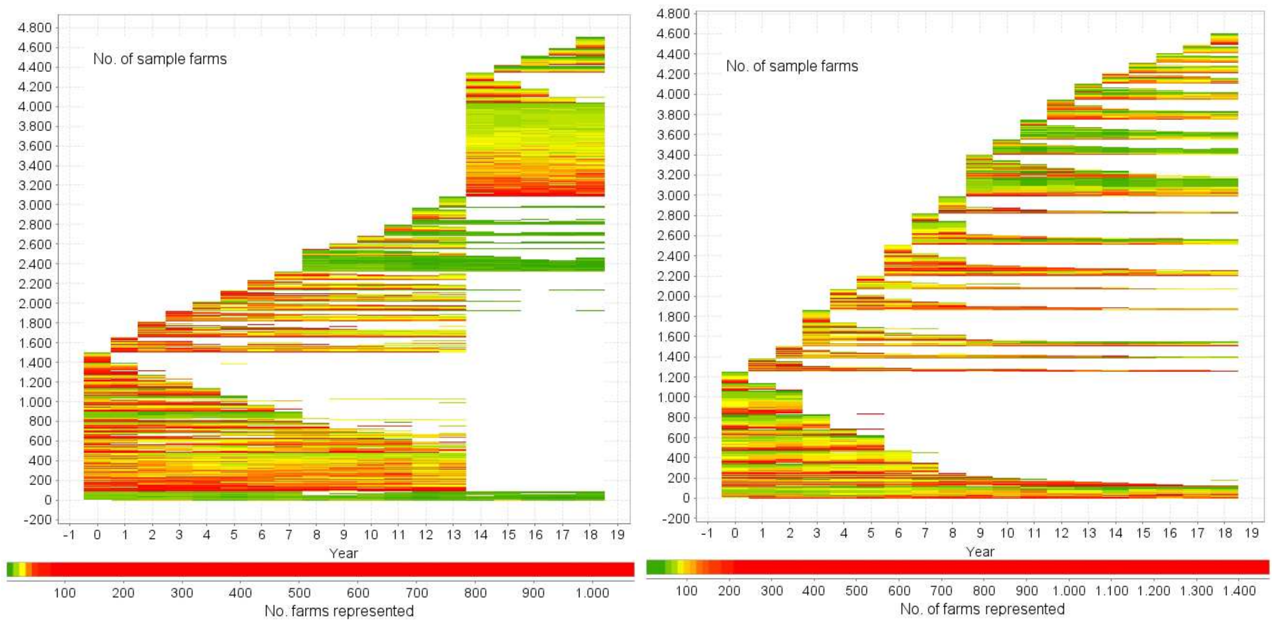


Source: FADN data mining tool (FADN, 2011).

The largest Irish farm manages 875 hectare of UAA. In Ireland, the sample started with over 1,200 farms in 1990, indicated by the vertical axes. Less than 200 farms stayed in the sample over the full time period of 19 years until 2008. In the following years new farms were added to keep the representativeness of the sample. Particularly in 1999 new farms entered the FADN sample in Ireland and remained in the accounting system until 2008.

Figure 34 depicts the development of the weighting factors per farm for Belgium (left side) and Ireland (right side). Due to the new regional classification in Belgium a large share of the farm records cannot be identified after 2003 and appear as new farm records in FADN in 2004. The colour gradient also indicates that mainly sample farms representing only a small number of farms, remain in the sample over the complete period from 1990-2008. A large share of the farms entering in 2004 remain in the sample until 2008. Non-continuous lines indicate that some farms re-enter the sample after some years. In Ireland, the sample started with over 1,200 farms in 1990, indicated by the vertical axes. Less than 200 farms stayed in the sample over the full time period of 19 years until 2008. In the following years new farms were added to keep the representativeness of the sample. Particular in 1999 new farms entered the FADN sample in Ireland and remained in the accounting system until 2008.

Figure 34: Representation of the development of the constant sample in Belgium (left side) and Ireland (right side) sorted by years, number of years in FADN and No. of farms representing



Source: FADN data mining tool (FADN, 2011) 0=1990; 19=2008.

In the course of this project the FADN-Unit from the EU Commission provided us with a new set of identical IDs which shall improve the constant sampling. After same checkes with this new information we cofirmed that ca. 10.000 FADN IDs were proceed wrongly. Although a farm could be observed over same years our ID, build upon A1-3 changed. Mainly, a result of changing regional A2 numbers. This could improved IDs was not considered in the current report. However, even in with the new IDs list wrong unique ID for Sachsen and Sachsen-Anhalt occurred after 2006. Therefore we have to wait until this is changed.

5 Conclusion

The main objective of this Deliverable 4.1 is to provide a guideline on how the farm accountancy data network (FADN) can be used to parameterize mathematical programming models. After the presentation of a summary statistic of important indicators from the FADN database, we discussed the sampling approach, how the accounting positions in FADN are organized and how the income is calculated. We also discussed drawbacks related to the FADN concept like the representation at the sub-national level, the selection bias, and the role of the SGM.

Although no decision about the finial MP structure or aggregation level was made, we aimed to extract the information from FADN in a detailed manner as possible. We aim not only to describe, but also to evaluate, the extraction rules, which define the path from the accountancy tables in FADN to the parameterization of farm models. In order to achieve this we built an FADN data mining tool which allowed us to verify the extraction rules at the farm, but also at higher regional aggregation levels. The extraction rules and results are presented for crop and animal production activities, costs, subsidies and income. The following conclusion can be drawn:

Land use activities

- We observed a strong increase in fodder activities in the EU-15 for three reasons. First, we observed a huge increase of fodder maize since 2003. No values can be found from 1990 until 1992 (except for the Netherlands in the year 1992). Second, *fodder on other arable land* increased rapidly since 2003. One possible explanation is that in Italy from 2002 onwards a large part of the pasture was rebooked as *fodder on other arable land*.
- Quantities and yields for fodder maize and particularly for pasture are not consistent. The quality of the information, however, seemed to improve in the last years. To improve the yield data animal requirements or other statistics should be considered to complement FADN.

Animal activities

- In comparison to crop activities, for which FADN accounting position for production, yields, returns and prices could be easily mapped, the animal production activities and the returns are recorded at different aggregation levels and units. We defined 16 animal production activities, which are in turn four aggregated groups. The monetary returns come from three different categories. The first category describes the selling of livestock and is defined at the aggregated groups. The second category is returns from selling products like milk and eggs, which could also be directly linked to the animal production activities in quantitative terms. The last category is changes of the livestock values and is recorded for the aggregated groups. The information in FADN does not allow all information to be linked directly to the animal activities but distributes it over the production activities using as an example the animal shares within the category.
- No information for fodder use per activity can be found in FADN. The only information is in monetary cost terms.

- The pig and poultry statistic in FADN underestimates the reality, which probably results from the exclusion of commercial farms in the FADN sample.

Inputs costs

- Inputs are only recorded as total expenses at farm in monetary terms for twenty different input categories. Production activity specific input costs cannot be observed and have to be estimated based on the total cost position by farm.
- No values can be found in the FADN database for the accounting position *depreciation for forestry and timber* (G100DP)
- The accounting position rent paid for land (F86) is not available before 2009. Total rent paid at farm can be used in order to approximate land rents. To further isolate the effect from rented or leased quotas the positions for rented or leased quotas costs recorded in FADN Table L should be subtracted. However, we observed only a minor impact of this clearance.
- Grants and subsidies and income
- No values are found for subsidies paid for Article 68 in the current FADN database. This is also true for the corresponding standard result.
- We detected inconsistencies between the official documents describing the calculation for the standard results for subsidies and describing the accounting position.
- The sub-positions for other rural development payments are not consistent with the standard result for other rural development in Portugal Ireland, Sweden and the Netherlands. This inconsistency also affects the income calculation which takes the subsidies as input.

Standard results comparison

- It is possible to recalculate all standard results using the RI/CC 882 formulas and the provided FADN database. The comparison of the recalculated or control standard result reveals deviations mainly for subsidies and output and consequently for income.
- We suggest using the accounting position to recalculate the standard results to validate the own developed routines. As the extraction rules in this document show, it is then possible to use the information in FADN at a very detailed level. However, more data is required from DG-AGRI.

Constant Sample

- A high number of observations of a constant sample of farms (sometimes also called identical farms) over time is extremely important for different estimation approaches. The Data Mining tool also reports a summary statistics on the number of farms which remain in the sample over time, aggregated at EU-27 and reported for each year until 2008 to the end year.
- From 57,615 farms in 1990 only 1,419 are recorded over the complete time series until 2008. Changes in the definition of the farm keys in Belgium, parts of Germany, the Netherlands, UK,

Italy and Portugal are the reason that that no constant sample can be observed over a longer period.

- Discussing this problem with DG-AGRI (FADN-Unit), we obtained a set of new keys for a better representation of the constant sample. This information will to be considered in the future.

Data Mining Tool

- This aim of this document is to describe whether and how different FADN accounting positions can be used to parameterize economic simulation models in a later step and to what extent non-FADN data are required. Beside the description of the extraction rule, one task was to implement the extraction rules into a software tool to proof and validate the content of the FADN database. Because of the time constraint of the project and the need that other FADNTOOL partner should be able to work and use the tool later on we had to build up on already existing and open source software solutions. We decided to program all the extraction rules in GAMS, which is a standard software for data manipulation and optimisation problems. The current FADN database includes ca. 274,000 farm accounts, with around 1,000 non-zero accounting positions. To process the extraction rules in an acceptable execution time, parallel processing was applied and a run for all farms, countries and years now takes less than 1.5 hour. All the results are stored in a GDX file format, which can easily be accessed as input by other partners.
- Another challenge was to present the results in a structured and hierarchical way (e.g., from the EU level down to the single farm level by different topics). This challenge was solved by applying the extraction rules to the single farm accounts and aggregating these to the NUTS II, MS and EU. To view the results, we set up the exploitation tool and defined predefined views and tables. The viewer is part of the GAMS Graphical Interface Generator. The predefined views are structured similarly to this document; however, it allows the data to be analyzed by pivoting, by sorting and by applying descriptive statistics.
- We also added a heat map chart, which was mainly used together with a ranking routine to analyse the evolution of farms over time. Although we can apply all the extraction rules at farm level, the resulting 1.7 Giga Byte file cannot be loaded in the exploitation tool. To avoid this, a separate file with all information for all countries and years excluding farm level information, is written. This can be used to analyse the effects EU-wide. Detected problems can then be analysed either for a certain years or by MS. This is possible by setting the options in the GGIG as depicted in Figure 1.

Outlook

- For the time being the extracted indicators for activity levels, total production value, supply, yield and product prices of the crop and animal production activities can be used to feed the farm level models.
- The costs have to be allocated to the crop and animal production activities. Therefore, the input allocation approach (Gocht, 2010) will be used and expand to EU-wide application.

- When costs and subsidies are allocated to the crop and animal production activities, the gross margins by production activities can be calculated. Then, most of the data is prepared for the final model set up.
- By combining the results of the FADN data-converting tool and the input allocation estimates, and using the CAPRI farm type layer approach (Gocht and Britz, 2011) the “robust models” for the project will be developed.

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Appendix

Table A1: Column description in FADN database

Column	Description	Column	Description	Column	Description
AA	Basic units	NF	Non-food	H_E	Closing valuation - total
AF	Agricultural fallows	NO	Net output = sales + farmhouse consumption - purchases	H_F	Closing valuation - land and building
AV	Average Number (x10)	OU	Obligatory uncultivated	H_G	Closing valuation - land
AW	Number of Annual Work Units (AWU) (x 100)	PI	Price index	H_H	Closing valuation - other assets
BN	Opening valuation number	PN	Number of animals purchased	IG	Investments before subsidy
BV	Opening valuation value	PU	Purchases	IR	Irrigated
CN	Closing valuation number	PV	Value of animals purchased	L_A	Purchases
CP	Compensatory payments	QQ	Quantity	L_B	Sales
CV	Closing valuation value	RY	Reference yield	L_C	Open valuation
D	Denominator	SA	Sales	L_D	Depreciation
DG	Gross stock change	SN	Number of animals sold	L_E	Closing valuation
DP	Depreciation	SU	Investments subsidies	L_F	Taxes
DR	Stock change after reevaluation	SV	Value of animals sold	L_G	Rent paid
EC	Energy crops	TA	Total area	L_H	Rent received
FC	Farmhouse consumption	TO	Total output = NO + DR	L_I	Quantity of own quota used (100 kg)
FU	Farm Use	TP	Total production value = Sales (SA) + Farm use (FU) + Farm consumption (FC)	L_J	Quantity of own quota rented out (100 g)
H_A	Opening valuation - total	YR	Year of birth (last 2 digits)	L_K	Quantity of rented in quota (100 kg)
H_B	Opening valuation - land and building	H_C	Opening valuation - land	LU	Livestock unit
NB	Code function performed or No. Persons	H_D	Opening valuation - other assets	N	Numerator

Quelle: Own compilation based on DG AGRI/L3.

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