PACIOLI 6
Models for data and data for models
Workshop report

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The Agricultural Economics Research Institute (LEI) is active in a wide array of research which can be classified into various domains. This report reflects research within the following domain:

- ☐ Business development and external factors
- ☐ Emission and environmental issues
- ☐ Competitive position and Dutch agribusiness; Trade and industry
- ☐ Economy of rural areas
- ☐ National and international policy issues
- ☑ Farm Accountancy Data Network; Statistical documentation; Periodical reports

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The PACIOLI network explores the needs for and feasibility of projects on the innovation in farm accounting and its consequences on data gathering for policy analysis in FADNs. PACIOLI 6 has been organized in Bordeaux in November 1998. This workshop report presents the presented papers on topics like FADN data in policy analysis, forecasting of farm income, monitoring energy use, measuring farm management performance, internet technology for FADNs and data quality management. In addition results of a masterclass on data modelling are included.

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Contents

Page

Page

Page

Preface

Decision making by farmers becomes more complex as economics, new agricultural policies and environmental aspects demand integration. Information systems require adaptation and there is a special need for innovation in farm accounting.

The concerted action PACIOLI was started to improve the possibility for managers and users of Farm Accountancy Data Networks to discuss informally these issues of adaptation and innovation and was in this respect very successful. After the closing of the official AIR-supported concerted action (AIR 3-CT94-2456) the participants decided to keep the network alive.

PACIOLI 6, the second follow-up, has been organized by the French delegation, leaded by Bernard Del'homme (ENITA de Bordeaux). It was held at the institute ENITA, near Bordeaux in November 1998. The workshop was mainly dedicated to discuss data models, which are needed for a beneficial application of information technology in farm accounting and to use the data successfully in policy research. Also several papers were presented which discussed related issues of Farm Accountancy Data Networks.

This book is the workshop report of PACIOLI 6. We would like to thank our French partners, and especially Mr. Bernard Del'homme, for the excellent local organizing activities. We would also like to thank all the participants of PACIOLI 6. Thanks to your enthusiasm at the workshop, we can now attempt to organize a follow-up.

The managing director,

Prof. Dr. L.C. Zachariasse

Summary

This workshop report is the result of the PACIOLI 6 workshop held near Bordeaux in France. It was the second follow-up after four successful workshops of the EU sponsored concerted action PACIOLI. The workshop PACIOLI 6 was divided in two parts: Masterclass Datamodelling and Exchanging National Experiences.

Masterclass Datamodelling

The masterclass was mainly dedicated to data models, which are needed for a beneficial application of information technology in farm accounting and to use the data successfully in policy research. Several items were studied in the masterclass:

- the advantages of a data model, compared to e.g. the description of the current FADN-farm return;
- how to handle different levels of aggregation in enterprises;
- how to document the data definitions flexible over time;
- how to document the data definitions in different languages;
- how to support conversion of data from one system to another;
- the value of using unharmonized, but documented, data;
- how to check the completeness of a data model.

To be able to understand data models, to know their place in building information systems and to communicate with experts that can make a data model, several presentations and four working group sessions were held. In the first session the participants had to come up with an extra table to the current FADN's farm return, which can be add to the current set of tables, that can be used by member states to send in their gross margin data for a farm (holding). At the end of this session the participants concluded that this approach is simple and understandable for most people, but not detailed enough. In the second and third working group session, the participants were asked to make a data model. The last session was dedicated to the making of a process model and c/u matrix for a WWW site with Gross Margins.

Exchanging National Experiences

During the workshop several papers were presented and discussed. A number of papers focussed on the use of FADN data in policy-oriented economic models. These include the use of FADN data in a regional farm-group model (Schleef and Kleinhanß); the estimation of factor productivity with FADN-data (San Juan and Herrero) and the application of positive mathematical programming with FADN data (Paris and Arfini). Accounting data are by definition historic. Two authors describe the experiences to update the data: Hirvonen describes the Finnish case, van der Veen the Dutch experience. Two papers describe inno-

vations in the Belgian FADN on glasshouse horticulture. Van Lierde and de Cock provide evidence on using of the FADN for measuring energy use and energy efficiency. Taragola discusses the use of the panel to study relations between management and firm performance.

The improvement of the performance of an FADN itself is described by Larsson in his paper on quality management in the European FADN. Van Lierde describes how new software has been developed in the multi-lingual Belgian FADN with very limited resources. Another software innovation in an FADN is presented by Ibrahim and Pfefferli in their paper on making tables available through the Internet for the Swiss FADN. Poppe describes the recent developments in the Dutch effort to modernize its FADN.

How to read this book

This report is the result of the sixth PACIOLI workshop. The workshop was organized around three days of presenting papers, discussing them and discuss related topics. This report is divided in two main parts: Masterclass Datamodelling (chapter 3 to 7) and Exchanging National Experiences (chapter 8 to 20). The order in which the chapters are given is not totally equal to the order of presentation. Especially the results of the Masterclass have been grouped together.

After the introduction to PACIOLI 6 (chapter 1), the introduction of the workshop is presented (chapter 2). Masterclass Datamodelling (chapter 3) contains the presentation of the case'a WWW with European Gross margins'. Chapter 4 contains the first working group session, RICA and Gross Margins. Masterclass datamodelling II (chapter 5) was spend on the making of a data model. After the presentation of a basic data model for Gross margins in Masterclass Datamodelling III (chapter 6), the participants were asked to update the data model. The last masterclass, Masterclass Datamodelling IV (chapter 7) was spend on the making of a process model, by specifying who should make a data model and what activities are necessary to make a WWW site, once a data model is available.

Chapter 8 to 20 contains the papers presented at the sixth PACIOLI workshop. During the workshop several papers were presented and discussed. A number of papers focussed on the use of FADN data in policy-oriented economic models. These include the use of FADN data in a regional farm-group model (Schleef and Kleinhanß, chapter 8); the estimation of factor productivity with FADN-data (San Juan and Herrero, chapter 9); and the application of positive mathematical programming with FADN data (Paris and Arfini, chapter 10). Accounting data are by definition historic. Two authors describe the experiences to update the data: Hirvonen (chapter 11) describes the Finnish case, van der Veen (chapter 12) the Dutch experience. Two papers describe innovations in the Belgian FADN on glass house horticulture. Van Lierde and de Cock (chapter 13) provide evidence on using of the FADN for measuring energy use and energy efficiency. Taragola (chapter 14) discusses the use of the panel to study relations between management and firm performance.

The improvement of the performance of an FADN itself is described by Larsson in his paper (chapter 15) on quality management in the European FADN. Van Lierde describes how new software has been developed in the multi-lingual Belgian FADN with very limited resources (chapter 16). Another software innovation in an FADN is presented by Ibrahim and Pfefferli in their paper on making tables available through the Internet for the Swiss FADN (chapter 17). Poppe describes the recent developments in the Dutch effort to modernize its FADN (chapter 18). Abitabile describes FSS and Rica: the attempt of integration (chapter 19).

Chapter 20 describes the final plenary session for all questions and answers the participants would like to discuss. Ideas for a follow up are discussed in chapter 21. In the appendices the address data of the participants of this workshop are presented.

1. Introduction PACIOLI 6

1.1 The PACIOLI project

This section gives an introduction and some backgrounds of the sixth workshop in the PACIOLI project. PACIOLI started as a concerted action for the EC in collaboration with the RICA/FADN unit. The objective of the concerted action is to explore the needs for and the feasibility of projects on the innovation farm accounting and its consequences for data gathering on a European level through Farm Accountancy Data Networks (FADN). The long-term objective of PACIOLI is to come to an infrastructural network of experts for continuos developments of FADNs. More specific, the concerted action is a step in preparation and development of projects in which information models will be developed that support the development of information systems to improve and extend the RICA/FADN network with various types of data in order to support policy making and evaluation at EU as well as member of state level.

1.2 Previous workshops

The concerted action has already lead to five workshops:

Workshop 1 (March '95, the Netherlands): Introduction and Information Analysis
In the first workshop the concerted action has been introduced and the objectives have been discussed. The need for Strategic Information Management in agriculture has been identified and some experiences with this in various member states were presented. A special focus was on the Dutch experiences with the Information Modelling Programme.

Results were published in:

- Workshop Report: 'Farm accountancy data networks and information analysis' (Mededeling 532)
- Reflection paper; 'On data management in farm accountancy data networks' (Mededeling 533)

Workshop 2 (September'95, the Netherlands): Accounting and managing innovation
In this workshop the process models of the various FADNs have been discussed and compared. With stakeholders' analysis the persons and organizations that are relevant for FADNs have been identified and classified. Discussing recent innovations in the various networks revealed the importance of stakeholders for the PACIOLI project. On the way to innovation the gathering of data on issues like environment and forestry was discussed. In the software field the use of data with a client-server approach using a Windows interface was presented.

Results were published in:

- Workshop Report; 'Accounting and managing innovation'. (Mededeling 534)
- Reflection Paper; 'On innovation management in farm accountancy data network' (Mededeling 535)

Workshop 3 (March '96, England): Need for change
In the third workshop ideas for innovation were generated and presented. This process was stimulated by discussions about the effect of new Agricultural Policy, as reflected in e.g. the Fischler paper, on the information requirements of policy makers and thus on the data that should be supplied by FADNs. The rough ideas have been combined and structured, which resulted in 16 project ideas.

Results were published in:

- Workshop Report; 'Need for change'. (Mededeling 536)
- Reflection Paper; 'RICA: Reform issues change the agenda'. (Mededeling 537).

Workshop 4 (October '96, Italy): Proposals for innovation
In this workshop the project indications of PACIOLI 3 had to be turned into project proposals. A number of problems had to be solved. Based on the discussions in the working groups and the arising consensus, it was decided to split some front office projects, and to cluster some infrastructure projects. As a result the 16 projects were brought back to 13 project proposals.

Results were published in:

- Workshop Report; 'Project proposals for innovation'. (Mededeling 538)
- Reflection Paper; 'Proposals for innovation of Farm accountancy data networks' (Mededeling 539)

Workshop 5 (June '97, Sweden) Development of farm accountancy data networks
In this workshop the innovation in the Farm Accountancy Data Network (FADN) of the European Commission has been discussed. The trigger for this theme was an invitation to tender for a feasibility study on the FADN's Farm Return. Special discussions were organized on quality management and the introduction of Internet. The discussions on quality management were based on the process models of FADNs, with reviews of perceived problems by outsiders from other participating countries.

Results were published in:

- Workshop Report; 'Development of farm accountancy data networks' (Mededeling 610)

1.3 Programme of the 6th workshop

The theme of the sixth PACIOLI workshop is 'models for data and data for models'. This stresses on one hand the fact that data models are needed for a beneficial application of information technology in farm accounting and to use the data successfully in policy research.

The programme

Monday November 2,1998
Masterclass datamodelling I
Presentation of the case 'a WWW with European Gross Margins' (Krijn Poppe)
Groupwork 1: RICA and Gross Margins

Exchanging National Experiences I
'Use of FADN data for policy assessment' (Werner Kleinhanß)
'Total Factor Productivity in European agriculture: an FADN approach'
Appendix I: Capital data for productivity measurement (Carlos San Juan)
'PMP and the FADN data for policy analysis' (Fillipo Arfini)
'The FADN as an instrument for monitoring energy use and efficiency in the Belgian greenhouse horticulture' (Dirk van Lierde)

Masterclass datamodelling II
Groupwork 2: make a datamodel

Exchanging national experiences II
'Forecasting income' (Hennie van der Veen)
'Modernization of the FADN of Finland and a method to utilize the data in farm income estimations' (Athi Hirvonen)
'Advanced solutions for accessing a FADN database; presentation of the Italian case (Guido Bonati)
'Integration between FSS and FADN; the Italian case' (Carla Abitabile)

Tuesday November 3, 1998
Masterclass datamodelling III
'Presentation of a basic datamodel for Gross margins' (Jerome Steffe and Krijn Poppe)
'Demo prototype RICASTINGS: include documentation of data and the language aspects in the datamodel (Bernard Del'homme and Jerome Steffe)
'Conversion of data' (Krijn Poppe)
Groupwork 3: update the basic datamodel

Exchanging national experiences III
'Use of FADN for modelling relations between management and firm results at Belgian glasshouse holdings' (Nicole Taragola)
'Towards quality management in the FADN' (Gunnar Larsson)

Data management in practice
Discussion in the Bordeaux wine sector on data management

Wednesday November 4, 1998

Exchanging national experiences IV

'De facto: an integrated software program for the Belgian FADN' (Dirk van Lierde)

Presentation Swiss experiences (Beat Meier)

'Dynamic queries on FADN-data by Internet' (Sami Ibrahim)

Presentation Accounting software Enita de Bordeaux (Bernard Del'homme and G. Vinhas)

'Turning a data model into software; explanation with the Dutch FADN as an example' (Krijn Poppe)

Masterclass Datamodelling IV

Groupwork 4: make a process model, c/u-matrix WWW site Gross margins

Place of the workshop

PACIOLI 6 was organized by Enita de Bordeaux, in the buildings of Enita at Gradignan, near Bordeaux.

2. Introduction Workshop

2.1 Welcome speech by Jean Magne, director of ENITA (Ecole Nationale d'Ingénieurs des Traveaux Agricoles)

Good morning everybody, welcome to the ENITA de Bordeaux, where I'm the headmaster. PACIOLI has nearly four years old, and I had the pleasure to participate to our first meeting in 1995 in Ameland. PACIOLI excists now through an informal way for the second time, after two years as concerted action financed by the European Union.

It shows the real and durable interest for a yearly meeting between researchers, teachers and professionals on statistics, computing and agricultural management.

If the beginning of our work was the European RICA, PACIOLI represents now a place for building research or work projects (for example RICASTINGS, whose some of you should have known). In this way, PACIOLI is open for new participants who are really welcome.

As usual, PACIOLI is always organized in a different place each time. This year, Bordeaux in France has been chosen. The E.N.I.T.A.B. represents very well this complementarity between research, teaching and professional activities, because in this school (which is similar a University) you will find:

- researchers (in the Information System Laboratory)
- lecturers and professors
- professionals in computing and management involved in software development activities (you will meet one of them Wednesday)

The 'close atmosphere', convivial and friendly associates alternation between serious work activities and moments more relaxed. As we are in a wine area well known over the world, we couldn't imagine to receive you without showing you such a wealth (this explains visits tomorrow afternoon). However, you will see that if we are well known for our wines, we also enjoy good food.

But one told me that your programme was heavy, so I will not speak much longer. Once again, welcome to the ENITA de Bordeaux, have a good meeting, enjoy your stay in Bordeaux to increase our European culture and, with fruitful exchanges, try to draw perspectives for after 2000 Europe.

3. Masterclass Datamodelling I

Krijn J. Poppe

3.1 The case 'a WWW with European Gross margins'

Background

The management of data in software and databases is a major concern for FADN managers as well as for researchers using large databases. As Enita de Bordeaux and LEI have some know how to share in data management, and especially data modelling, we organized part of the PACIOLI-6 workshop as a Masterclass Data Modelling. Some of the presentations and papers of participants have been included in this master class, as examples to be studied.

Objective

The objective of the masterclass is to be able to understand a data model, to know its place in building information systems and to communicate with experts that can make a data model. It is not our intention to teach you to become an expert in a few hours. But you will learn to be familiar with some key concepts and to be able to judge the usefulness for your own work.

A case as domain

To learn the technique, we will use a case method. The case is called 'A World Wide Web site for European Gross Margin data'. The situation on gross margin data in Europe is at the moment as follows:

- gross margin data are at the moment not available at the European level, although there is a clear need for them in policy analysis;
- gross margins are gathered in several member states, in different forms and with different methodologies;
- gross margins are often needed in policy research models;
- standardgross margins are available at the European level for typology, however with lacking details on cost items and output.

For a number of reasons this situation means that this case is attractive as an example in our masterclass:

- many of you will be more or less familiar with the gross margin concept;
- there is not a good European information system at the moment concerning gross margins, so we can make our data model(s) without being handicapped of a system we know;
- many of you might think it useful to see how such data could be brought together.

Our choice does not mean that we have plans or funds to create the WWW site for which we are going to design a datamodel. However if we think at the end of the masterclass that progress in this area might be useful, we could develop together a project proposal after the workshop.

The Master class in detail

The following items will be explicitly studied in the masterclass:
- the advantages of a datamodel, compared to e.g. the current FADN-farm return;
- how to handle different levels of aggregation in enterprises;
- how to document the data definitions flexible over time;
- how to document the data definitions in different languages;
- how to support conversion of data from one system to another;
- the value of using unharmonized, but documented, data;
- how to check the completeness of a datamodel.

Case description 'The concept of a WWW site with European Gross Margin Data'

Assume you are working with a European oriented research institute or policy unit, and that you are often asked by your clients to provide them with policy research papers on the effects of EU policy proposals on the income and competitiveness of certain products.
Typical questions are:
- 'what means Agenda 2000 for the production costs and income in beef?'
- 'what means the Nitrate directive for the competitiveness of pig production in Nieder Sachsen compared with Bretagne?'
- 'what is the effect of Agenda 2000 on the sales of hybrid seed for maize?'

Many of these questions are difficult to answer, unless you have good data on gross margins per enterprise (crop or animals). These often lack and therefor some research questions are answered by using specialized farms, others by estimating costs of production by an arbitrary allocation of farm level costs to enterprises, and sometimes by gathering gross margins in different regions.

As a manager of this research institute or policy unit you are unhappy with this situation, and you decide to gather all data on gross margins that are available in the public domain and make them available on the intranet of your institute with a WWW database.
At the start of this exercise you have a number of materials available:
- examples of gross margin data as they are published by several European data collecting sources. Appendix 1, 2 and 3 provides a number of examples. It is from these sources that you are going to take your data (by scanning, typing them in, or in electronic form if these sources are willing to provide them). The sources can be grouped into three different types:
    - gross margin data gathered in a FADN and published as averages from groups of farms. Examples are from the UK, Netherlands and Denmark;

- gross margin data estimated as a budget for a typical farm or region, often for extension purposes. Examples are from management handbooks in the UK, the Netherlands and Germany;
- standard gross margins, published by Eurostat and used mainly for typology purposes. These gross margins are three-year averages;

- a document from Eurostat that provides harmonized definitions for the calculation of Standard Gross Margins (SGM) - the so-called Classex 44, reproduced in Appendix 4. Note for your WWW that is unlikely that all other data available on gross margins uses the same definitions as this document;
- some relevant material from the Farm Return of the European FADN (Appendix 5).

Appendix 1
LEI
Cambridge
Mr. Gras
Denmark

Appendix 2
KTBL
PAV
John Nix

Appendix 3
Eurostat publication

Appendix 4
Classex 44

Appendix 5
FADN-Farm Return Table K; RI/CC 1256 prov. Page 39-51

(Appendices not reproduced in workshop-report)

4. Masterclass Datamodelling I

4.1 Working group session I: RICA and Gross margins

Instruction working group session I

Assume you are responsible as a data manager for the current European Farm Return (see Appendix 5 of the Masterclass description for the relevant parts). You plan to add table Z to the current set of tables, that can be used by member states to send in their gross margin data for a farm (holding). You are asked:

- to give a lay out of the table Z, including suggestions for the enterprises
- a list of advantages and disadvantages of this approach

Groups

I	II	III	IV
Gunnar Larsson	Carlos San Juan	Werner Kleinhanß	Guido Bonati
Beat Meier	Arne Bolin	Sami Ibrahim	Jerome Steffe
Paul Bantzer	Athi Hirvonen	Nicole Taragola	Vincent Chatellier
Dirk van Lierde	Hennie van der Veen	Carla Abitabile	Snieguole Pucinskaite
Fillipo Arfini	Bernard Del'homme	Filiz Ersoz	Juan Intxaurrandieta

Results

Group I

	Output	**Seeds**	**Fertilizer**	**Sprays**	**Other Direct Cost**	**Gross Margin**

Table Z for crops

	Output	Concentrate bought	Concentrate farm	Veterinary costs	Other costs	Gross margin

Table Z for animals

Advantages at farm level

- limited table, not detailed, gives a good overview;
- it is understandable for most people.

Disadvantages

- for a more detailed table you need too many columns (too many will not be filled in);
- it is better to have a hierarchical codification so you can give the details you have, or… details you don't have (based on this system you can constitute overview tables).

Group II

	Winter Wheat	**Milk**	**Potatoes**	**Cattle**	**Pigs**	**Wine**
	Total Sales Stock Variation	Total Sales Stock Variation	Total Sales Stock Variation	Total Sales Stock Variation	Total Sales Stock Variation	Total Sales Stock Variation
Yield	Kg/ha	L/cow	Kg/ha	Kg/unit	Kg/unit	Hl/ha
Cost Variable /fixed direct/ indirect	Total Variable Costs	Total Variable Costs	Total Variable Costs	Total Variable Costs	Total Variable Costs	Total Variable Costs

Table Z

Advantages
Variable margins
- easy to compare farms

Direct Margins
- most cost are attributed
- efficiency of the farm is easier to find

Disadvantages
Variable margins
- a lot of costs are not useful (fixed costs)

Direct margins
- quite impossible to compare farms

Group III

<=OUTPUT=> <= INPUT=>

Year -> Wheat	Market P		Int. consum.	Direct subs.	Seeds	Fertilizer	Pesticide	O-thers	Total Input	Gross Margin	Ener-gy
	Quantity	price									
Corn											
Grapes											
……											
Milk-cow											

Z table

Advantages

- simplicity
- possibility to compare

Disadvantages

- can not collect quantity data on input
- problems for category of animals
- few data
- problems with contract work
- allocation of specific subsidies
- we have to keep the typology detailed by product

Group IV

	Fixed indicators (obliged)			Optional indicators (not obliged) The number of columns is variable)		
	????	**Specific costs**	**Subsidy**			**Gross Margin**
????	- prices - specific costs (fertilizers, seed) - subsidy			- Environmental - Fixed costs		
Barley						
Rice						
Maizen						
Milk						
Cattle						

Z-table

Advantages
- Very good definition of different kinds of products
- Good information on production and prices
- It could be possible to compare gross margins for the main production (wheat, milk)

Disadvantages
Actually:
- not the same definition/ countries
- direct subsidies
- bottom of ratio (area;…)
- old coefficients for gross margin standard

Future
- it's …… to collect specific costs (environmental)
- we have to limit the information for the main product

5. Masterclass Datamodelling II

5.1 Working Group session II: make a data model

Instruction working group session II:
make a data model

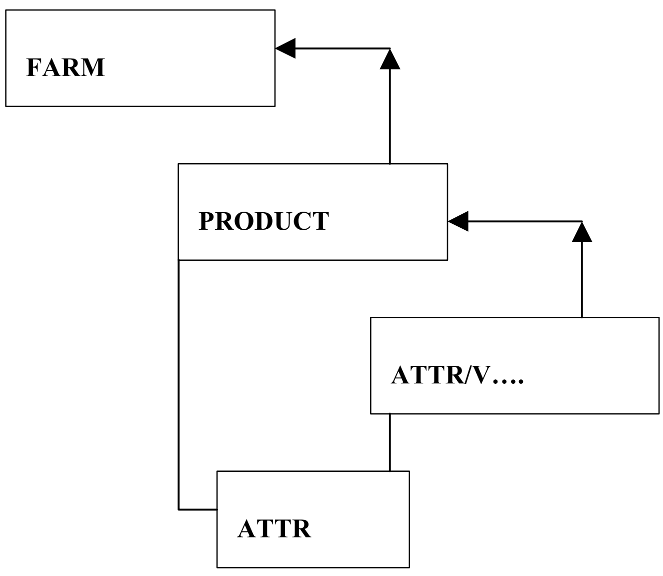
Groups:

I	II	III
George Beers	Jerome Steffe	Krijn Poppe
Paul Bantzer	Guido Bonati	Beat Meier
Werner Kleinhanß	Carlos San Juan	Gunnar Larsson
Arne Bolin	Sami Ibrahim	Athi Hirvonen
Nicole Taragola	Dirk van Lierde	Hennie van der Veen
Carla Abitabile	Vincent Chatellier	Fillipo Arfini
Bernard Del'homme	Filiz Ersoz	Snieguole Pucinskaite
Juan Manuel Intxaurradietta		

Results

Group I

Method: Compute GM

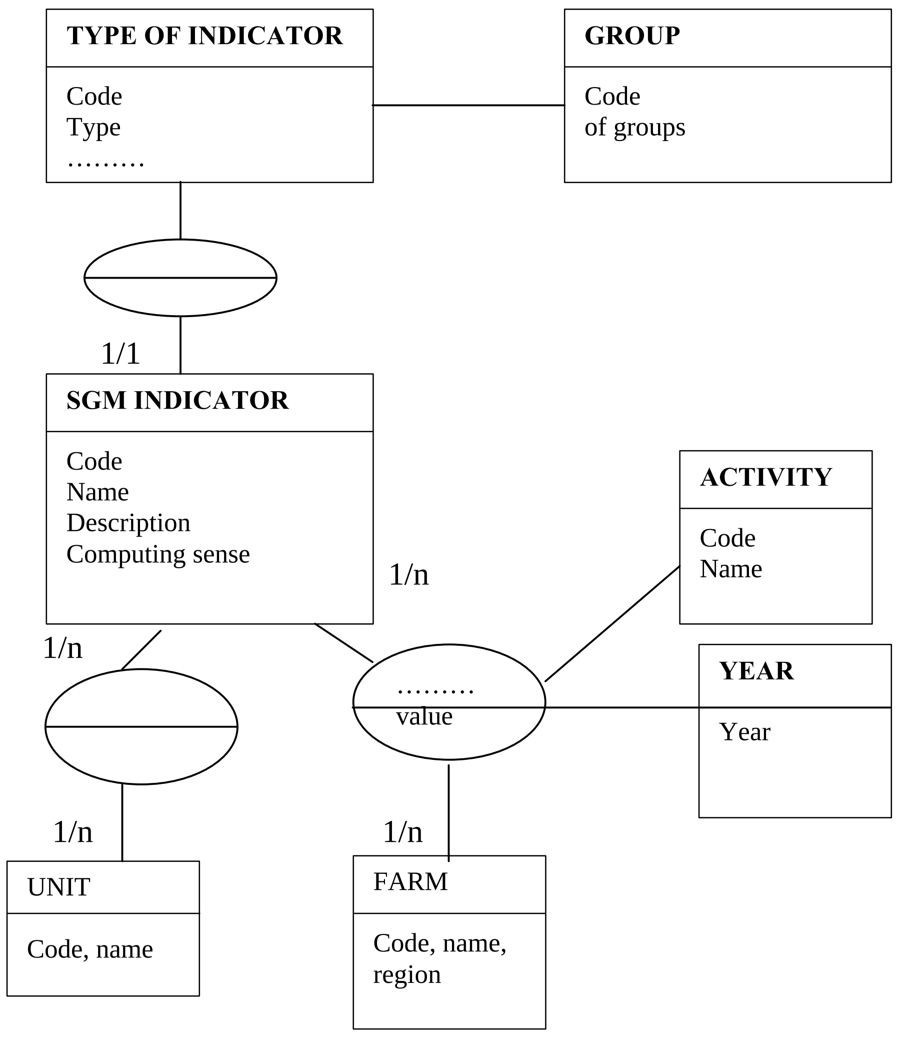


Group II

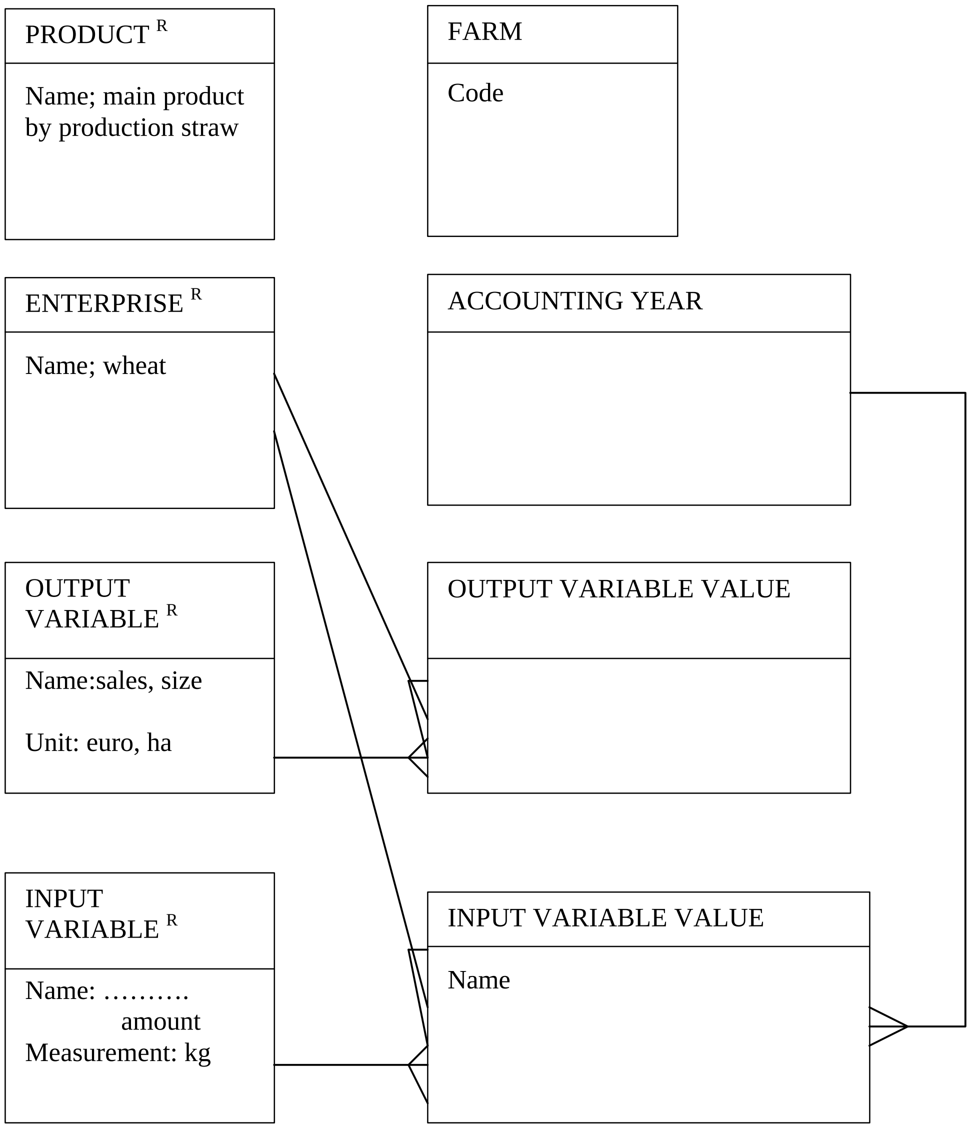
- Farm
- Crops
- Animal production

Indicator:
- Cost
- Revenues
- Prices
- Yields
- SGM
- Quantity

- Year
- Region



Group III


PRODUCT R
Name; main product
by production straw
FARM
Code
ENTERPRISE R
Name; wheat
ACCOUNTING YEAR
OUTPUT
VARIABLE R
Name:sales, size
Unit: euro, ha
OUTPUT VARIABLE VALUE
INPUT
VARIABLE R
Name: ……….
amount
Measurement: kg
INPUT VARIABLE VALUE
Name

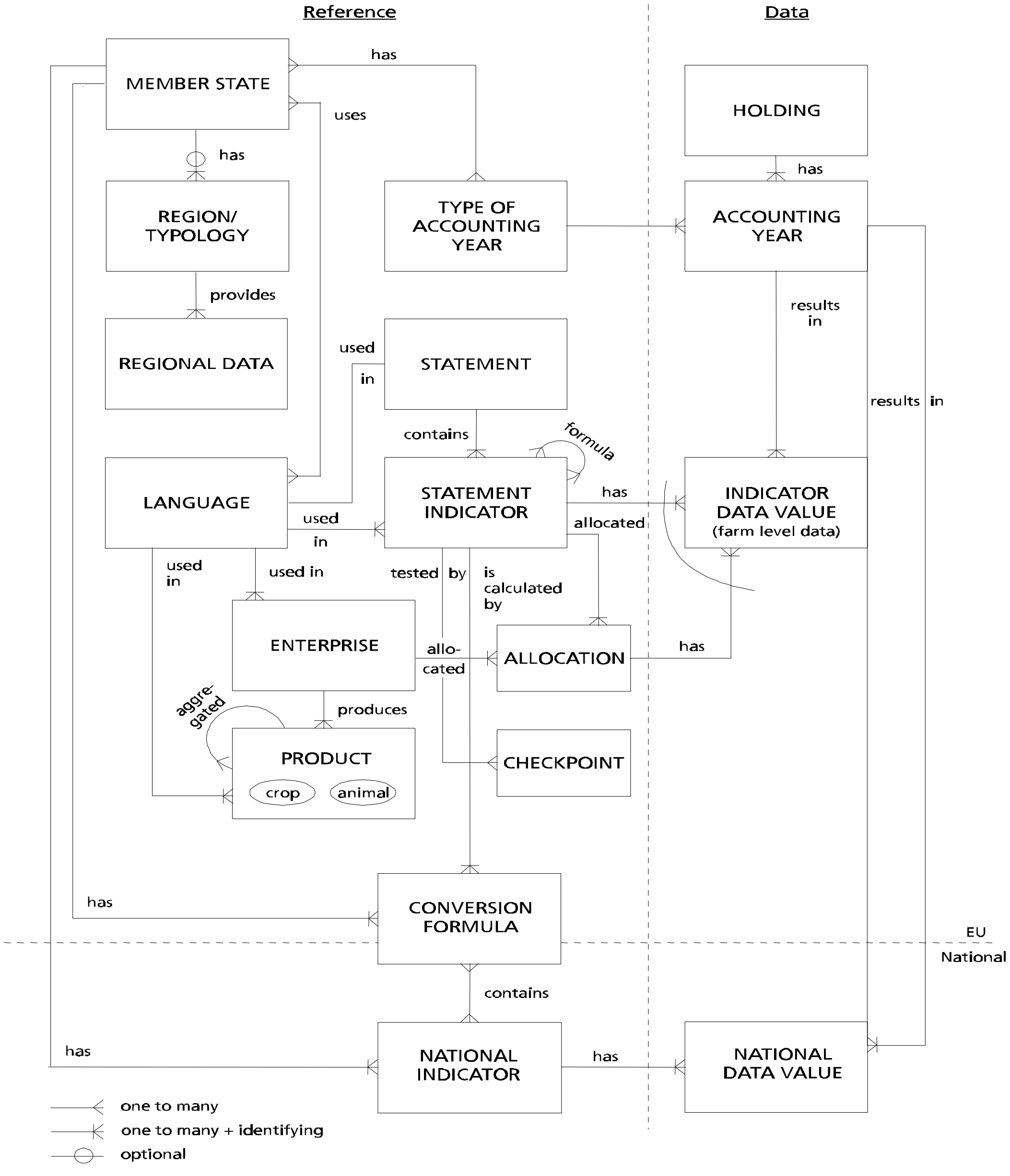
6. Masterclass Datamodelling III

Krijn J. Poppe

6.1 Conversion of Data

Conversion of data can be explained by the datamodel develop in the RICASTINGS project on the new EU-farm return.

It shows how conversion formula can be included in a datadictionary/database.



6.2 Working group session III: update the datamodel

Instruction working group session III: update the data model

Groups

I	II	III
George Beers	Jerome Steffe	Krijn Poppe
Dirk van Lierde	Carla Abitabile	Bernard Del'homme
Juan Manuel Intxaurradieta	Werner Kleinhanß	Arne Bolin
Sami Ibrahim	Nicole Taragola	Carlos San Juan
Beat Meier	Vincent Chatellier	Filiz Ersoz
Athi Hirvonen	Gunnar Larsson	Paul Bantzer
Snieguole Pucinskaite	Hennie van der Veen	Fillipo Arfini

Results

Group I

Remarks on the datamodel:
- a relation between indicator and enterprise (milk related to cow, sheep,…) make a table per year, this is quicker;
- for SGM the data model must be flexible (new member states = new activities; innovation activities and indicator);
- there can be a separate entity for the types of enterprise (crop, animal,…);
- problems with the regions, one farm can belong to more than one region, or the definition of a region can change;
- enterprise: add an entity with information;
- organic or traditional farming;
- immigrated or not;
- calculate SGM and put them in the database, or will the SGM be computed every time you ask for a table;
- do we need codes? Prefer relational databases instead of hierarchical codes.

Do not forget:
- there must be a paybook of information to the farmer (develop software adapted for reporting);
- new tables for report.

Group II

Relationships
- indicator - enterprise
- indicator - account year
- indicator - indicator calculation/hierarchy

Entity

- languages
- data control (university, multi, formal)
- characteristics
- unit of meas (type and relation between meas)

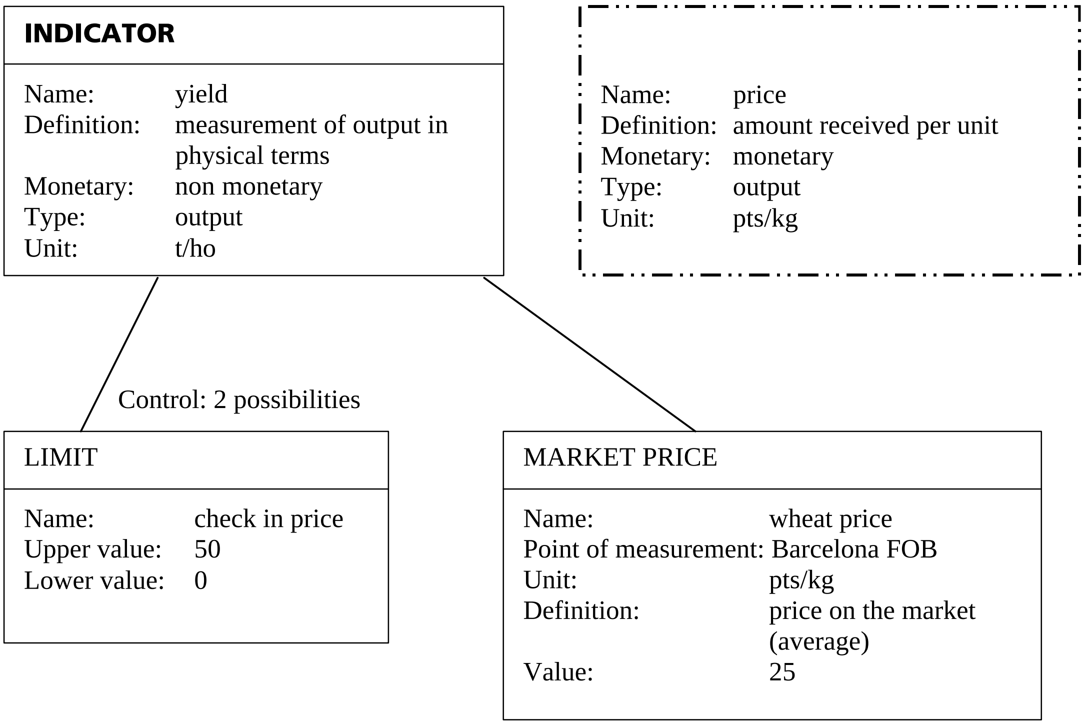
Group III

Ideas noticed around GM model:

- flexibility;
- possibility to homogenise;
- questions on conversion:
    - regional level;
    - national level;
    - European level;
- control of data values (checking quantities and values);
- costs of the system (could be expensive for new countries);
- designing data presentation in tables;
- languages (regional, national, European)
  links with problems of conversion.

Example for checking data

Price/unit - 2* standard deviation - boundaries



7. Masterclass Datamodelling IV

7.1 Working group session IV: make a process model, c/u matrix WWW site Gross margins

Instructions:

1. Who should make a data model?

Compose a group of persons to make a data model for Gross margins: expertise needed

2. What to do when a good data model is available?

Make a list of things to be done to build a WWW-server with aggregated Gross margin data, once a data model is available

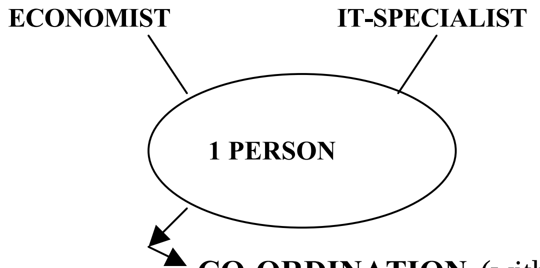
Groups:

I	II	III
Beat Meier	Werner Kleinhanß	Gunnar Larsson
Juan Manuel Int	Vincent Chatellier	Snieguole Pucinskaite
Jerome Steffe	Bernard Del'homme	Nicole Taragola
Arne Bolin	Filiz Ersoz	Sami Ibrahim
Carlos San Juan	Hennie van der Veen	Paul Bantzer
Filippo Arfini	Athi Hirvonen	Dirk van Lierde

Group I

1. Who should make a data model?

- depends on subject
- knowledge & technical experience



CO-ORDINATION (with good contacts in FADN and representation of users)

Internal/External

- integrate consumers
- < 10 people
- internal people and after disseminate

2. Gross margin on WWW

- different users with different needs
- for example: farmers, advisors, politicians, research....
- database -> several products
- intertemporal/interspacial comparison

- state of the art (examples, technology)
- concept of dissemination
- who will maintain the system
- feedback

Group II

1. Who should make a data model?

- economic expert
- information technology expert
- data providers
- users representants (professional or not)
- secretary - management (not to loose too much time)
- specialist or technical (only when if it is necessary)

2. Gross margin on WWW

- Define tools for building home page and Internet page
- define Internet server; hardware; operating system (f.e. windows)
- define users (who are allowed?)
- functionality
- interaction with users (e-mail/contacts)
- marketing ... (links to important sites)
- name of....
- development tools for accountancy to database
- build a system for other Internet services (PTP)

Group III

1. who should make a data model?

It must be a mixed groups involving:

- researchers (25 days);
  necessary characteristics:
  - agricultural economics specialist;
  - able to define the requirements for the data model;

- expert in the statistical methods;
- potential user of the data model.

- Administrators (representative of the administrative side) (25 days)

  necessary characteristics:
  - knowledge for project administration;
  - IT-specialist (30 days);
  - Data protection person (5 days);
  - Quality insurance person (10 days).

2. Gross margin on WWW

list of activities:

- allocation of resources (50-60 days);
- detailed analysis, which contains data model (220 days);
- technical analysis (110 days);
- technical implementation, which contains data transformation (110 days).

8. Use of FADN data for policy assessment

Karl-Heinrich Schleef and Werner Kleinhanß [1]

8.1 Introduction

Policy assessment is a main research area of the economic institutes of FAL. Four years ago a working group was established (Modellgestützte Politikfolgenabschätzung) aiming at the development of models and tools and its use for policy assessment. The basic idea is to have different models covering agricultural markets and the whole agricultural sector, at the regional as well as at the farm level. The models are used complementarily; for the definition of scenario conditions the market and the sector-model are closely linked. Advantages and weakness of this approach are described by Manegold et al. (1998). Policy assessments were realized in the area of 'de-coupling of compensation payments' (Cypris et al., 1997), Agenda 2000 (Kleinhanß et al., 1998) and other items (Henrichsmeyer et al., 1996), some of them are realized on the request of the Federal Ministry of Agriculture (BML).

Within the above named working group scientist of FAL, FAA[2] and IAP[3] are working together. Experts from BML are involved in projects realized for the Ministry of Agriculture. The work is co-ordinated by the second mentioned author of this paper. Within this collaboration we have got the chance to use national FADN data for policy assessment; at the beginning only for farm groups being selected by specific selection criteria. Since this year we have also access to individual farm data.

With regard to this data base a farm-group model has been developed during the last years (Jacobs, 1998; Schleef, 1998). Basic elements of this system are a module determining input-output coefficients being consistent with farm accounts, an optimization module and an aggregation module. With this bottom-up approach it is possible to quantify sector consistent impacts of policy changes in minimizing aggregation errors. The degree of disaggregation depends on policy measures, in some cases it is necessary to build homogeneous farm groups of only few farms. Actually the model is modified with regard to the new farm return (neuer BML-Jahresabschluß) being introduced in 1995/96. Due to available data base up to now the model can only be used for Germany. We hope, that together with partners of other countries, the system could be extended to other countries.

In the following, the structure of the model-system, its basic elements and first applications are briefly described.

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Contribution to the PACIOLI VI-workshop 'Models for data and data for models', Bordeaux, 02.-04.11.1998.
[2] Forschungsgesellschaft für Agrarpolitik und Agrarsoziologie, Bonn.
[3] Institute of Agricultural Policy, University of Bonn.

8.2 Conception of the Farm Group Model

The structure of the Farm Group Model (FGM) and the data flow is illustrated in figure 8.1. The FGM includes three main components: a basic data system, a process analysis system and a presentation system. Within the *basic data system*, data from different sources are used to derive complete input-output-tables of agricultural production (see chapter 8.4.1). By the help of the *process analysis system* future developments of agricultural production, input use, farm income and environmental indicators in different farm groups can be simulated under alternative policy scenarios. For the simulation of adjusting processes in different farm groups a positive quadratic programming model (PQP-Model) is used (see section 8.4.2). The *presentation system* allows to transform the output of the optimization model into clearly arranged graphs and tables, which afterwards can be discussed with policy makers and experts. If necessary, assumptions can be modified recursively. The conception of the FGM allows to integrate expert knowledge of different disciplinces and to satisfy the actual information demand of policy makers (HENRICHSMEYER, 1994, p. 186). The FGM is a partial supply model, which can depict most of the Western German agricultural sector in a consistent way.

8.3 Calculation of representative aggregation factors

Data from the national FADN are an important data source for the FGM. In a first step consistent aggregation factors for the farms included in the network have to be calculated (see figure 8.1). This is necessary because within the existing system being used for the annual report on agriculture (Agrarbericht) only a simplified aggregation scheme is used. Aggregation factors for each sample farm are calculated with regard to socio-economic classification criteria and standard farm income. If these aggregation factors are applied to derive information about sectoral land use and livestock figures a wide deviation to 'real data' covered by other statistical sources can be found. Figure 8.2 provides an insight in the difference between the 'free-aggregation' procedure, which is used by the Agricultural Ministry and the official farm group statistics of Baden-Württemberg.

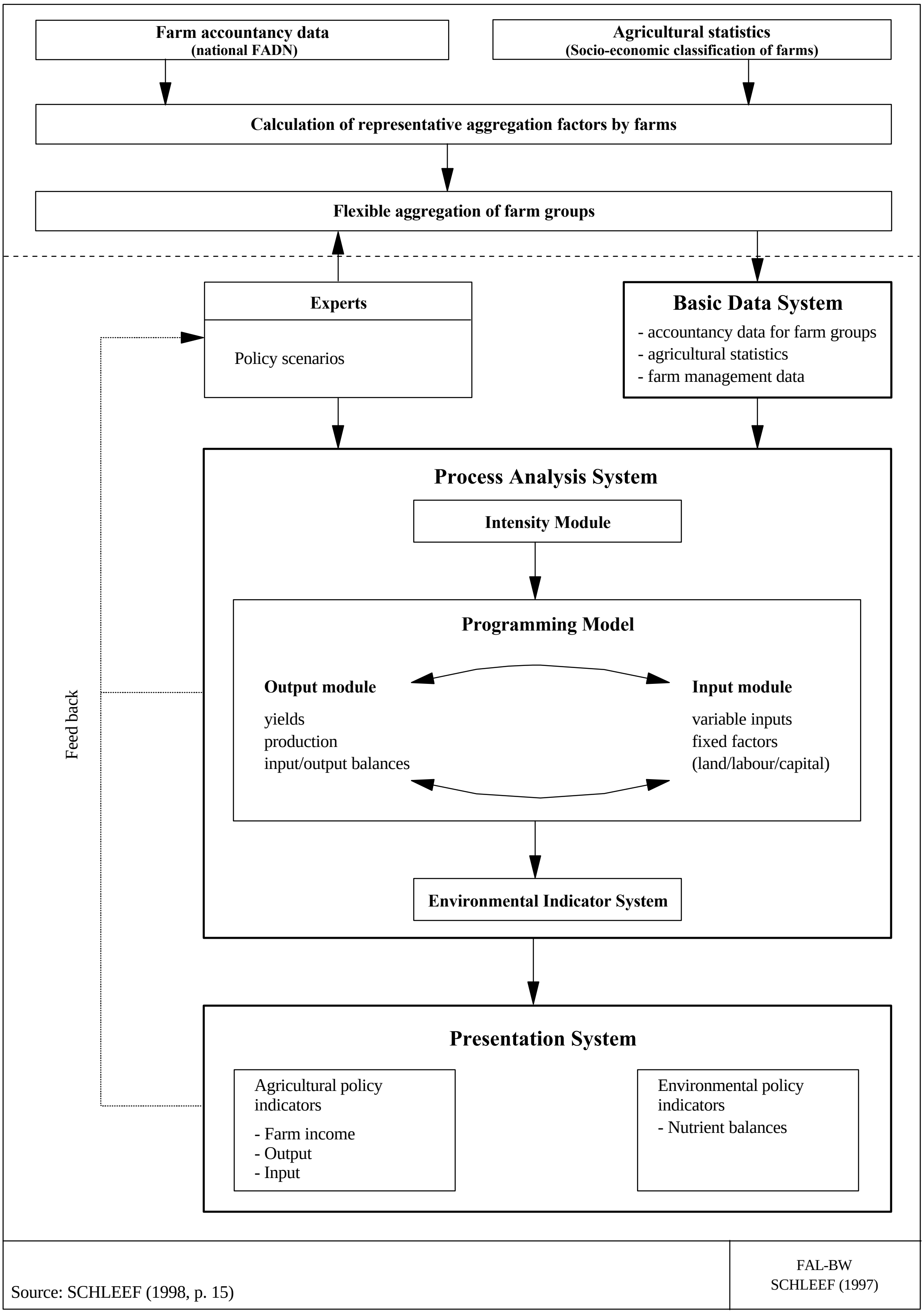

Figure 8.1 The Farm Group Model

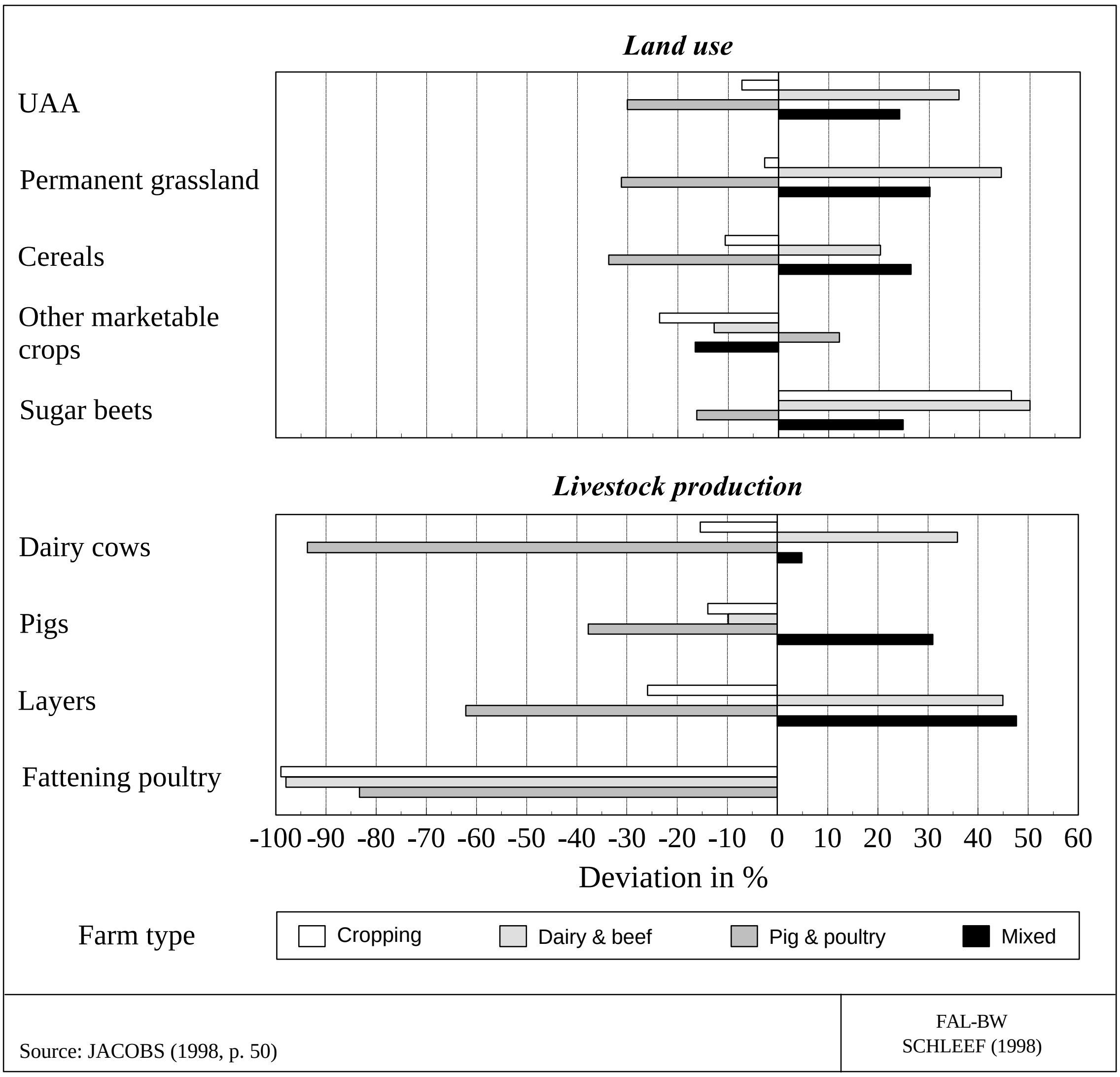

Figure 8.2 Differences between the „free aggregation' of farm accountancy data and the official farm group statistics of Baden-Württemberg

The opportunity to aggregate results from different farm groups to an almost consistent sectoral result was one of the basic aims within this project. This objective requires not only a representative depiction of the income situation in different farm groups, which can already be reached by using the aggregation factors from the Ministry of Agriculture. In addition it is necessary to correctly depict the production basis of different farm groups. Every four years the Federal Statistical Office publishes data on land use and livestock numbers differentiated by the Laender, farming types and standard farm income classes. The farm accountancy data and the aggregation factors of the Agricultural Ministry are used together to build up a non-linear optimization model. During the optimization process the 'free-aggregation factors' are changed in a way that land use data and livestock numbers, known from the Federal Statistical Office for different farm groups, are reached (see figure 8.3).

			Sample farms			
			B_1	**B_2**	**. . .**	**B_n**
Objective function:	minimize	= >	$HF_{n,\,b1}$ * lg ($HF_{n,\,b1}/HF_{a,b1}$)	$HF_{n,\,b2}$ * lg ($HF_{n,b2}/HF_{a,b2}$)		$HF_{n,\,bn}$ * lg ($HF_{n,bn}/HF_{a,bn}$)
Known values:						
Number of total farms	$\sum_{i}^{N} HF_{a,i}$	=	1	1		1
Agricultural land (LF_g)	$LF_g * X_{min,\,LF}$ $LF_g * X_{max,\,LF}$	≥ ≤	LF_1 LF_1	LF_2 LF_2		LF_n LF_n
Permanent grassland (GL_g)	$GL_g * X_{min,\,GL}$ $GL_g * X_{max,\,GL}$	≥ ≤	GL_1 GL_1	GL_2 GL_2		• •
Cereals (GT_g)	$GT_g * X_{min,\,GT}$ $GT_g * X_{max,\,GT}$	≥ ≤	GT_1 GT_1	GT_2 GT_2		• •
Sugar beet (ZR_g)	$ZR_g * X_{min,\,ZR}$ $ZR_g * X_{max,\,ZR}$	≥ ≤	ZR_1 ZR_1	ZR_2 ZR_2		• •
Other marketable crops (HG_g)	$HG_g * X_{min,\,HG}$ $HG_g * X_{max,\,HG}$	≥ ≤	HG_1 HG_1	• •		• •
Dairy cows (MK_g)	$MK_g * X_{min,\,MK}$ $MK_g * X_{max,\,MK}$	≥ ≤	MK_1 MK_1	• •		• •
Pigs (SC_g)	$SC_g * X_{min,\,SC}$ $SC_g * X_{max,\,SC}$	≥ ≤	SC_1 SC_1	• •		• •
Layers (LH_g)	• •	≥ ≤	• •	• •		• •
Fattening poultry (MG_g)	• •	≥ ≤	• •	• •		• •
Deviation boundaries: lower limit (l) upper limit (u)			$HF_{a,b1} * X_{min,\,l}$ $HF_{a,b1} * X_{max,\,u}$	$HF_{a,b2} * X_{max,\,l}$ $HF_{a,b2} * X_{min,\,u}$		$HF_{a,bn} * X_{min,\,l}$ $HF_{a,bn} * X_{max,\,u}$

N = Number of farms in the sample
HF_a = Predetermined aggregation factor
HF_n = Adjusted aggregation factor
i = Index of sample farm (i=1, ...N)
g = Index of the total of known value
X_{min}, X_{max} = Deviation factors
Source: JACOBS, (1998, p. 82)

FAL-BW
SCHLEEF (1998)

Figure 8.3 Calculation of consistent aggregation factors

The formulation of the objective function is based on the, theory of the minimum information loss', which was developed by Merz (1983). Due to the formulation of the objective function 'free-aggregation factors' are changed as little as possible in order to fulfil the restrictions of the model. The first restriction ensures that the number of farms represented by the sample is kept constant. An increasing aggregation factor for one sample farm leads to a decreasing weight of at least one other farm. A decreasing aggregation factor means a lower importance of farm specific characteristics of the corresponding farm in the whole sample (loss of information), while the opposite holds for an increased factor. Due to the specific formulation an increasing deviation of the adjusted aggregation factor from the initial one leads to an exponentially increasing value of the objective function, which acts as a brake on the 'loss of information'. At the same time 'farm structural gaps' concerning land use and livestock numbers in the farm sample are closed.

When the restrictions of the model are fulfiled, adjusted aggregation factors can be used to correctly estimate land use data and livestock for the total of farms. Experiences from the practical use of this model shows, that it is not reasonable to formulate land use and livestock restrictions in the form of equations, because the model might become infeasible. Therefore, separate individual ranges are assigned to each restriction. Two further restrictions are introduced to ensure that adjusted aggregation factors can not become zero, which would lead to neglecting the characteristics of a particular sample farm.

Until now it is only possible to calculate consistent aggregation factors for former Western Germany. Reasons are:

- for the new Laender the former FADN only contains a sufficient number of cropping and dairy & beef farms;
- statistical data on land use and livestock by farming types are not available at the same level of dis-aggregation than for Western Germany.

Further, farms with standard farm incomes of less than 5,000 DM and farms being organized as e.g. commercial enterprises are excluded from the data network in Western Germany. Because of this reasons the existing FGM can represent only the main part of the agricultural sector in Western Germany.

Figure 8.4 shows the representation of the agricultural sector by the FGM in Western Germany. From the total number of farms more than half is represented, the remaining are very small farms. This can be seen from a more than 80% representation of land use and the number of dairy cows and pigs. Furthermore, poultry production is to about 50% in the hand of commercial enterprises. As a consequence policy impact analysis by the FGM does not take into account adjusting processes in small farms and in the more or less commercial part of poultry production.

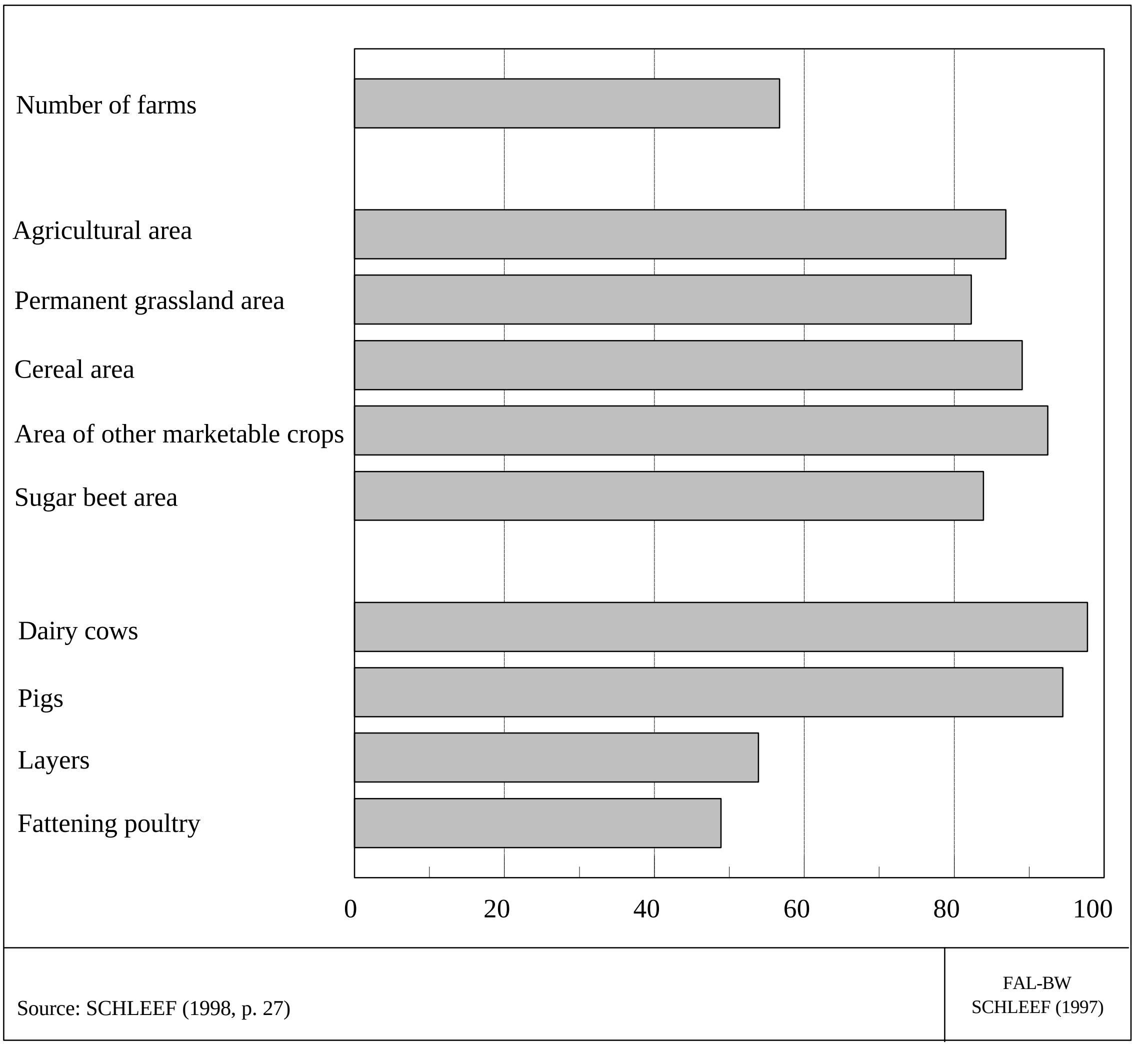

Figure 8.4 Representation of the agricultural sector in former Western Germany by the farm group model

8.4 Description of the programming model

8.4.1 Generation of matrix coefficients

This chapter roughly describes the generation of matrix coefficients for the optimization model of the FGM. A complete description is given by Jacobs (1998) and Schleef (1998).

The core of FGM is a standard optimization matrix (see figure 8.5), which contains 27 activities of crop (PA_1 .. PA_N) and 15 activities of livestock (TA_1 .. TA_N) production. The extent of crop production is restricted by the UAA and crop rotational requirements. The output of crop production can be either sold (VP_1 .. VP_N) or it can be used for feed (FU_1 .. FU_N). Feed demand can either be covered by farm grown feed or purchased feed (FK_1 .. FK_N). A farm group overlapping feed balances ensures the sectoral equilibrium of feed supply and demand. Such a sectoral feed balance can be calculated only for the base situation when the extent of all crop and livestock production processes is known from ex post data. During the simulation of alternative policy measures (ex ante analysis) each farm group is optimized separately. Intermediary livestock products as e.g. piglets or heifers can either be produced by the farm itself or being purchased from or sold to other farm groups (JK_1 .. JK_N). Physical output coefficients like crop yields, milk yield per cow or piglets per sow and the corresponding prices in most cases are directly derived from the farm accounting data.

	Crop production process PA_1 ... PA_N	**Crop rotational restric-tions**	**Sales of crop products VP_1 ... VP_N**	**Livestock production processes TA_1 ... TA_N**	**Young stock purchase and sales JK_1 ... JK_N**	**Fertilization DU_1 ... DU_N**	**Fertilizer purchase DK_1 ... DK_N**	**Animal feeding FU_1 ... FU_N**	**Sales and purchase of feed stuffs FK_1 .. FK_N**	**RHS**
Objective function	(-)		(+)	(+)	(+/-)		(-)		(+/-)	**max.**
Agricultural area	(+)									≤(+)
Crop rotation	(+)	(-)								≤0
Crop yields	(-)		(+)					(+)		≤0
Livestock replacement				(+/-)	(+/-)					≤0
Organic manure liquid solid				(-)		(+)				≤0
Fertilizer demand (N, P, K, CA)	(+)					(-)	(-)			≤0
Feed demand (min/max)				(+)				(-)	(+/-)	≤0
Labour	(+)			(+)						≤(+)
Capital variable fix	 (+) (+)			 (+) (+)						 ≤(x) ≤(x)

Source: JACOBS (1998, p. 181) FAL-BW SCHLEEF

Figure 8.5 Structure of the optimization matrix of the farm group model

Income calculation	**Farm group data**	
	Monetary data	**Physical data**
Gross output		
Crop production processes (WWEI ... ZRUE)	Production value per process	Extent and yield of each production process
Livestock production processes (MIKU ... SOTI)	Production value resulting from the sales of cattle, pigs, poultry, sheep, milk and eggs	Extent of each production process - Milk yield per cow - Eggs per layer - Extent of animal purchase and sales
- Variable inputs		
Fertilizer	Account of fertilizer purchase	
Seed	Account of seed use	
Crop protection	Account of crop protection products purchase	
Energy Repairs Veterinary Other costs }	Aggregated account	
Feed	Account of feed purchase	
- **Taxes**	Account of taxes and levies	
+ **Subsidies**	Different accounts of subsidies granted in Germany	
- **Depreciation**	Aggregated account	
= **Net value added (Farm income)**		
		FAL-BW SCHLEEF (1998)

Figure 8.6 Income calculation by the farm group model
Source: Jacobs (1998, p. 102).

The FGM was already used to asses impacts of different policy measures to reduce nitrogen emissions from agricultural sources (Schleef, 1998). Therefore the depiction of fertilization practice is quite well advanced in the FGM. In a first step fertilizer demand of different crop production processes is roughly estimated in relation to yields. Fertilizer demand can either be satisfied by fertilizer purchase (DK_1 .. DK_N) or from organic manure. In a second step fertilizer demand and fertilizer supply are adjusted in a way that they are constistent with the monetary account. Labour input coefficients of different production processes are calculated based on farm management handbooks taking into account farm group specific characteristics like field or herd sizes.

The coefficients of all other inputs, e.g. seed, crop protection, energy and depreciation are calculated in monetary terms. In a first step, these coefficients as for labour are taken from farm management handbooks, afterwards they are adjusted to corresponding accounts. An overview on the information available from farm accounting data is given by figure 8.6.

Figure 8.6 also shows the scheme of income calculation by the FGM. The relevant income indicator used in the objective function is farm income. From this the costs of fixed factors, irrespective whether they are in the ownership of the farmer or not, have to be covered.

8.4.2 Positive quadratic programming and policy impact analysis

For the base situation (actual year of the accounting data) the extent of production processes and most of the physical coefficients as well as product prices for each farm group are known directly from the accounting data. As described in the previous chapter most of the input coefficients are derived by plausible assumptions in consistency with the accounting data. Nevertheless a mis-specification of matrix coefficients might occur. Furthermore, it is possible that not all relevant restrictions or production options are specified correctly by the model. If such a model would be optimized with a linear objective function, the result might differ from information given by the accounting data.

To avoid the influence of such possible weaknesses a positive quadratic programming model is used. In a first step a base year optimization using a linear objective function is conducted. To ensure that the result of the optimization process reflects the actual situation the extent of activities in each farm group is fixed by bounds. The dual solution of this model usually will show positive or negative shadow prices for the activities. Using some mathematical transformations these shadow prices can be used to derive additional costs or benefits to be included in a quadratic objective function. The same matrix, being optimized with a quadratic objective function, delivers the correct base year result without bounds on activities.

The policy simulation process (ex ante analysis) usually proceeds in two steps (figure 8.7). In the first step a reference scenario is created for a target year assuming that the present agricultural policy will continue. Nevertheless, structural changes, technical progress and changing market conditions might alter production conditions in different farm groups. Such changes are incorporated into the model by an exogenous change of matrix coefficients based on experts estimations. Afterward the new model is optimized.

In a second step alternative policy measures are specified by the help of additional activities and restrictions or changes of matrix coefficients. The outcome of the optimization can be compared to the result of the reference scenario and allows to derive statements on the impacts of different policy measures.

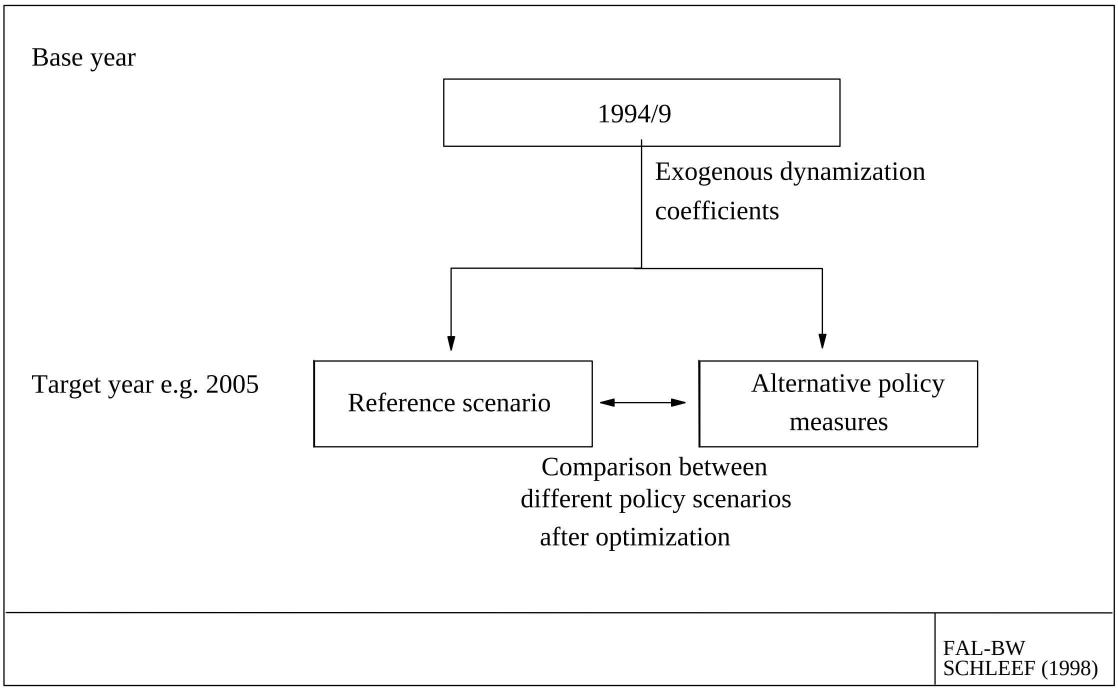

Figure 8.7 Conception of the comparative-static policy simulation
Source: Jacobs (1997, p. 32).

8.5 Conclusions

The model-system allows policy assessments based on a bottom-up approach. Its main components are a basic data system, a process analysis system and a presentation system. The determination of consistent aggregation factors allows sectoral aggregation of results. Homogeneous farm groups are built up on the base of national FADN data; selection criteria are determined with regard to underlying questions and policy measures. Due to data availability the model can be used for quantitative policy assessments for the German agricultural sector. First applications of the model are realized in the area of agri-environmental policies (Schleef, 1998) and of Agenda 2000 (Kleinhanß, 1998). It would be an interesting task to extend this type of modelling to other countries of the European Uion.

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9. Total factor productivity in European agriculture: an FADN approach

Carlos San Juan Mesonada [1] *and Esther Decimavilla Herrero* [2]

9.1 Introduction

This paper aims at measuring the total factor productivity (TFP) of the European agricultural firms. With a Translog index, an interspatial comparison of the twelve European countries and intertemporal productivity variations are computed to measure the different rate of TFP in the European firms. A Translog index was used for intertemporal comparisons for several reasons. First, it is appropriate from an economic point of view, to the multiple-input single-output case. Second, we assume that most of the firms are multiple-input multiple-output, which imply that the 'Fisher ideal' total factor productivity indexing procedure can be used. Third, the assumption that all inputs are instantaneously adjustable is not contemplated, thus ignoring the impacts of short run fixity of the quasi-fix factor (the family work). For that reason we calculate the Hulten index, as a short run productivity measure. By comparing the Hulten and Fisher indexes we try to measure the extend to which observed TFP growth exceeds or falls short of the growth of long run equilibrium TFP. With these, we can calculate both, the long run changes due to the growth of TFP and the short run changes in productivity due to variation in the utilization of the quasi-fix factor.

The approach that we use is to calculate non parametric indexes of total factor productivity which allow flexible modelling of underlying technology and easy calculation from the account data of the firms. We emphasise the implicit economic assumptions about the underlying aggregation functions of each indexing procedure, which drives us to the recent Diewert (1976, 1981, 1992) developments about *ideal superlative* indexes.

In this paper we use micro data from the FADN (Farm Accountancy Data Network), which provides homogeneous account data of the firms. The sample is representative at both, country and European Union (EUR12) levels.

Computing the input and output ratios allows us, for instance, careful calculations of capital stock, and the interest paid due to firm loans, something which is useful when calculating, for example, the ratio of the quasi-fix factor. Information about labour input in Annual Work Units (AWU), distinguishing between Family Work Units and waged labour, is also gathered. The aggregation of material inputs can be also carefully deflated and then used in real terms.

After the introduction, the theory of the accounting growth and its economically relevant implications are presented. The third paragraph is devoted to present the index number used here for TFP measurement: Translog (interspatial and intertemporal), Fisher and Hulten. Next the characteristic of the data used are briefly exposed. Finally we present the empirical results, emphasizing that:

[1] University Carlos III of Madrid.
[2] University of Valladolid.

1. for interspatial comparisons, of the 1986-1994 period, the Translog index yields two basic groups according to productivity:
   - above the EUR12 average, the north-central countries;
   - under the European average, the Mediterranean countries and Ireland.
2. The use of three productivity indexes (Translog, Fisher and Hulten) for measuring intertemporal comparisons shows that:
   - the Translog index tends to underevaluate productivity;
   - by comparing the short run TFP Hulten index to the TFP Fisher index we obtained an interesting view of the ratios of capital-labour and material inputs-labour, which varied according to state of the countries (depending if they were or weren't on the long run equilibrium).

The relevance of the results must be shown from the point of view of the potential growth of each country. We also expect that they can be useful for evaluating the effects of the CAP reform on the technical progress path and on the processes of real convergence between firms during the period toward the European Economic and Monetary Union.

9.2 Accounting growth and technological change

Barring technological advance, the growth of total output might be explained in terms of the growth of total factor input. The neo-classical theory of production and distribution states this view claiming that competitive equilibrium and constant return to scale implies that payments to factor exhaust total product.

However, supposing *technological advance*, payments to factors would not exhaust total product, and there would remain a *residual* [1] output not explained by total factor input.

The growth accounting approach involves compiling detailed accounts of inputs and outputs, aggregating them into input and output indexes, and using these to calculate a total factor productivity index *(***TFP** *index)*. In determining aggregate output and aggregate input measures, the method by which the raw data are combined into a manageable number of sub-aggregates, and in turn reaggregated, is important. If a firm produces only one output and utilizes only one input during each accounting period, then defining productivity change for the firm between two periods (t = 0,1) is:

$$PTF(x^0, x^1, y^0, y^1) = [y^1/y^0]/[x^1/x^0]$$

with positive quantities of produced output $y^t>0$ and input $x^t>0$. Thus productive change is positive if output grows faster than input.

[1] This famous 'residual', as Domar (1961) termed it, was associated with productivity growth in the early growth accounting literature and remains a fundamental concept in measuring and explaining productivity growth. Research by numerous economists has been devoted to mesauring and explaining the residual (for example, Kendrick, 1961, 1973; Denison, 1967, 1979; Jorgenson and Griliches, 1967; for literature surveys, see Antle and Capalbo, 1984).

But the practical problem is to measure productivity on the real world when virtually all firms produce more than one output using more than one input (multiple-output, multiple-input firm). The theory of index number addresses this issue. Diewert (1976, 1981, 1992) identifies the economic assumptions about the underlying aggregation functions that are implicit in the choice of an indexing procedure.

Here, data were collected from the Farm Accountancy Data Network (FADN) and three indexes (exacts for a linear homogeneous flexible form for the aggregator function) were chosen to compare European farms TPF:

- Törnqvist-Theil index (**TFP_T**)
- Fisher index (**TFP_F**)
- Hulten index (**TFP_H**)

A good alternative would be to use an index that is exact for a linear homogeneous flexible functional form for the aggregator function. Indexes with that latter property have been termed *superlative* by Diewert (1976).

Törnqvist-Theil or Translog is exact for a well-know linear homogeneous production function, the translog, and then is superlative.

For a multiple input firm, under constant returns to scale (CRS), Caves et al. (1982a) present valid economic justification for the use of the following Törnqvist-Theil productivity index to measure the technological change.

For both theoretical and practical reason, The Törnqvist-Theil index is used in the measuring of total factor productivity. The Törnqvist-Theil index compares both inter-country and intertemporal productivity. The former ranges countries along a scale of 12 agriculture-type farms representing FADN samples of the oldest members of the European Union. The latter compares productivity from 1986 to 1994.

Fisher total factor productivity index offers a better shape of productivity by analyzing multiple-output and multiple-input information from the view point of the test approach to index number. **TFP_F** is also a *superlative* measure of productivity change (c.f. Diewert, 1992).

The *Hulten index* measures short run productivity when there is a quasi-fixed factor. This index was calculated because it also considers allocative inefficiency (Grosskopf, 1993), something which does not take into consideration **TFP_T** and **TFP_F**. If, however, under-utilization of capacity occurs in the short term, the **TFP_T** can lead to interpreting short run variation of capacity utilization as long term decreases of productivity growth (Morrison, 1986; Berndt and Fuss, 1986; Hulten, 1986; see Bureau et al., 1995, for an empirical application to TFP comparisons with agricultural macro-data similar, on this point, to our micro-data approach). Hulten (1986) claims that if the firm is not in long run equilibrium and there is an under-utilization of the quasi-fixed input capacity, then the measure of the TFP must be calculated taking into consideration the appropriate input shares to avoid bias.

9.3 Use of index numbers for measuring TFP

9.3.1. Use of Törnqvist-Theil index [1]

From an economic point of view the Törnqvist-Theil procedure is used to obtain an index of TFP considered as a discrete approximation to the continuos Divisia index (Hulten, 1973; Diewert, 1976). To build it up the TPF_T we need first to obtain the quantities and price index.

The Törnqvist-Theil *quantity* index expressed in logarithmic form is:

$$\ln Qi_{t\,\equiv} \ln \{f(X^1) / f(X^0)\} = ½ \textstyle\sum_i (S_i^1 + S_i^0) \ln (X_i^1 / X_i^0) \qquad (1)$$

where S_i^j is the share of the *i*th input in the total payments for period *j*.
Similarly the Törnqvist-Theil *price* index:

$$\ln Pi_{t\,\equiv} \ln \{C(W^1) / C(W^0)\} = ½ \textstyle\sum_i (S_i^1 + S_i^0) \ln (W_i^1 / W_i^0) \qquad (2)$$

is exact for a translog unit cost function.
The Divisia indexes of aggregate output **Q** and aggregate input **X** are defined in terms of proportional rates of growth:

$$\dot{Q} = \sum_j \left\{ \frac{Pj\ Qj}{\sum_i Pi\ Qi} \right\} \dot{Q}_j \qquad (3)$$

$$\dot{X} = \sum_j \left\{ \frac{Wj\ Xj}{\sum_i Wi\ Xi} \right\} \dot{X}_i \qquad (4)$$

Since **TFP** = **Q/X** , the proportion rate of growth of TFP is:

$$TFP = \dot{Q} - \dot{X} \qquad (5)$$

The Törnqvist-Theil quantity index given in equation (1) can be used to approximate equations (3) and (4) as:

$$Q_T = \ln(Q_t / Q_{t-1}) = ½ \textstyle\sum_j (S_{jt} + S_{jt-1}) \ln (Q_{jt} / Q_{jt-1}) \qquad (3')$$

$$X_T = \ln(X_t / X_{t-1}) = ½ \textstyle\sum_j (S_{it} + S_{it-1}) \ln (X_{it} / X_{it-1}) \qquad (4')$$

and the discrete approximation to equation (5) is:

$$\ln(TFP_t/TFP_{t-1}) = \ln(Q_t/Q_{t-1}) - \ln(X_t/X_{t-1}) \qquad (5')$$

or

[1] The material on this section draws on Diewert (1980, 1981, 1992) an Capalbo and Antle (1984).

$TFP_T = Q_T/X_T$

where $\mathbf{Q_T}$ is the translog index of aggregate output and $\mathbf{X_T}$ the similar translog input index. Last equation assumes that the production technology is input-output separable, and linear homogeneous production function and exhibits extended Hicks-neutral technological change.

In fact, under the hypothesis of constant returns to scale technology, Caves et al. (1982a) present a strong economic justification for the use of the Törnqvist or translog productivity index to measure technological change (Diewert, 1992).

The Törnqvist-Theil index number is also superlative for some very general production function structures, that is, nonhomogeneus and nonconstant returns to scale (Caves et al., 1982 a,b). If the aggregator functions are nonhomothetic, the Törnqvist-Theil index is still attractive, since the translog function can provide a second-order differential approximation to an arbitrary twice-differentiable function (theorems 26 and 27 in Diewert, 1981)[1]. In addition Diewert's (1976) results show that the natural discrete approximation of productivity growth index PTF_T 'not only captures multifactor productivity, but is exact for translog technology. Furthermore, this index is superlative since the translog form is flexible. Thus these nonparametric approaches are very appealing in terms of ease calculation and flexible modelling of underlying technology, good reason for their popularity' (Grosskopf,1993) [2].

In this paper, for intertemporal and intercountry comparisons, we started from a translog function in the country **i** at time **t**:

$$\ln Y_{it} = F_{it}[\ln L_{it}, \ln K_{it}, \ln M_{it}, T_t, D_i] \quad (6)$$

where:

- Y_{it}= aggregate of outputs at time **t** in country **i**.
- L_{it}= work force inputs at time **t** in country **i**.
- K_{it}= capital inputs at time **t** in country **i.**
- M_{it}= material inputs at time **t** in country **i.**
- T_t= state of technology at time **t**.
- D_i=spatial indicator for country **y** or 'efficiency difference indicators'.

This production function is weakly separable both between inputs and outputs [3], and between three subsets of inputs [4], and, in addition, constant yields and final remuneration

[1] Since nonhomothetic production functions are not characterised by a constant distance between any given pair of isoquants along a ray from the origin, input bundles are not directly comparable without reference to the output levels in each period. Diewert´s results show that when reference point is the isoquant for the geometric mean of output in the two periods, the Törnqvist-Theil index is exact for a nonhomothetic translog function (see Diewert, 1992, for stronger result).

[2] Note, however, that no account is taken of possible inefficiency, as well as show Grosskopf,1993, calculating TFP growth as the residual between observed output and input use may lead to bias in the presence of inefficiency.

[3] A function is said to be weakly separable into inputs and outputs if and only if the marginal rate of substitution among any output is independent of the amount of inputs considered.

[4] A function is said to be weakly separable into subsets of inputs, if the marginal rate of substitution between two input x_i and x_j of a subset is independent of the number of inputs which do not correspond to the subset N.

equal to marginal productivity are supposed. Applying Diewert´s (1976) quadratic lemma [1] to this translog function in two countries (**i,i'**) at two times (**t,t'**), the following expression was obtained:

$$
\begin{aligned}
\ln Y_{it} - \ln Y_{i't'} =& \tfrac{1}{2}(a_{it}+a_{i't'})(\ln L_{it} - \ln L_{i't'}) + \\
& \tfrac{1}{2}(b_{it}+b_{i't'})(\ln K_{it} - \ln K_{i't'}) + \\
& \tfrac{1}{2}(c_{it}+c_{i't'})(\ln M_{it} - \ln M_{i't'}) + \\
& \tfrac{1}{2}(\partial F/\partial D_{D=Di} + \partial F/\partial D_{D=Di'})(D_i - D_{i'}) + \\
& \tfrac{1}{2}(\partial F/\partial T_{T=Tt} + \partial F/\partial T_{T=Tt'})(T_t - T_{t'}) \qquad (7)
\end{aligned}
$$

where:

- **i**, **i'**= countries.
- **t**, **t'**= time periods.
- **a**, **b**, and **c** = shares of work force, capital, and intermediate material inputs in total production (in the country and at the time shown in the subindexes, and where a+b+c =1 if we assume constant returns to scale).
- **L**, **K** and **M** = productive factors: labour, capital, and intermediate material inputs respectively.
- **Y** = total output.

The last two terms of the equation are translog indexes, i.e., they are exact indexes in translogarithmic functions. Denoting them as $r_{i,i'}$ and $t_{t,t'}$, they indicate interspatial and intertemporal productivity respectively:

$r_{ii'} = \tfrac{1}{2}(\partial F/\partial D_{D=Di} + \partial F/\partial D_{D=Di'})(D_i - D_{i'})$

and

$t_{t,t'} = \tfrac{1}{2}(\partial F/\partial T_{T=Tt} + \partial F/\partial T_{T=Tt'})(T_t - T_{t'})$

The general formula for the translog TFP in logs is:

$$
TFP_T = \ln Y_{it} - \ln Y_{it'} - \Phi \sum_{i=1}^{N} \frac{1}{2}\left[s_{it} + s_{it'}\right]\left(\ln X_i^t - \ln X_i^{t'}\right) \qquad (8)
$$

where Φ is the degree of homogeneity of the production function.

From equation (7) and (8), these conclusions can be drawn:

1. Assuming that $D_i=D_{i'}$, $t_{t,t'}$ compares intertemporal productivity. In other words, we can check productivity shift for different time periods in a country firm-type or the weighted average European 12-farm-types:

$$
\begin{aligned}
\tau_{t,t'} = (\ln Y_t - \ln Y_{t'}) &- [\tfrac{1}{2}(a_t+a_{t'})\cdot(\ln L_t - \ln L_{t'})] \\
&- [\tfrac{1}{2}(b_t+b_{t'})(\ln K_t - \ln K_{t'})]
\end{aligned}
$$

[1] The quadratic lemma states that the difference between the values of a quadratic function evaluated at two points is equal to the average of the gradient evaluated at both points multiplied by the difference between the points.

$$- [\tfrac{1}{2}(c_t+c_{t'})\cdot(\ln M_t - \ln M_{t'})] \quad (9)$$

Hence, $\mathbf{t_{t,t'}} > \mathbf{0}$ denotes productivity increases against last year's yields. The opposite holds when $\mathbf{t_{t,t'}} < \mathbf{0}$.

2. When $T_t = T_{t'}$, $r_{i,i'}$ compares interspatial productivity. In other words, we can check the efficiency difference indicator, considering two countries *i* and *i'*:

$$\rho_{i,i'} = (\ln Y_i - \ln Y_{i'}) - [\tfrac{1}{2}(a_i+a_{i'})\cdot (\ln L_i - \ln L_{i'})] - [\tfrac{1}{2}(b_i+b_{i'})\cdot (\ln K_i - \ln K_{i'})] - [\tfrac{1}{2}(c_i+c_{i'})\cdot (\ln M_i - \ln M_{i'})] \quad (10)$$

Hence, $\mathbf{r_{i,i'}} > \mathbf{0}$ indicates lower productivity in country **i'**. The opposite holds when $\mathbf{r_{i,i'}} < \mathbf{0}$.

9.3.2. Use of Fisher index

In economic approaches, the assumption of optimizing behaviour is always used. In the test or axiomatic approach, no assumption about optimizing behaviour is required, which might be an advantage of this approach.

Diewert (1992) shows that the Fisher ideal quantity index Q_F is the unique function which satisfies all these 20 tests or mathematical properties that have been suggested as desirable for an output index. And his results provide equally strong economic justifications for the use of the Fisher productivity index, $\mathbf{TFP_F}$, rather than the translog productivity index, $\mathbf{TFP_T}$, for the TFP case with multiple inputs and outputs (see Christensen and Jorgenson, 1970; Jorgenson and Griliches,1972).

The Fisher index is the geometric mean of the Laspeyres and Paasche indexes.

The Laspeyres quantity index for the output is:

$$Q_L = p^0 y^1 / p^0 y^0 \quad (11)$$

Where *p* is output price and *y* is output quantities.

The Paasche quantity index for the output is:

$$Q_p = p^1 y^1 / p^1 y^0 \quad (12)$$

Then, the Fisher quantity index of aggregate output is:

$$Q_{F} = \left(\frac{p^0 \bullet y^1}{p^0 \bullet y^0} \; \frac{p^1 \bullet y^1}{p^1 \bullet y^0} \right)^{1/2} \quad (13)$$

Similarly, the Fisher quantity index of aggregate inputs is:

$$X_{F} = \left(\frac{w^0 \bullet x^1}{w^0 \bullet x^0} \; \frac{w^1 \bullet x^1}{w^1 \bullet x^0} \right)^{1/2} \quad (14)$$

Where *w* is input price and *x* is input quantities.

Thus the Fisher total factor productivity index is:

$$\mathbf{TFP_F = Q_F/X_F} \quad (15)$$

The $\mathbf{TFP_F}$ is consistent with the following assumptions (Bureau et al., 1995):

1. Technology can be approximated by a twice differentiable form (Diewert, 1992).
2. Farms are competitive and profit maximizes in each period.
3. Technology satisfies non-increasing returns to scale.
4. All inputs and outputs can be adjusted to the market price or user cost.
5. User cost is an appropriate representation of the value of service flows of the quasi-fixed inputs.

This implies that anticipated discount rates in the presence of uncertainty are correctly approximated, and that depreciation is also correctly measured. If the technology is not putty-putty, i.e. factor combinations cannot be freely adjusted after quasi-fixed inputs are purchased (for example that *ex-post* complementary exists between factors); for example the user cost of capital is not independent of the price of other inputs. The assumption of putty-putty technology is necessary for the derivation of Jorgensons's (1963) expression of the user cost.

In the TFP_F calculation, we assume long run equilibrium. That means not asignative inefficiency and then factor price equal to marginal cost. On the long run equilibrium, short run marginal cost, short run average cost, long run marginal cost and long run average cost intercept at the same point.

In practice, the TFP_F calculation requires the construction of Paasche $\mathbf{Q_P}$ and Laspeyres $\mathbf{Q_L}$ quantities index for inputs and outputs. From the account data and the price index of agricultural inputs and outputs published by Eurostat and using the Diewert (1992) theorem:

$$\frac{p^1q^1}{p^0q^0Q_P} = \frac{p^1q^0}{p^0q^0} \equiv P_L$$

then, to obtain the Paasche quantity index:

$$\frac{p^1q^1}{p^0q^0P_L} = Q_P$$

and similarly, from the current values index series and using the Paasche index price:

$$\frac{p^1q^1}{p^0q^0Q_L} = \frac{p^1q^1}{p^0q^1} \equiv P_P$$

Hence we have the Laspeyres quantity index:

$$Q_L = \frac{p^1 q^1}{p^0 q^0 P_P}$$

The above formulation allows us to calculate both Fisher and Hulten total factor productivity indexes starting from the available account data and price index.

9.3.3. Use of Hulten index

To calculate TFP_H , we use equation (15) but calculating the ratios of the quasi-fixed factor under the hypotheses that because of different causes (like draughts, market instability,...) the quasi-fix factor is under (or over) utilized on the short run. Thus we shall interpret the Hulten index like a short run TFP measurement when a quasi-fixed factor is not long run equilibrium.

On this alternative approach we use the Hulten (1986) result assuming that if the firms are no longer in a long run equilibrium, there is under-utilisation (or over-utilisation) of the quasi-fixed input capacity, which will imply that the TFP measure is biased.

Suppose, now, that a quasi-fix input **F** is fixed in the short run and only the other variable inputs **L**, **M** (waged labour and material inputs) can be adjusted. Short run equilibrium is determined by the equality of price with short run marginal cost (SRMC).

This equilibrium may or may not occur at the level of output at which short run average cost (SRAC) is minimized and equal to the long run average cost (LRAC).

Only when the rate of utilisation of the quasi-fixed input equal to one the firm is in long run equilibrium and under CRS variable input levels minimized SRAC and LRAC, that is:

$Q(t) = Q^*(t)$ (16)

where:

- $Q(t)$= actual output.
- $Q^*(t)$= long run equilibrium output (SRMC=SRAC=LRAC=SRAC).

We define the rate of utilisation as the ratio of actual output to the level of output at which SRAC is minimized. Thus:

$$U(t) = \frac{Q(t)}{Q^*(t)} \quad \text{and} \quad U(t)=1 \qquad (17)$$

on long run equilibrium and the firm is cost-minimizing/profit maximizing, but when lower quantity of variable inputs **L, M** is applied to the quasi-fixed factor **F, U(T)<1.**

Conversely when greater quantity of inputs is applied **U(t)>1** when **Q(t)>Q*(t)** and then the quasi-fixed factor **F** earns a quasi-rent $\mathbf{Z^F(t)}$ which exceeds the rent $\mathbf{P^F(t)}$ earned in other uses (alternatively, $\mathbf{P^F(t)}$ may be thought as a long run rent which would be earned if **Q(t)=Q*(t))**.

On the other situation, when $\mathbf{Q(t) \neq Q^*(t)}$:

$$P(t)\,\frac{\partial Q(t)}{\partial Q^*(t)} = Z^F(t) \neq P^F(t) \qquad (18)$$

With these fundamental equation of Berndt and Fuss (1986), the Hulten approach shows that TFP should be measured by:

$$\frac{\dot{A}^*}{A^*} = \frac{\dot{Q}}{Q} - V_F \frac{\dot{F}}{F} - V_L \frac{\dot{L}}{L} - V_M \frac{\dot{M}}{M} \qquad (19)$$

where the quasi-fixed factor stock is used in place of capital services and where the weights are now defined by:

$$V_F = \frac{Z^F F}{PQ}$$

$$V_L = \frac{P^L L}{PQ} \quad (20)$$

$$V_M = \frac{W^M M}{PQ}$$

where:

$$PQ = Z^F F + P^L L + W^M M \qquad (21)$$

Note that these weights equal the corresponding output elasticities:

$V_F=E_F$, $V_L=E_L$ and $V_M=E_M$ (22)

And there for:

$V_F + V_L + V_M = 1$, under CRS (23)

Note, too, that the weights are now based on $\mathbf{Z^F(t)}$ rather than $\mathbf{P^F(t)}$.

In order to operationalize this contribution is necessary to measure the quasi-rent $\mathbf{Z^F}$ and to construct the weights V_F, V_L and V_M:

$$P(t)Q(t) = Z^F(t)F(t) + P^L(t)L(t) + W^M(t)M(t) \qquad (24)$$

and thus $\mathbf{Z^F(t)}$ using:

$$Z^F(t) = \frac{P(t)Q(t) - [P^L(t)L(t) + W^M(t)M(t)]}{F(t)} \qquad (25)$$

We consider the quasi-fixed factor like the aggregate of the 'entrepreneurial capacity' of the firm, that is the equities (land, buildings, cattle,...) plus the non-waged family works units (FWU). For these first steps we used equation (25). Therefore the quasi-rent of the aggregate fixed inputs is decomposed, in a second step, between the user cost capital (the ex-post average implicit interest rate paid for each country firms, obtained from their own account results) and a residual which is interpreted as the quasi-rent for family labour FWU. The share V_L and V_M can be obtained directly from the account data for each year.

The Hulten index is thus consistent with the following assumptions (as in Bureau et al., 1995):

1. Short run competitive profit maximization for the variable inputs and freely adjustable outputs in each period.
2. Constant returns to scale (CRS).
3. Realization of expected (ex-ante) output and variable input prices. If the expected output or the variable input price does not hold, the ex-post unit residual remuneration of the quasi-fixed factors does not correspond to the quasi-rent, since decision about output and variable inputs are made prior to the start of production.

Finally we consider that the divergence between Fisher and Hulten total factor productivity indexes is due to the Hulten index correction on the utilisation capacity of family labour (Hulten, 1986; Morrison, 1986). But Bureau et al. (1995) claim that these depends on the assumption that the ex-post measurement of the returns to family labour is a correct approximation of the quasi-rents. Climatic variations in agriculture not only involve differences between ex-post prices and ex-ante expectations, but also uncertainty about the output level itself.

9.4 The farm accountancy data network

The Farm Return is a format used by Farm Accountancy Data Network (FADN) to describe the data of an individual farms in the form in which it is exchanged between the member states. The current Farm Return was introduced in 1977 (published as Regulation (EEC) 2237/77 of the Commission dated 23.9.1977 in the Official Journal L 263, dated 17.10.1977) and replaced the first one, that lasted for a decade. The Farm Return is used to gather data on nearly 60,000 'commercial' farms in the European Union. The FADN is a network of networks: accounting offices keep records of the 60,000 individual farms and submit the data to national liaison offices, who convert them to the Farm Return and send them to Brussels (D.G. VI). The sample in each country is addecuately weighted according to the represented population.

To begin, we classify the various budget inputs items into three categories:

1. Labour input, measured in Annual Work Unit, AWU, and distinguishing Family Work Unit, FWU, from Paid Labour Input;
2. Capital input as the aggregate of the land, permanent crops and quotas, buildings, machinery and breeding livestock. Also depreciation data can be gathered from the accounts;
3. Material input as the aggregate of the seeds and plants, fertilizers, crop protection agrochemical, feed, machinery and buildings current costs, energy and farming overheads.

Output aggregate included output crops and products (cereals, protein crops, potatoes, sugar divergence between Fisher and Hulten total factor productivity indexes is due to the Hulten index correction on the utilisation capacity of family labour beet, oil-seed crops, industrial crops, vegetables and flowers, fruits, citrus fruit, wine and grapes, olives and oliveoil, forage crops), output livestock and products (cows milk and products, beef and veal, pigmeat, sheep and goats, poultrymeat, eggs and ewes' and goat' milk) and other products.

Input and output price indexes to calculate variables in real terms are gathered from Eurostat.

It is important to emphasise, and to note by way of contrast, that the level of input and output detail contained exceeds the detail found in the studies using macroeconomic data.

9.5 Results and final comments

First we will refer to the results about the ranking of productivity during the period of 1986-94 obtained using the translog TFP interspatial index for comparing productivity. The data of the FADN sample for the twelve European countries show that (see table 9.1 and graph 9.1 and 9.2):

- Belgium shows the highest average in each year productivity level, with The Netherlands trailing;
- France, Denmark, United Kingdom and Luxembourg appear in a second group, also above the European average;
- Germany, Spain and Italy are place around the average (the former a bit up and the Mediterranean's a bit down);
- Ireland, Greece and in Portugal are well below the European average, Portugal in the last place.

Second, referring now to the *intertemporal* productivity, the results obtained with the three indexes (Translog or Törnqvist-Theil, Fisher and Hulten) are similar. Our results clearly show an increase of the average productivity level of the European firms (EUR12) but with different average speed depending on the country (see table 9.2):

- France, Denmark, Germany and Ireland show the highest scores in productivity growth;
- the Netherlands and Belgium also increased the productivity, but at a slower path;
- Spain is below the average;
- the other countries moves their ranking positions depending on the index used to compute productivity.

Third, comparing the TFP_T , TFP_F and TFP_H indexes (see graphs 9.3 to 9.15), we can find some interesting regularities along the time:

- the results for the twelve European countries firms are very similar when using Fisher (2.6) or Hulten (2.5) productivity measures. The translog index, however, yielded the lowest rate (1.1) but also followed a close path (see graph 9.3);
- France, Denmark, Germany and The Netherlands moved faster than the average. The three indexes showed similar trends (see graphs 9.6, 9.5, 9.7 and 9.12);
- Spain increases its still low level of productivity, observing a similarity in the three indexes (see graph 9.14);
- conversely, the Hulten index clearly diverts after 1991 from TFP_T and TFP_F in Belgium, Greece, Portugal and Italy (see graphs 9.4, 9.8, 9.13 and 9.10). Luxembourg,

Ireland and United Kingdom also show some soft diversions (see graphs 9.11, 9.9 and 9.15).

Four, by comparing long run against short run productivity measures, the empirical results yield:

A. Countries with high productivity level seem to be around the long run equilibrium, then Hulten and Fisher indexes ratios are similar. On these situation we found Denmark, Germany, France and United Kingdom. Others countries with high level of productivity and productivity increasing faster than the average EUR12 are Belgium, Luxembourg and The Netherlands which show that the rate of productivity TFP_F varies less than TFP_H. On this group we find that (see tables 9.2 and 9.3):
- the level of capital per work unit is high, the group is on the top seven capital intensive firms (the exception is France with a negative capital-labour rate variation of -1.6 and on the 10^{th} position and Denmark -2.2 on the 4^{th});
- the use of material inputs per work unit is high. This group is also on the top seven ranking of the material inputs per worker (and increasing very fast in France at a 5.2 average annual rate);
- the wage level is over the European average.

B. In countries like Spain, Ireland and Italy in which the Fisher index is over the Hulten index, our empirical results show that (see tables 9.2 and 9.3):
- the capital per work is increasing faster than the European average during these years;
- the wages paid are around the average but increasing (faster in Spain 7.3 than Ireland 3.8 and Italy 3.0 on average annual rate 1986-94);
- the use of material inputs per worker is lower than the average in Spain and Italy but over the average in Ireland and increasing at the highest rate 5.4 (since the EUR12 rate is 2.3 on average annual rate 1986-94).

The participation of the quasi-fix rent of the family work is negative the same years due to poor *ex post* returns. Thus Hulten index computation, using *ex post* returns as price for family labour in computing labour shares, is pricing at lower level than when we use Fisher index, which uses the wage rate to price family labour.

C. Countries like Greece and Portugal show poor results on productivity. The Hulten index gives higher rates of productivity than the Fisher index. The magnitude of the discrepancies between these two indexes is relevant because it depends on the importance of labour on the input combination, and in both countries (see tables 9.2 and 9.3):
- the level of capital per work unit is low and even decreases during this period;
- the wages paid are placed on the lowest European level;
- the use of material inputs per worker is also on the lowest European level;
- the participation of the quasi-fix factor (family labour) is negative in Portugal, because of the fast increase of the wages paid, and thus the Hulten index gives

higher rates of productivity than the Fisher index. In the same years Greece also has negative ratios of the quasi-fix factor but the wages even decrease on average annual rate 1986-94.

From the empirical point of view, countries on the A) group has a low ratio of labour in the input combination and the magnitude of the discrepancies between Fisher and Hulten indexes is low. Conversely on the B) and C) groups the diversions between these two indexes are higher, due to the important weight of the labour input. In the B) countries it also depends on the high rate of decrease of the labour since capital and material inputs are used in a more intensive way.

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Tables and graphs in order of appearance in text

Table 9.1 Tornquist-theil index interspatial TFP EUR12=100

Country	Average 1986-1994
EUR12	100,00
Belgium	128,76
Denmark	117,34
France	132,67
Germany	107,66
Greece	80,29
Ireland	84,67
Italy	88,95
Luxembourg	111,78
The Netherlands	126,13
Portugal	62,51
Spain	92,79
U. Kingdom	113,57

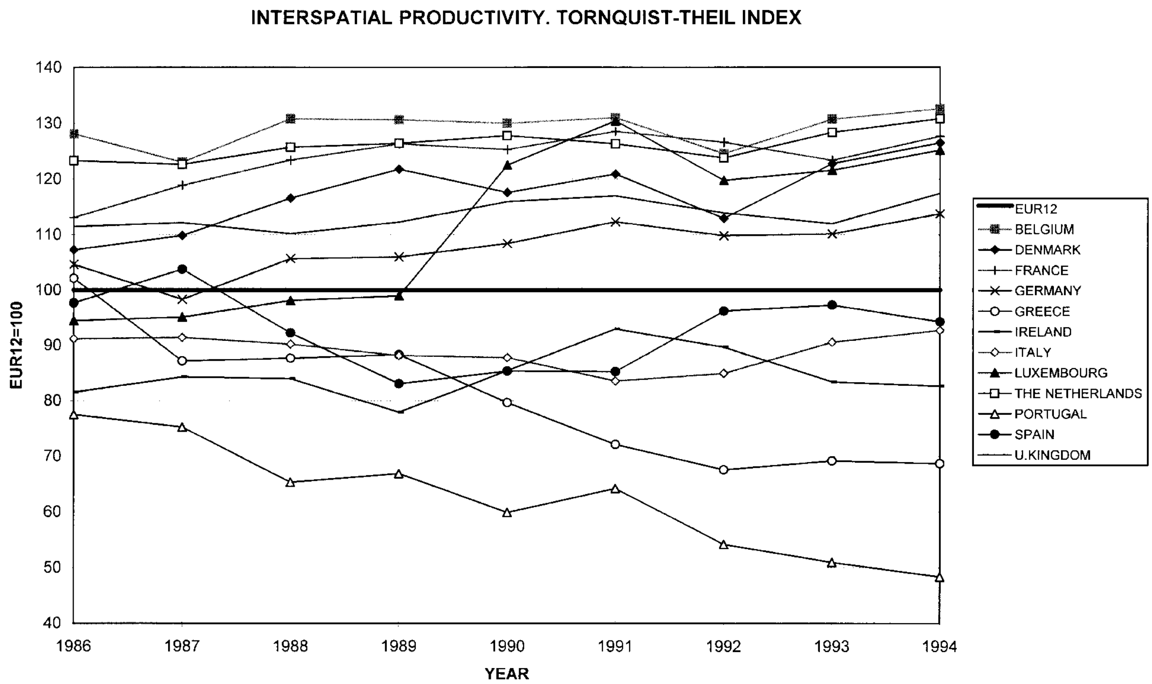

Figure 9.1 Interspatial productivity, Tornquist Theil index

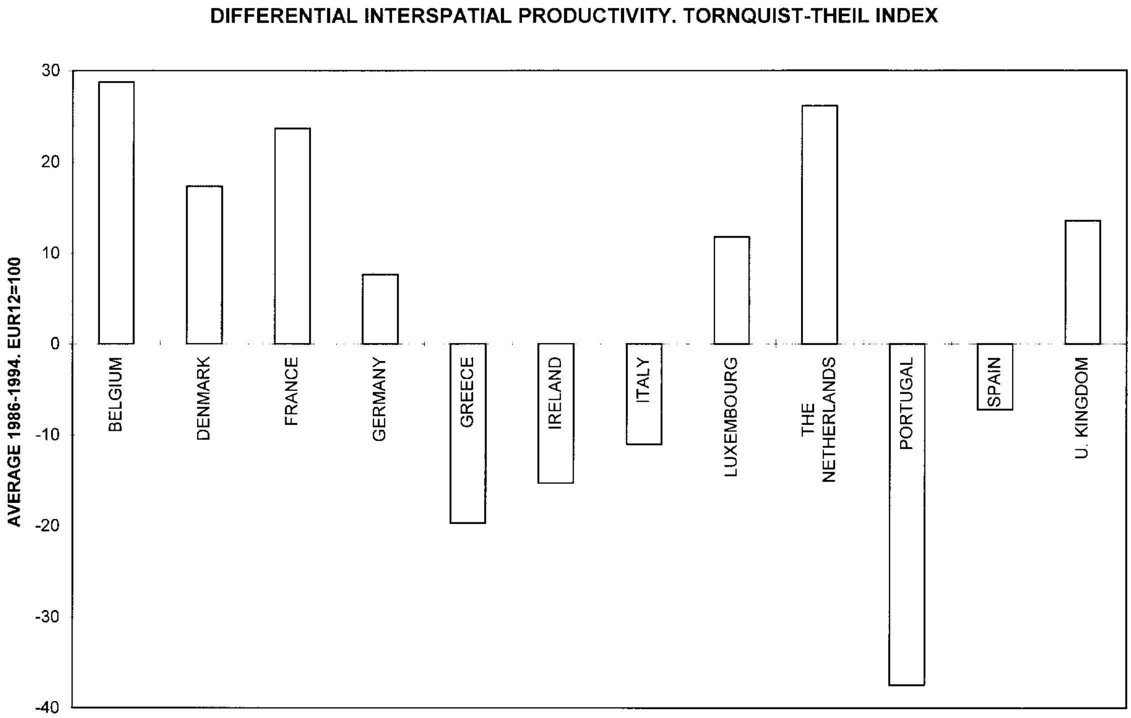

Figure 9.2 Differential interspatial productivity, tornquist theil index

Table 9.2 Total factor productivity index (%) average 1986-1994

Country	Törn.-Theil	Fisher	Hulten
EUR12	1,06	2,67	2,55
Belgium	1,35	1,88	4,98
Denmark	3,38	3,24	3,35
France	3,59	5,58	5,7
Germany	1,88	2,96	3,09
Greece	-4,39	-0,48	2,38
Ireland	1,2	2,78	2,6
Italy	2,01	3,75	-2,12
Luxembourg	4,14	-0,53	1,47
The Netherlands	1,59	1,89	2,33
Portugal	-3,24	1,78	7,37
Spain	0,49	2,43	0,81
U. Kingdom	1,33	1,41	1,46

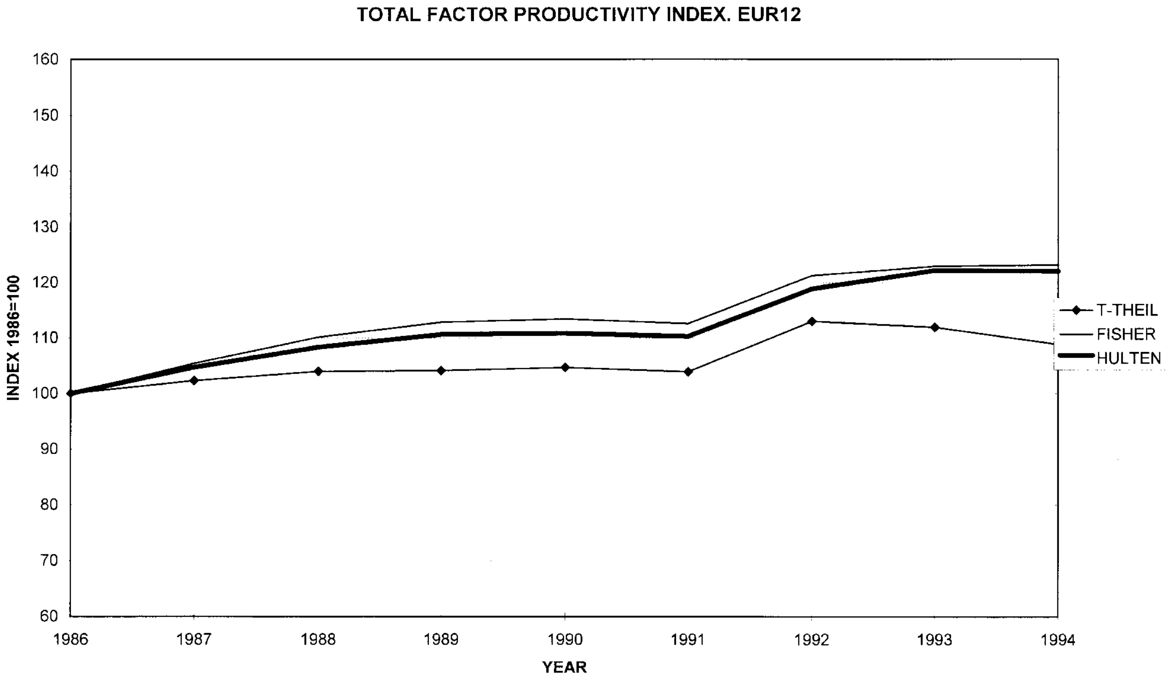

Figure 9.3 Total factor productivity index, EUR12

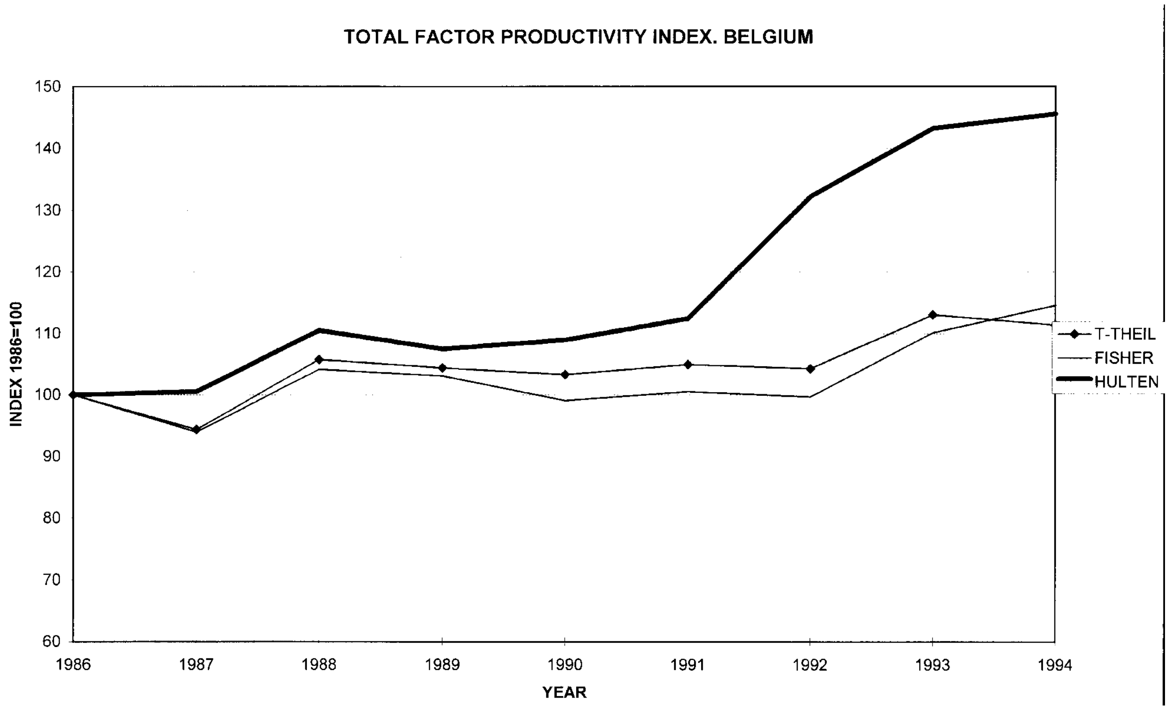

Figure 9.4 Total factor productivity index, Belgium

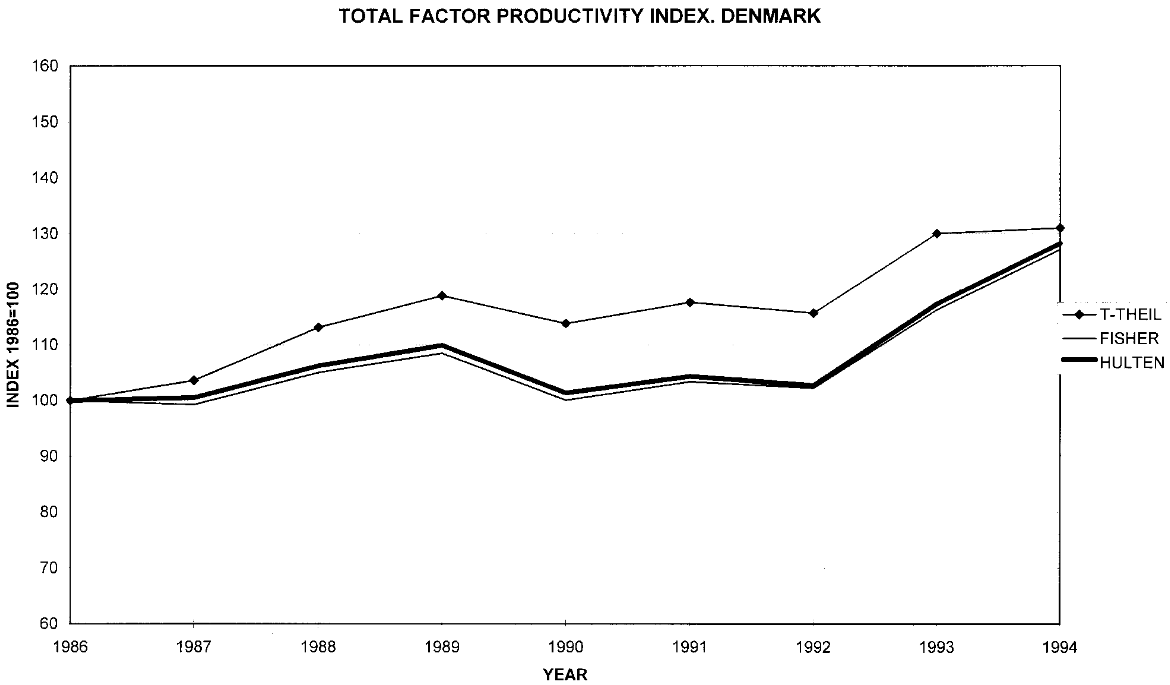

Figure 9.5 *Total factor productivity index, Denmark*

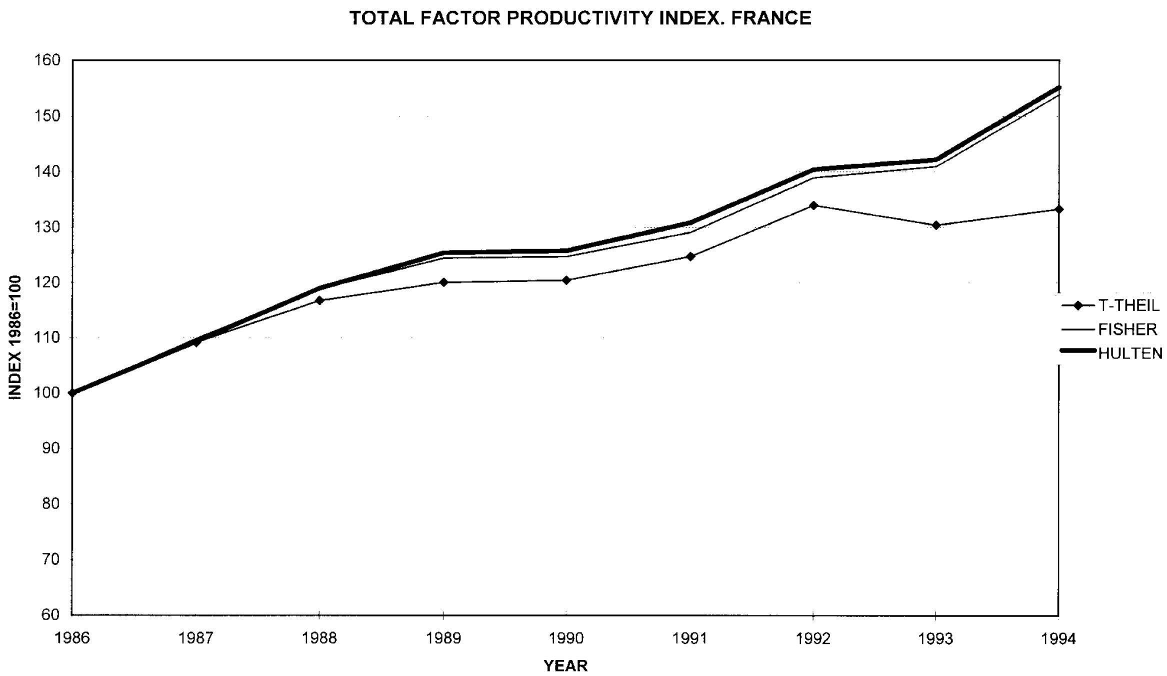

Figure 9.6 *Total factor productivity index, France*

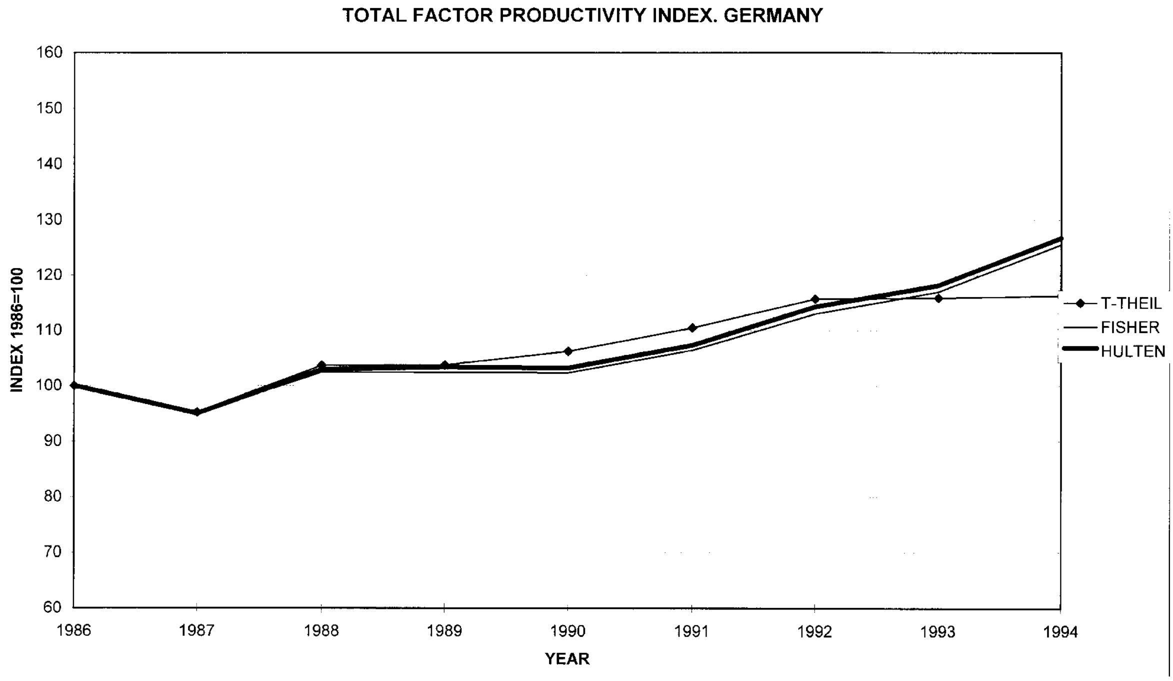

Figure 9.7 *Total factor productivity index, Germany*

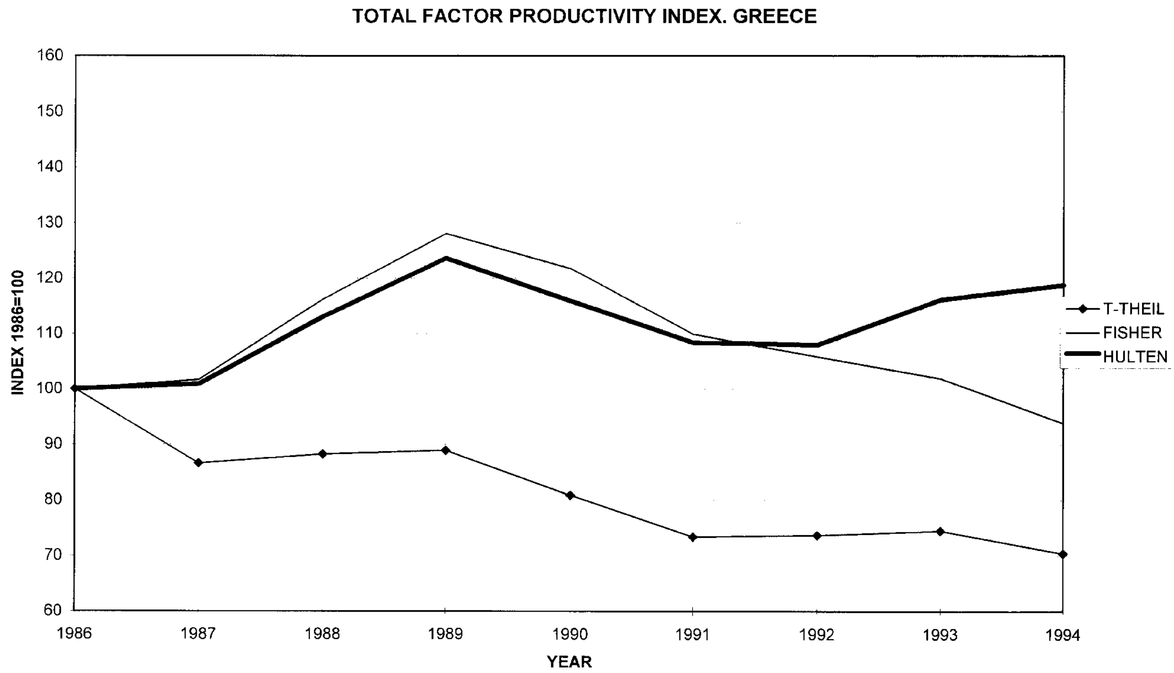

Figure 9.8 *Total factor productivity index, Greece*

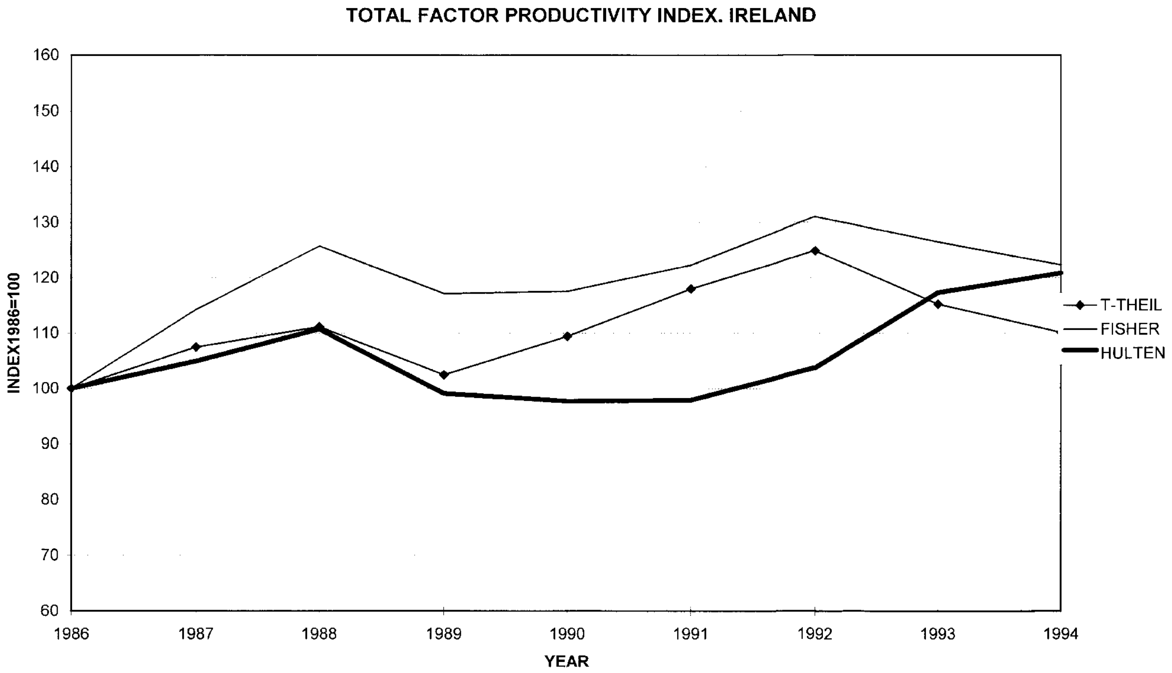

Figure 9.9 Total factor productivity index, Ireland

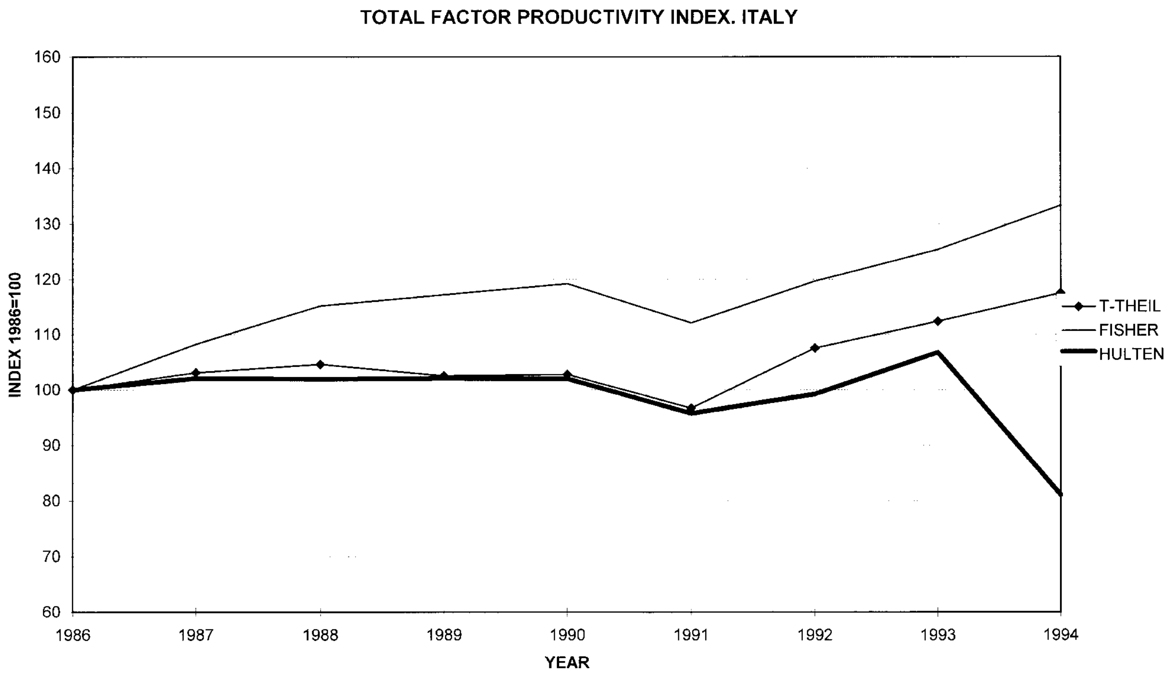

Figure 9.10 Total factor productivity index, Italy

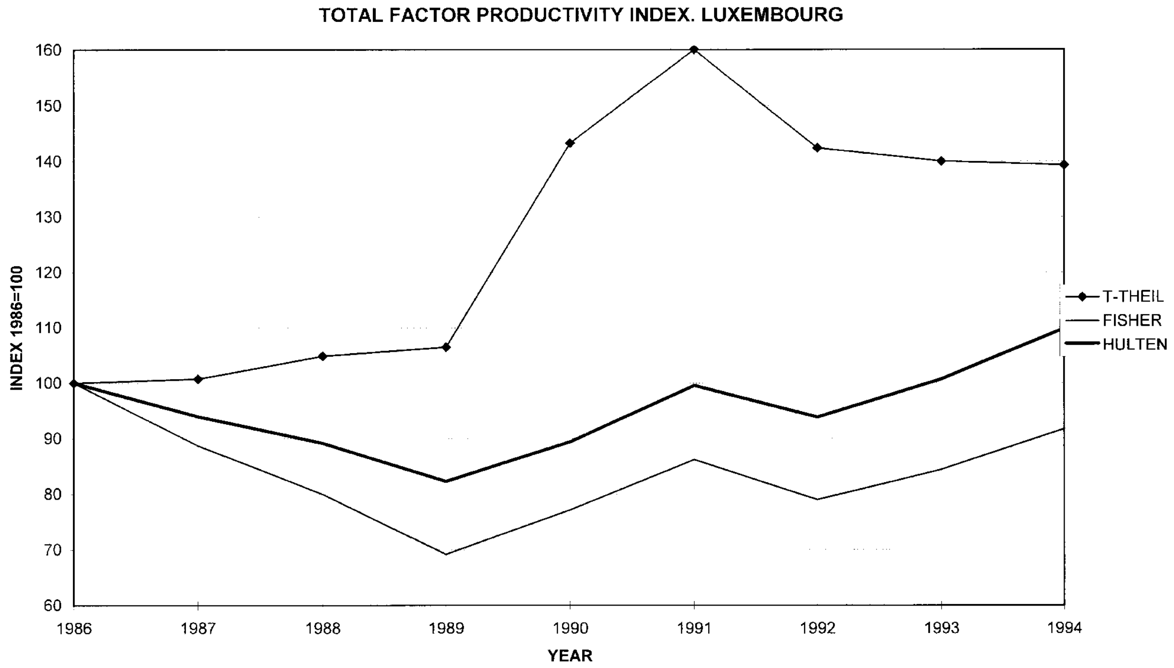

Figure 9.11 Total factor productivity index, Luxembourg

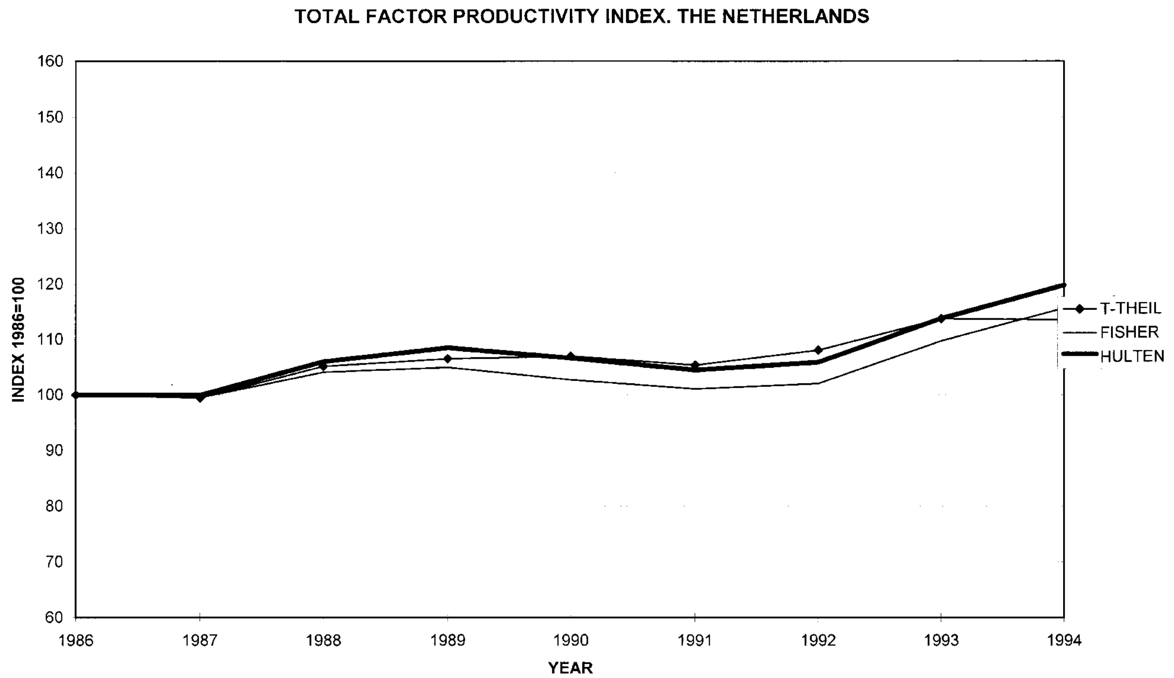

Figure 9.12 Total factor productivity index, The Netherlands

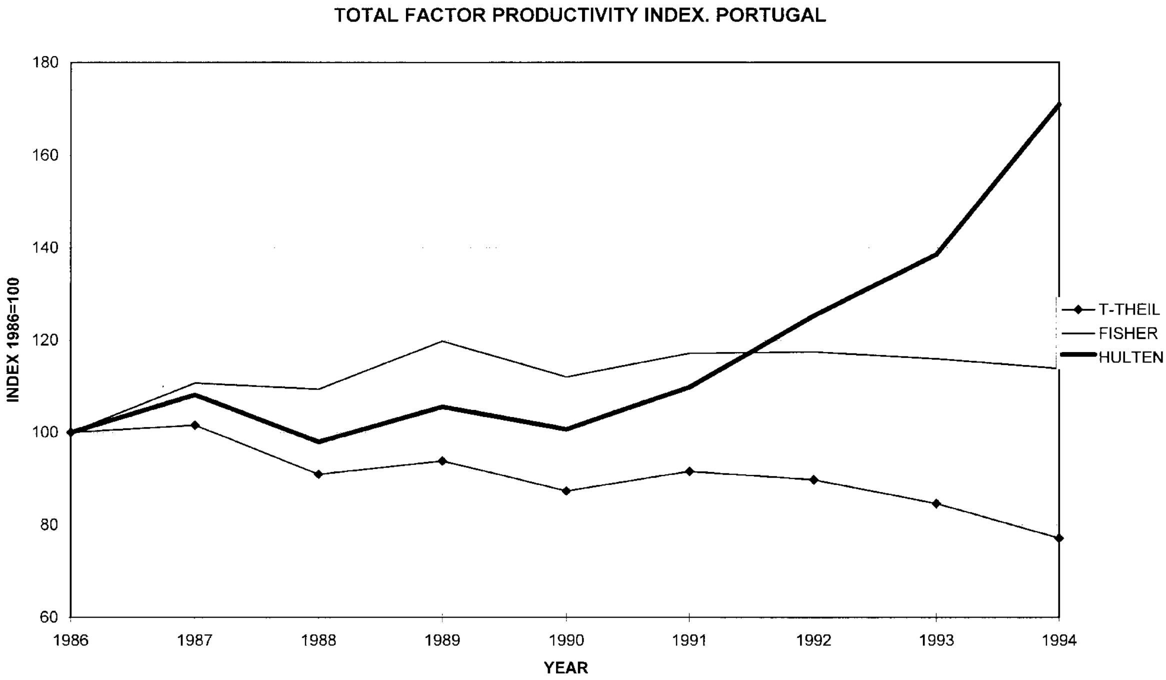

Figure 9.13 Total factor productivity index, Portugal

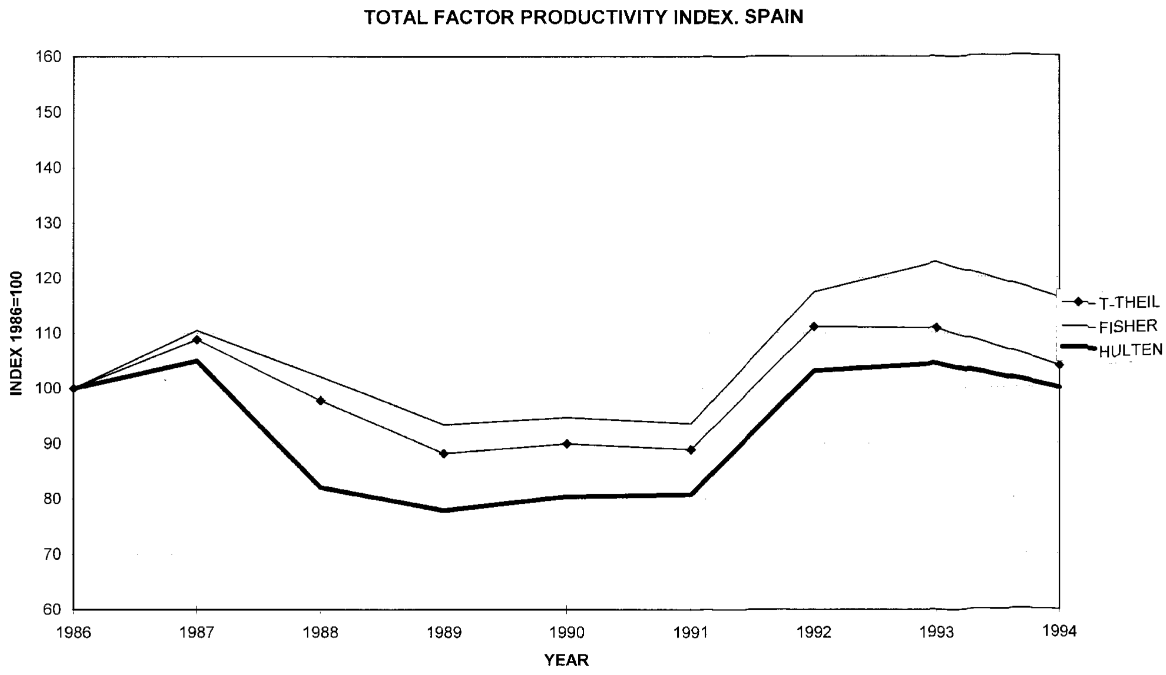

Figure 9.14 Total factor productivity index, Spain

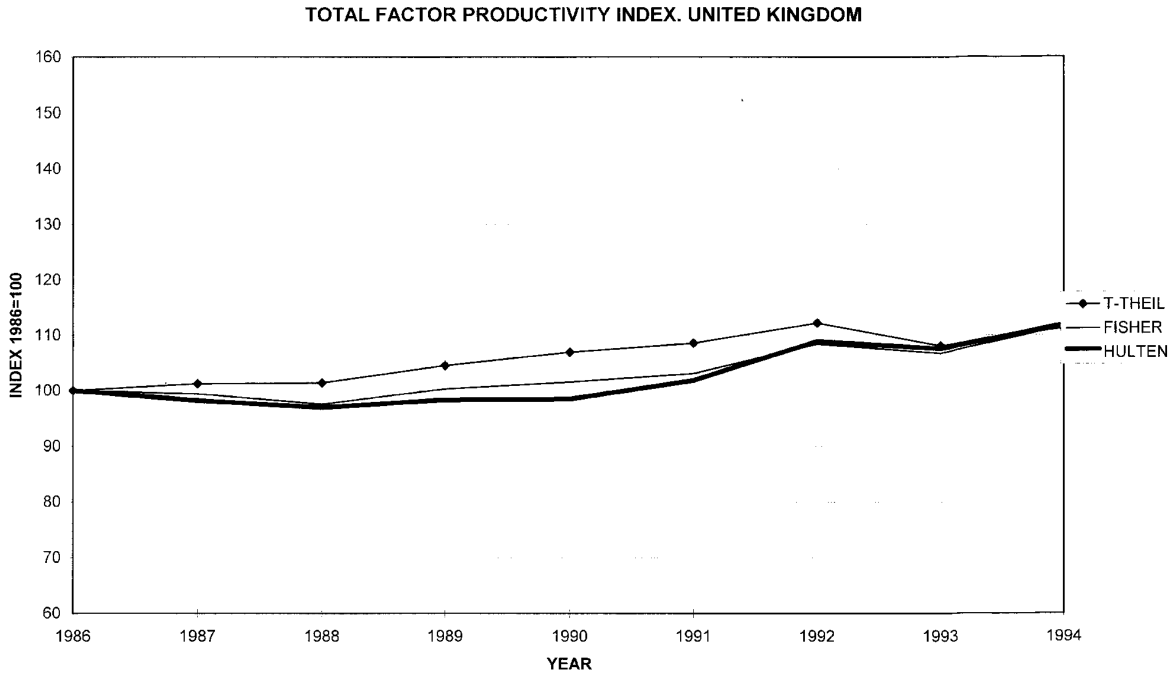

Figure 9.15 Total factor productivity index, United Kingdom

CAPITAL, MATERIAL INPUTS AND WAGES PAID PER WORK UNIT

Average 1986-1994	EUR12	BELGIUM	DENMARK	FRANCE	GERMANY	GREECE	IRELAND	ITALY	LUXEMBOURG	THE NETHERLANDS	PORTUGAL	SPAIN	U. KINGDOM
Capital per Work unit:													
-Average Level	84016	104507	144195	71440	121839	37771	135954	91160	202878	207616	35920	93500	199706
-Average Anual Rate(%)	1,25	3,01	-2,16	-1,62	0,11	-10,07	3,2	9,66	5,59	1,19	-6,24	4,27	0,06
Material Input per Work Unit:													
-Average Level	13347	31080	38363	23034	25608	2981	14290	7134	32097	43178	4441	9762	33700
-Average Anual Rate(%)	2,33	3,81	1,91	5,23	2,23	-8,84	5,39	2,27	-0,39	3,03	0,65	1,27	1,4
Wages Paid per Work Unit:													
-Average Level	9934	12552	14898	13795	10325	4007	9870	11929	10874	16024	4731	8017	14363
-Average Anual Rate(%)	7,2	5,99	3,15	5,16	4,5	-0,29	3,88	3,02	7,96	4,91	11,54	7,35	5,7

Note: Values in ECU in SPP.
Source: Own elaboration.

Table 9.3 Capital, material inputs and wages paid per work unit

Appendix I Capital data for productivity measurement

Carlos San Juan Mesonada [1]

I. Introduction

The aim of this paper is to discuss the use of capital data from FADN (Farm Account Data Network) for agricultural total factor productivity measurement calculating multifactor productivity index. However, before turning to an analysis of the existing statistics it is necessary to briefly mention the uses which may be made of the existing data.

When using capital data to build up productivity measurements, we assume that the most important uses of productivity statistics are:

1. identifying sources of economic growth;
2. justifying the appropriation of agricultural research funds;
3. estimating production relationships or production functions;
4. serving as an indicator of technical changes;
5. comparing intersectoral or inter-country economic performance, and;
6. justifying price changes;
7. calibrating the effects of the structural policy.

The meaning and concept of productivity and the meaning of alternative productivity indexes intended to measure productivity are currently under debate.

The measurement of technological change is frequently approached with the measurement of intertemporal total factor productivity (TFP).

Economic studies of TFP change have usually employed a growth accounting framework. The primary motivation for pursuing this approach was the ease with which various index numbers could be computed. These index number depend on no unknown parameters and are simple algebraic aggregates based on price and quantity data.

For practical reasons the translog index is one of the most used. Inter-spatial and inter-temporal comparison of productivity are possible with the translog index, a discrete approach to a Divisia index.

Also, the Fisher index has been recently used after the Diewert, W.E. (1992) paper that shows its interesting properties.

The formulas and theoretical implication of these indexes have been widely discussed in the literature, and has been summarized in the paper which presents our results on productivity comparisons in European agriculture, gathering the data from FADN. In this paper (San Juan and Decimavilla,1998), first, for inter-temporal and inter-spatial comparisons we use a translog index justifying that it is appropriate, from the economic point of view, to the multiple-input single-output case.

Denny and Fuss provided a general approach for measuring intertemporal and inter-spatial TFP and this has been adapted by Hazilla and Kopp (1984) for agricultural

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productivity measurement using a unique data set derived from the Firm Enterprise Data System (FEDS), a USA equivalent of the European FADN.

Intertemporal TFP is usually interpreted *in primal space* as the rate of change over time of an index of outputs divided by an index of input (growth accounting approach), or by a rate of shift in a production function (structural analysis). The last one requires to assume no allocative inefficiency to be interpreted as technological progress. That's all input prices must by equal to it's marginal productivity.

In the *dual space,* intertemporal TFP, under the maintained assumption of producer cost minimization and competitive factor markets, is equivalent to:

1. the rate of change of production cost minus the rate of change of an index of outputs minus the rate of change of an index of all inputs prices, or;
2. a rate of shift in a cost function (the dual interpretation of a production function).

Interspatial TFP can be defined *in the primal* as the logarithmic difference in an index of outputs between two countries divided by the logarithmic difference of an index of inputs

Secondly, in the San Juan and Decimavilla (1998) paper we assume that most of the firms are multiple-input multiple-output, then we use the 'Fisher ideal' total factor productivity indexing procedure. That allows intertemporal comparisons of productivity for European countries assuming that farms shift between a set of productions adjusting to market conditions and policy regulations (changes on the CAP common market organizations).

Thirdly, the Hulten index of total factor productivity is used to allow for adjustments for variation in capital services and capacity utilisation.

Despite methodological problems related to construction of the indexes, as well as problems associated with the appropriate measurement of particular inputs, especially capital input, growth accounting estimates generally provide a great deal of information regarding productivity.

The appropriate measurement of capital in the explanation of productivity change is an important and debated topic.

The purpose of this paper is to debate a method for deriving the appropriate measure of capital services and find a way to make the FADN supply data that allows measures for varying levels of capital utilisation.

Capital Input

The capital data that can be obtained from the FADN are, in general terms, of better quality than the macroeconomics data when analyzing the agricultural private sector. They are also very useful if we want to increase the level of desegregation on the productivity analysis should it be important to discuss the procedures involved in constructing the capital input index.

1. Real Estate

The real estate input index contains three main items intended to measure *service flows* provided by the capital stock:

1.a Buildings

- Interest charged on land and farm service buildings
- Depreciation of farms
- Other improvements: a remainder item composed of estimated accidental damage to buildings, cost of repairs to service buildings and grazing fees.

1.b Land

The main problem is to obtain a constant quality land index both in inter-temporal and inter-spatial comparisons. Then separate information is required about the:

- area of cropland (FADN distinguishes: Cereals, Other field crops, Vegetables and flower areas measured in ha.);
- irrigated area of cropland (It is on the farm return but not on the published results of FADN);
- permanent crops (FADN distinguishes: Vineyards and Other permanent crop areas measured in ha);
- window house area (not on the published results of FADN, but can be gathered from the farm return);
- pasture area (FADN includes forage crops. Is always calculate in the same way for European countries);
- woodland area;
- agricultural fallow (all uncultivated but potentially arable areas) FADN also distinguishes land diverted from current production under special programs like Set Aside)
- non-agricultural areas in farms are included in Others (rural tourist facilities: horse riding areas, hunting areas, environmental preservation areas are not included)

All the stock should be measured at constant prices. That means that we need to use a land price index. The problem is that if not all the UE countries have this information then we are forced to use the implicit deflator obtained from the land value and the SAU. The point is that we have to assume that the land values in the account are at current prices and not at historical prices. And also that the land depreciation (the declining of the flow of services from land) is appropriately calculated.

1.c Buildings

The farm return in FADN has a separate item for buildings. Within the buildings, farm dwellings are excluded because they don't produce capital services but services to the farmer is family. In order to exclude the dwelling from total farm building the USDA uses a ratio of dwelling/building equal to .54 and building/land equal to .18 but, of course, it is better to have direct information when possible or even to estimate an appropriate ratio in each country or region if necessary. Does the information on FADN include dwellings in some countries? That point has been discussed with national statistical offices. The accounting data do not include dwellings.

The value should include insurance of buildings. This information is included on the FADN.

To obtain a service flow from the capital stock a conversion is necessary. The USDA does the conversion differently for the equity and debt portions of real estate value.

- For the **equity** portion, the ratio of net cash rent (after property taxes) to current value is multiplied by the (base period) constant prices value of real estate. The current value of the equity proportion is estimated by subtracting the value of outstanding mortgages from the total value of farm real estate.
- For the **debt** proportion, the constant prices value is multiplied by the base period average mortgage interest rate to obtain the annual flow.

The FADN has sufficient information about interest paid on the farm return. Actually, it is not included on the published results but an implicit interest rate paid by farms can be calculated from loans and annual payments for borrowed capital. When European countries have appropriate statistical information to calculate a representative mortgage interest rate paid for the farm loans, that allows us to contrast the FADN data.

1.d Depreciation

Estimated depreciation must be added to the services flow of buildings. It is difficult to find a figure for the rate of depreciation of buildings. It should reflect the flow of services that they provide during their useful life. The USDA accepts 2 per cent but other authors use much higher figures. The problem of over valuing the depreciation rate is that the stock of building vanishes in the statistics but continues in use in reality, and in this way, productivity measurement can be biased.

This problem is especially complicated when the amortization period is fixed (normally limited) by fiscal law. Then farmers are forced to include capital amortization of their investments in their accounts but this legislation is not yet harmonized in the EU and then the productivity comparisons risk being biased.

Currently depreciation is published on the FADN but it is not certain that the method of calculation is homogeneous. This situation can be easily improved. Anyway, it is a point for discussion.

Service flows from public or communal lands should be also included. Then these data should be collected.

2. Machinery services

Services flows from machinery and mechanical power is calculated from capital stock of farm. Purchases minus estimated depreciation indicate changes in stocks. The stock of motor vehicles and farm machinery should be aggregate in a HP index as a way to obtain a constant price index.

The basic service flow from capital goods in this category is an estimate of capital used up, or depreciated, during the year. The accounting information needs to use the information for the capital balance but FADN does not publish the data. So individual farm return data has to be used for gathering this information.

The USDA estimates are based on a declining balance method in which a constant percentage represents the annual rate of depreciation of each type of capital.

The percentages used are:

- automobiles 22%;

- trucks 21%;
- tractors 12%;
- other machinery 14%.

The stock values are put in real terms by deflating through a price index. To deflate the FADN date value of stock of machinery the prices index used are available from EUROSTAT input prices.

In addition to depreciation, the opportunity cost of funds invested in machinery and other capital equipment should be included as input. This flow can be estimated by multiplying the farm share of the deflated capital stock values by the base period interest rates on farm real estate debt. The implicit interest rate on farm real estate debt can be directly obtained from FADN information about paid interest and loans. Some European countries publish series of paid interest rate on loans for agricultural machinery. These are especially important to take into account in periods with subsidized interest rates.

3. Irrigation

Operating and maintenance expenditures on irrigation are included as input. The use of electricity and fuel for pumping are included elsewhere. Then pumps, tubs and other irrigation materials amortization should be included as capital flows of services. Even though the USDA does not calculate these items due to lack of information, in most of the European countries, for practical reasons, payments for water supply index can be used as a proxy for irrigation prices.

4. Livestock services

Livestock services from breeding livestock in LU (Livestock Units) is included on the FADN published results. The livestock FADN data also includes values and LU per dairy cows, other cattle, pigs and poultry.

Also quotas (milk quotas, e.g.) are included and then we should calculate the flow of services from quotas using a published index of quantity (e.g. litres per farm)

5. Taxes and subsidies

This information is available on the FADN. The intention of including taxes is to reflect the intangible inputs such as education, farm to market roads, and research.

Also subsidies on investments should be considered as a capital transfer from the public sector. A proxy price index is available from Eurostat input prices and can be used to deflate these series.

II. Final comments

The FADN data constitutes an interesting source for gathering statistical data to calculate the total factor productivity index for the agricultural private sector in Europe. In general terms, these data are more homogeneous and have higher quality than the alternative macro-data.

Macro-data include several items in which it is difficult to distinguish private from public flows of capital services and makes it more difficult to capture technical change of the productive sector, especially when the objective is international productivity comparisons.

FADN and the Eurostat data about wages, input and output prices provide a reasonable homogeneous set of data which joint with carefully treatment, can yield a good approximation of the total factor productivity comparisons.

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10. PMP and FADN data for policy-analysis

Quirino Paris, Filippo Arfini [1]

10.1 Introduction

The aim of this paper is to show a methodology suitable for policy analysis using the FADN data. This methodology is called Positive Mathematical Programming because its feature is the exploitation of positive information which is able to reflect the farmer behaviour and estimate the level of Gross Margin for the whole farm. This methodology was presented in PACIOLI III when it was at the beginning of the application and when its was applied to each farm of FADN. Now , in just one PMP model it is possible to include all the farms having homogeneous character (i.e. same OTE) improving its ability as tool for policy analysis.

10.2 Problems connected with the use of FADN data

The FADN data is a valuable source of information since it allows an articulated, structural and economic reading of the main types of production carried out in the national and EEC agriculture. However, the use of the FADN data has some limits which prevent a thorough exploitation of this Data Bank.

The first problem connected with the use of FADN data originates from the fact that the Accounting Network was created for the surveying purposes of the EEC, therefore it does not fully meet the requirements of the agricultural holding of a support to its operation choices. In fact, complaints have come from many parts about the limited usefulness of the FADN for the management of the surveyed agricultural holdings or, better, the 'return' for the farmers who have provided the data appears to be poor.

Also for the usefulness of the FADN information for research purposes, many problems are encountered which, in practice, limit its use. Among the main ones there is the poor representativeness of the sample with respect to the actual agricultural situation. Concerning the problem of the sample representativeness it must be pointed out that, whilst the numerousness of the sample is determined through a statistic method, the agricultural holdings from which the accounting data is obtained are not chosen on the basis of representativeness criteria, but within the agricultural development systems at a regional level which the farms join spontaneously.

Also linked to the poor representativeness of the sample of the farms included in the Network is the problem of the difficulty in maintaining the farm sample constant over the time, due to the possible exit of the units registered on a given date.

Many agricultural holdings, due to the poor usefulness of the FADN as a support to the business management, often withdraw from the Network immediately after concluding the period for which their enrolment is mandatory. The difficulty of building a constant

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sample for a significant period of time is also a strong limit to the possibility to run surveys on the structural evolution of farms with respect to innovative boosts.

A further problem is represented by the quality of the information collected. Related to this problem specific study carried out in Emilia Romagna (Alvisi e Filippucci , 1993) show how the anomalous values do not appear to be such to cause a gross bias of evaluations as far as proceeds and costs are concerned. However, the outliners found in the individual production processes of the holdings certainly represent a source of error. Therefore, it is important to define a compatibility and control plan capable of detecting and rectifying these anomalies.

A further limit of the FADN data lies in the fact that the information shown in the EEC business sheet does not allow for a direct calculation of the company costs and operational margins of each product. In particular, it is difficult to charge directly to each process the cost of family labour and employees under no-time limit contract. The choice to calculate only the total availability of family and non-family labour at company level - without considering the placements - does not allow to determine its absorption per process.

Also, it must not be forgotten that the FADN data completely lack information relative to the quantity of inputs used by the farm for each process and to the cultivation techniques (e.g. if harvest is manual or mechanized) for the various crops. The presence of this information would not only overcome some of the recent environmental problems but would also satisfy, at least in part, the demand of information about quantities which are necessary for the building of 'technical matrixes' to be used in the standard-type models for the ex-ante analysis of the effects of certain agricultural policies (above all in those models based on Linear Programming) and to tackle with a greater degree of accuracy the problems linked to the technical efficiency and the analysis of the production processes.

10.3 The PMP methodology

In order to setup a model able to reflect the main character of the farm activity in specific area, is possible organize in functional way the FADN data . In this case arise specific problem related to the over specialization of the farm.

Related to this aspect the farm classification in the FADN database exhibits several production systems (OTE) which describe the prevalent crop and activity pattern prevailing in each recorded farm. One important consequence of this classification is that not all crops and activities of a given OTE appear in every farm which is classified as belonging in that production system. In other words, farmers have selected a preferred subset of crops and activities even though they could have produced all the crops and activities defining a given OTE. A successful model of this particular OTE, therefore, must account for self-selection in order to avoid a possible bias.

We assume a sample of **T** farms cultivating annual crops belonging to a particular production system defined by **J** crops. Not all the crops, however, are produced by every farm. The available information of the t-th farm consists in acreage allocations, $\boldsymbol{h_t}$, unit accounting costs per unit of output, c_t, realized output levels of the crop activities, x_{Rt}, and their prices, $\mathbf{p}_t$.

The technical coefficient matrix, $\mathbf{A}_t$, is defined as $\mathbf{A}_t = [a_{tj}] = [h_{tj} / x_{Rtj}]$. The total available land is given by $\mathbf{b}_t$.

The objective of the analysis is the recovery of a total variable cost function for the entire sample defined over all the crop activities specified in the annual crop production system. This means that we wish to reconstruct a single total variable cost function for the given OTE which, when used by the individual farmer, will reproduce her output decisions as determined in the base year. In other words, this total variable cost function, when re-tested in the calibration of every farm production plan, must be capable of reproducing the exact combination of crops and the associated output levels as chosen by the farmer in every farm.

With more than one farm, the first phase of the PMP approach is articulated in a series of LP problems, one for every farm. The objective of this phase is the recovery of the (differential) marginal cost vector, λ_t, associated with the t -th entrepreneur's output decisions. A more detailed specification of this process will be given further on.

In the first phase of PMP, therefore, T LP problems will be solved, one for each farm, $t = 1,.... T$ specified as follows:

(1) $\max TNR_t = \mathbf{p}_t' \mathbf{x}_t - \mathbf{c}_t' \mathbf{x}_t$ Dual Variables

subject to $\mathbf{A}_t x_t \leq \mathbf{b}_t$ y_t

$\mathbf{x}_t \leq \mathbf{x}_{Rt}(1+\varepsilon)$ λ_t

$\mathbf{x}_t \geq 0.$

Although the above vectors appear to have the same dimension in every farm, in reality, some of the components have zero value, indicating the entrepreneur's decision of not producing the given activity. This self-selection condition must be taken into account in the estimation of the overall variable cost function in order to avoid a possible bias.

The dual of the above LP problem can be stated as finding nonnegative vectors y_t and λ_t such that

(2) $\min TC_t = \mathbf{b}_t' \mathbf{y}_t + \lambda_t' \mathbf{x}_{Rt}$

subject to $A_t' y_t + \lambda_t \; ^3 \; \boldsymbol{p_t} - \boldsymbol{c_t}$

The interpretation of the dual constraints is the familiar *Marginal Cost* $\geq$ *Marginal Revenue,* with marginal revenue given by the price vector $\mathbf{p}_t$ and the marginal cost divided into limiting marginal cost, $\mathbf{A}_t' \mathbf{y}_t$, and variable marginal cost, $(\lambda_t + \mathbf{c}_t)$. A similar LP model is specified and solved also for the entire sample considered as an aggregate farm.

The second phase of the PMP approach deals with the specification of a marginal cost function and the recovery (estimation) of the associated parameters. In this paper we assume a quadrate variable cost function (but PMP admits many flexible forms). The relevant marginal cost equations for the t -th farm are

(3) $\lambda_t + \mathbf{c}_t = \mathbf{Q}\mathbf{x}_{Rt} + u_t$

where the matrix $\mathbf{Q}$ is symmetric positive semidefinite as required by the theory of cost and production in the presence of multiple outputs. The terms on the left-hand-side, $\lambda_t + c_t$, and the vector of realized levels of outputs, $\mathbf{x}_{Rt}$, are the known quantities while the $\mathbf{Q}$ matrix constitutes the unknown set of parameters to be recovered. The vector $\mathbf{u}_t$, represents a farm specific vector of unknown residuals which will play a relevant role in the calibrating phase (third phase) of the PMP approach.

For the sample aggregate, we assume that the marginal cost function is specified as

(4) $\lambda + \mathbf{c} = Qx_R$

where ($\lambda + \mathbf{c}$) is the solution of the LP problem associated with the sample aggregate and $x_R = \sum_t \mathbf{x}_{Rt}$. The integral of equation (4) over the domain (0 to x_R) provides the desired total variable cost function

$$\mathbf{x}'_R \mathbf{Q} \mathbf{x}_R \,/ = \int_0^{x_R} (\mathbf{Q}\mathbf{x})' \, d\mathbf{x}$$

The cost function **x'Qx / 2** will be used in the calibrating non-linear models of phase three defined for every farm and for the sample aggregate

A further property of the cost function of Eq. (5) dictates that the **Q** matrix be symmetric positive semidefinite. To implement this theoretical requirement in the estimation process the Cholesky factorization will be applied. The Cholesky factorization is a technique for computing the inverse of a square matrix using one of the most robust and stable algorithms. The Cholesky factorization of the Q matrix is given by

(6) $\mathbf{Q} = \mathbf{LDL'}$

where **L** is a unit lower triangular matrix and **D** is a diagonal matrix. From equation (6) it is clear that **LDL'** is symmetric. It can be shown that **LDL'** corresponds to a Q matrix that is positive semidefinite if and only if the diagonal elements of the **D** matrix are nonnegative.

10.4 The Self Selection Problem

In order to simply the notation, let us define the marginal cost as $mc_t \equiv \lambda_t + c_t$. The self selection process postulated for the t -th entrepreneur is specified as follows: The jth crop will not be produced if a certain latent parameter is non-positive; the crops that will be produced exhibit a positive latent parameter. The latent parameter is related to the supply function. In symbolic terms,

(7i) $x_{tj} = 0$ iff $Q^{-1}{}_j{}' \mathbf{mc}_t + u_{tj} \le 0$

(7ii) $x_{tj} = Q^{-1}{}_j{}' \mathbf{mc}_t + u_{tj}$ iff $Q^{-1}{}_j{}' \mathbf{mc}_t + u_{tj} \ge 0$

The relation in (7) is the inverse marginal cost function. In reality, the vector of marginal cost, mc_t, contains zero values in correspondence of those crops that were not produced by the farm. The missing values of this vector, therefore, are replaced with the sample aggregate values and the first pass model to recover the matrix $\mathbf{Q}^{-1}$ becomes the following least-squares problem

(8)
$$\min_{\mathbf{Q}^{-1},\mathbf{u}_t} \sum_t \mathbf{u}_t'\mathrm{u}_t$$

subject to
$$0 \geq \mathbf{Q}^{-1} j' \,\mathrm{mc}_t + \mathrm{u}_{tj} \qquad \text{iff} \qquad x_{Rtj} = 0$$
$$x_{Rtj}, = \mathbf{Q}^{-1} j' \,\mathrm{mc}_t + \mathrm{u}_{tj} \qquad \text{iff} \qquad x_{Rtj} > 0$$
$$\mathbf{x}_R = \mathrm{Q}^{-1}\,\mathrm{mc}.$$

The specification in (8) is equivalent to (7).

In traditional econometrics, a censored regression problem such as the one specified in (8) is handled by making strong distributional assumptions. These assumptions allow for the estimation of Mills ratios which account for the censored part of the sample information. The complete estimation of the model requires a two-pass procedure. On the contrary, the mathematical programming specification stated in (8) is eminently suitable for dealing with censored problems stated in inequality form. Such a model does not require any special distributional assumption.

The need to guarantee that the $\mathbf{Q}^{-1}$ matrix be symmetric positive semidefinite suggests the use of the Cholesky factorization in problem (8) to obtain the following estimable specification

(9)
$$\min_{\mathbf{L},\mathbf{D},\mathbf{u}_t} \sum_t \mathbf{u}_t'\mathrm{u}_t$$

subject to
$$0 \geq \mathrm{LDL}\, j' \,\mathbf{mc}_t + \mathrm{u}_{tj} \qquad \text{iff} \qquad x_{Rtj} = 0$$
$$x_{Rtj}, = \mathbf{LDL}\, j' \,\mathbf{mc}_t + \mathrm{u}_{tj} \qquad \text{iff} \qquad x_{Rtj} > 0$$
$$\mathbf{x}_R = \mathbf{LDL'}\,\mathbf{mc}.$$

Model (9)can easily be solved for the matrices **L** and **D** and vectors $\mathbf{u_t}$ using a nonlinear programming package such as GAMS. With the estimates of the Cholesky matrices it is possible to recover an estimate of the $\mathbf{Q}^{-1}$ matrix.

The solution of model (9) provides the platform for reconstructing the missing values of outputs in each firm. This objective can be achieved as

(10)
$$\hat{x}_{tj}, = \hat{\mathbf{LDL}}\, j' \,\hat{\mathbf{mc}}_t + \mathrm{u}_{tj} \qquad \text{iff} \qquad x_{Rtj} = 0$$

At this point, both vectors of marginal cost and of output levels have been completed by replacing their missing values with appropriate estimates.

The direct marginal cost function can now be estimated by solving a model similar to (9):

(11)
$$\min_{\mathrm{L},\mathrm{D},\mathrm{u}_t} \sum_t \mathbf{u}_t'\mathrm{u}_t$$

subject to
$$0 \geq \mathrm{LDL}\, j' \,\mathbf{x}_{Rt} + \mathrm{u}_{tj} \qquad \text{iff} \qquad c_{tj} = 0$$
$$mc_{tj}, = \mathbf{LDL}\, j' \,\mathbf{x}_{Rt} + \mathrm{u}_{tj} \qquad \text{iff} \qquad c_{tj} > 0$$

$$\mathbf{mc} = \mathrm{LDL'}\,\mathbf{x}_R.$$

where smc_j is the sample value of the corresponding crop activity which replaces the missing information in the individual farm.

The solution of model (11) provides the final estimate of the Q matrix which defines the quadrate total variable cost function: $\hat{Q} = \hat{L}\,\hat{D}\,\hat{L}'$

Another approach able to extracting the largest amount from a given data sample is the Maximum Entropy. Have to be stressed that the traditional econometric approach based on the maximization of a likelihood function fails to produce any estimates unless strong a priori assumption are imposed on the model and the number of parameters to be estimates is lowered below the number of observations. In contrast, the maximum entropy framework obtains a unique solution because the objective function is strictly concave function of the probabilities and the Hessian matrix is negative definite.

These different outcomes of the two analytical frameworks can be explained with reference to the least-squares approach. In particular, when a Linear statistical model is ill-posed, the least-squares residuals are identically equal to zero and the moment matrix of the regressor is singular. Hence the least-squares objective function vanishes. In contrast, with me ME approach two distinct event occur. First, additional information is added to the sample information in the form of discrete supports for the prior distribution of the unknown parameters. Second , the objective function never vanishes. Hence , the probability estimates are positive for every support value and play a crucial role (trough the Hessian matrix) in determining the uniqueness of the ME solution.

A remarkable feature of the ME approach , therefore, is the ability to exploit all the available information regardless of sample size. More reliable estimates, of course, are obtained with more observation. But even when only handful of observation is available, they contain, in general, a sufficiently strong signal capable of providing an informative picture of the desired model. Such a picture may not be in perfect focus (the true model), but it can give an image from which the desired model (a model that predicts better than the alternatives) can be recognized. This process of signal extraction is in analogy to an out-of-focus picture of a speeding car which nonetheless, reveals the numbers of the license plate when an ME algorithm is applied.

The use of few observation , therefore, is legitimized by the uniqueness of the ME solution and the ability of the ME method to extract the maximal signal. As more observation become available, they can be incorporated into the ME framework to provide a more realible estimate of the desired model. The ME framework, is the formal link between mathematical programming and traditional econometric models.

The specification of second phase of PMP method using ME approach consider the following aspects:

L,D, u_t , are average of distribution of unknown probability

$L = Z_L\, p_L$,

$D = Z_D\, p_D$,

$u_t = Z_u\, p_u$

where :

$p_{(L,D)}$, is the probability vector

$Z_{(L,D)}$, is the support matrices. For this matrix the support interval should be centred around the likely value of parameters to be recovered in order to assure feasible solution of the marginal cost constrain , and the Q matrix must be symmetric positive semidefinite in order to conform with the theoretical requirements of production economics. The second objective is guaranteed by the Cholesky factorization framework. To achieve the first goal for the quadratic and generalized Leontief models, the ratio of marginal cost to realized output levels is used in combination with appropriate weights to centre the support interval.

10.5 Calibration of Individual Farm's Decisions

The estimated Q matrix calibrates the aggregate sample information in the third stage models of PMP, which is defined in the traditional specification:

(12) $$\max TNR = p'x - x'\hat{Q}x/2$$

$$\text{subject to} \quad Ax \leq b$$

The solution of model (12) is identical (up to an arbitrary precision level) to the total output levels of the various crop activities measured in the sample farms. It is possible, therefore, to use model (12) for analyzing different scenarios of agricultural policy.

Of methodological interest is also the possibility to use the same estimated Q matrix to calibrate the entrepreneur's decision at the level of each individual farm. This operation re-validates the estimation procedure developed above for taking into account the self selection process occurred during the formulation of individual farm production plans.

In order to judge the result of the self selection procedure, it is necessary to give each entrepreneur the possibility to produce every crop. The first step, therefore, is to re-integrate the price vector of each individual farm of the missing information for the given crop activities not produced by that farm. A similar re-integration concerns the missing technical coefficient(s) of the **A** matrix. The sample information replaces the missing data in each farm.

The relevant model for the t -th fan-n is thus

(13) $$\max TNR = \hat{p}'x - x'\hat{Q}x/2 - \hat{u}_t x$$

$$\text{subject to} \quad \hat{A}x \leq b$$

where **p,** and **A,** are the reconstituted elements of the *t* -th farm. The least-squares vector of residuals $\mathbf{u}_t$ is now re-interpreted as the vector which characterizes the t -th farm and carries all the relevant information for calibrating the individual farm output decisions using an overall cost function such as $\mathbf{x' Q x /2}$, which is not indexed with respect to any farm. The vector $\mathbf{u_t}$**,** transmits all the information of the i -th farm which is relevant for reproducing with precision the production plan selected by the t -th entrepreneur.

10.6 Policy Analysis and some results

Forecasting the consequences of variations in farm policy can now be done in two ways. The first approach is to use the sample aggregate model to analyze the consequences of a price reduction, set aside targets, etc. The second approach uses every farm to measure the individual consequences of the same parametric variations. All the individual farms solutions can now be aggregated at the sample level for an overall measure of the policy consequences. The two approaches will likely produce different results. The harmonization of these two different ways to forecast the likely consequences of policy variations should be taken into account during the model specification and model selection phases.

In order to verify the validity of PMP methodology we tested the effect of some measure of policy analysis using data from a sample of 40 farms included in Italian FADN. In particular we used data from farm located in Ferrara which are specialized in cereal an vegetable crops (OTE 120) using bot the methodology for recovered the Q matrix, the ME approach and least-square approach.

Both the recovered Q matrix with ME and LS, shows how a good estimation of the Total Variable Cost can be obtained using two different approach. It is very easy to observe how the difference between the estimated variable cost and the observed variable cost is very low (0,3%).

The difference between the two approaches is carried out in the policy analysis . Using the same scenario,(i.e Agenda 2000) the solution obtained with maximum entropy is much more stable than the least-square approach. Both the methodologies are theoretically correct and the different results the model show us , reflect the different capability to utilize the few information available recovering in a better way the farmer character and his or her behaviour.

Observed Cultural Cost (Variable Cost) for farm and process in OTE 120 - Ferrara (in .000 Lire)									
	Sugar beet	D. Wheat	S. Wheat	Corn	Potatoes	Soja	Melone	Tomato	Total Variable Cost
Azi1	4.659		1.616	2.575			2.517	3.305	14.672
Azi2	1.300		556	1.256					3.112
Azi3	1.214	1.071		1.143	848				4.276
Azi4				981				613	1.594
Azi5		2.345		4.016					6.361
.									.
.									.
Azi36		13.433						13.988	27.421
Azi37	15.883		6.039			3.820	20.457	23.500	69.699
Azi38	7.936	3.476		4.591					16.003
Azi39					18.944				18.944
Azi40	2.926	5.892						3.201	12.019
Total variable cost of the sample	**200.397**	**89.053**	**60.460**	**227.224**	**36.322**	**67.800**	**74.235**	**123.764**	**879.255**

Observed selling price for farm and process in OTE 120 - Ferrara (in.000 Lire)

	Sugar beet	D. Wheat	S. Wheat	Corn	Potatoes	Soja	Melone	Tomato
Azi1	6.953		36.380	39.315			22.129	18.426
Azi2	8.500		33.494	33.495				
Azi3	11.288	40.552		33.000	39.670			
Azi4				34.173				34.800
Azi5		44.000		38.000				
.								
.								
Azi36		41.930						12.026
Azi37	7.300		37.439			43.678	16.639	18.000
Azi38	8.931	36.067		30.450				
Azi39					53.657			
Azi40	10.131	42.600						16.861
Average price of the sample	**7.955**	**38.998**	**35.375**	**34.147**	**43.411**	**41.145**	**18.866**	**18.361**

SAU utylized for farm and process in OTE 120 Ferrara (Ha) A44

	Sugar beet	D. Wheat	S. Wheat	Corn	Potatoes	Soja	Melone	Tomato	Totale Ha
Azi1	3,6		3,8	3,4			1,2	3,1	15,1
Azi2	1,1		1,1	2,0					4,2
Azi3	1,1	2,2		1,2	0,3				4,8
Azi4				0,9				0,5	1,4
Azi5		3,1		3,4					6,5
.									.
.									.
Azi36		42,0						9,0	51,0
Azi37	10,2		7,5			6,8	6,0	14,3	44,8
Azi38	5,5	5,3		6,4					17,1
Azi39					26,0				26,0
Azi40	3,2	8,7						2,6	14,5
Total Ha for farm and process	**127,1**	**160,8**	**111,4**	**205,9**	**30,8**	**98,6**	**34,4**	**82,7**	**851,7**

Output for farm and process in OTE 120 - Ferrara (in q.li)

	Sugar beet	D. Wheat	S. Wheat	Corn	Potatoes	Soja	Melone	Tomato
Azi1	2.150,0		239,0	365,0			540,0	985,0
Azi2	650,0		72,4	201,4				
Azi3	826,0	103,2		82,0	38,8			
Azi4				115,0				125,0
Azi5		112,0		356,0				
.								
.								
Azi36		1.690,0						1.648,5
Azi37	5.253,0		435,0			241,4	3.096,5	4.656,1
Azi38	4.450,6	325,3		528,0				
Azi39					722,0			
Azi40	1.179,8	459,2						711,7
Total output of the sample	**75.495**	**7.573**	**6.174**	**22.353**	**1.588**	**3.758**	**11.806**	**26.708**

Q Matrix of the Quadratic Variable Cost : Estimation method - Max entropy

	Sugar beet	D. Wheat	S. Wheat	Corn	Potatoes	Soja	Melone	Tomato
Barbabietola	0,0006449	-1,19E-13	-3,94E-14	2,57E-14	-7,55E-15	-2,42E-14	5,04E-14	-2,45E-14
F. Duro		0,0172193	-9,81E-09	-1,96E-08	-4,11E-10	-3,19E-09	-1,13E-08	-1,89E-08
F. Tenero			0,0215843	-2,44E-08	1,70E-09	-7,58E-10	-3,54E-08	-4,97E-08
Mais Granella				0,0122258	8,67E-10	-7,63E-10	3,12E-09	1,96E-09
Patata					0,2144958	0,0000241	0,0000437	0,0000716
Soja						0,100293	-0,0000126	-0,0000107
Cocomero							0,0114608	1,71E-08
Pomodoro								0,0047458

Q Matrix of the Quadratic Variable Cost : Estimation method - Least Square

	Sugar beet	D. Wheat	S. Wheat	Corn	Potatoes	Soja	Melone	Tomato
Barbabietola	0,0011427	-1,55E-04	4,45E-03	-8,53E-04	1,31E-04	3,36E-04	-1,24E-03	-1,19E-03
F. Duro		0,0062279	-1,92E-02	2,08E-03	-2,84E-04	2,77E-03	3,72E-03	4,23E-03
F. Tenero			0,1206337	-1,14E-02	1,85E-02	4,29E-02	-2,68E-02	-1,58E-02
Mais Granella				0,0093989	4,89E-03	-7,04E-03	8,03E-03	3,98E-03
Patata					0,011508	0,0151928	0,0000747	0,0011628
Soja						0,2304714	-0,0257108	-0,0136182
Cocomero							0,0118031	5,37E-03
Pomodoro								0,0066919

Comparation between observed and estimate Variable Cost for a sample of 40 farms - Ferrara - OTE 120 (value in .000 of Lire)

N. 40 farms	Variable cost	Variation in Lire	Variation in %
Observed situation	923.217		
Estimation of Variable Cost with quadratic model using Maximum Entropy	926.179	2.962	0,3a
Estimation of Variable Cost with quadratic model using Least-Square	926.178	2.961	0,3

Use of the resource Land for scenario and process (in Ha)

Maximum Entropy solution

	starting scenario	only comp.	reduc. in price :- 5%	reduc. in price :- 10%	reduc. in price :- 15%	reduc. in price :- 20%
Sugar beet	127,1	120,0	123,9	127,8	131,7	135,7
D. Wheat	160,8	232,9	232,2	231,5	230,8	230,1
S. Wheat	111,4	152,9	151,5	150,2	148,8	147,5
Corn	205,9	191,5	184,8	178,2	171,5	164,8
Potatoes	30,8	27,9	29,5	31,1	32,7	34,3
Soja	98,6	42,7	43,5	44,2	44,9	45,7
Melone	34,4	33,1	33,8	34,5	35,1	35,8
Tomato	82,7	79,5	81,3	83,1	84,9	86,6
Total Ha	851,7	880,5	880,5	880,5	880,5	880,5

Least square solution

	starting scenario	only comp.	reduc. in price :- 5%	reduc. in price :- 10%	reduc. in price :- 15%	reduc. in price :- 20%
Sugar beet	127,1	41,1	58,6	98,8	141,7	138,0
D. Wheat	160,8	153,3	158,8	139,7	117,5	101,9
S. Wheat	111,4	245,7	232,8	126,6	9,0	-
Corn	205,9	231,8	196,1	124,4	48,2	-
Potatoes	30,8	-	-	211,3	448,7	528,1
Soja	98,6	64,8	75,5	49,8	19,7	10,5
Melone	34,4	71,1	68,2	41,4	11,8	13,1
Tomato	82,7	72,8	90,5	88,4	84,0	88,8
Total Ha	851,7	880,5	880,5	880,5	880,5	880,5

Variation in use of the land rispect the starting scenario for process (in %)

Maximum Entropy solution

	only comp.	reduc. in price :- 5%	reduc. in price :- 10%	reduc. in price :- 15%	reduc. in price :- 20%
Sugar beet	-5,6	-2,5	0,6	3,6	6,7
D. Wheat	44,8	44,4	44,0	43,5	43,1
S. Wheat	37,3	36,1	34,8	33,6	32,4
Corn	-7,0	-10,2	-13,5	-16,7	-19,9
Potatoes	-9,5	-4,3	1,0	6,2	11,4
Soja	-56,7	-55,9	-55,2	-54,4	-53,7
Melone	-3,5	-1,6	0,3	2,2	4,2
Tomato	-4,0	-1,8	0,4	2,6	4,7

Least square solution

	only comp.	reduc. in price :- 5%	reduc. in price :- 10%	reduc. in price :- 15%	reduc. in price :- 20%
Sugar beet	-67,6	-53,9	-22,3	11,4	8,6
D. Wheat	-4,7	-1,2	-13,1	-26,9	-36,6
S. Wheat	120,6	109,1	13,7	-91,9	-100,0
Corn	12,6	-4,7	-39,6	-76,6	
Potatoes	-100,0		586,2	1.356,8	1.614,6
Soja	-34,3	-23,4	-49,5	-80,1	-89,3
Melone	106,8	98,4	20,7	-65,5	-61,7
Tomato	-12,0	9,4	6,9	1,5	7,3

Economic parameter of the whole FADN sample for scenario (in .000 of Lire)

Maximun Entropy solution

	starting scenario	only comp.	reduc. in price :- 5%	reduc. in price :- 10%	reduc. in price :- 15%	reduc. in price :- 20%
GSP	2.854.683	2.856.348	2.794.121	2.734.646	2.677.923	2.623.950
Compens.	534.136	649.798	641.435	633.072	624.709	616.347
Set aside	24.566	-	-	-	-	-
Variable Cost	926.179	874.734	878.687	884.015	890.720	898.799
Gross Margin	2.487.207	2.532.844	2.556.182	2.483.015	2.411.225	2.340.809

Least-square solution

	starting scenario	only comp.	reduc. in price :- 5%	reduc. in price :- 10%	reduc. in price :- 15%	reduc. in price :- 20%
GSP	2.854.683	2.810.724	2.769.183	2.949.989	3.214.046	3.302.408
Compens.	534.137	728.912	695.081	461.643	203.679	117.856
Set aside	24.566	-	-	-	-	-
Variable Cost	926.178	912.437	919.991	934.453	977.721	995.376
Gross Margin	2.487.207	2.532.844	2.540.986	2.464.587	2.424.975	2.417.858

Shadow price of the land for scenario (in .000 of Lire)

	starting scenario	only comp.	reduc. in price :- 5%	reduc. in price :- 10%	reduc. in price :- 15%	reduc. in price :- 20%
Maximum Entropy solution	1.833	1.995	1.906	1.817	1.728	1.638
Least Square solution	1.833	1.947	1.845	1.752	1.661	1.624

Variation of shadow price of the land (in %)

	only comp.	reduc. in price :- 5%	reduc. in price :- 10%	reduc. in price :- 15%	reduc. in price :- 20%
Maximum Entropy solution	8,8	4,0	-0,9	-5,7	-10,6
Least Square solution	6,2	0,6	-4,4	-9,4	-11,4

11. Modernization of the FADN of Finland and a method to utilize the data in farm income estimations

Ahti Hirvonen [1]

11.1 Modernization of the farm accountancy data system in Finland

11.1.1 Introduction

In MTTL the unit of farm accountancy is responsible for carrying out and developing the profitability study of agriculture in Finland. By joining to the EU in 1995 the profitability bookkeeping became part of the FADN network of the EU. In this activity data from over a thousand farms (1300) based on the accounts are compiled each year. The present data-system has been used since the accounting year 1989. The software consists of a set of DOS-based programmes, where the data is recorded in sequential files and it is identified by a tabular index. The annual farm-level data is recorded into four different files: general information, labour input, receipts and expenses, and results. In the result file nearly 2,000 items of data are stored of each farm. Special programmes have been made to prepare the standard statistics and to pick up variables. Other needs and reporting, e.g. compiling and making the FADN-tape, are carried out by using dedicated programmes. In many aspects the present data system has become obsolete. New needs from clients, advanced IT, and the need to control the costs made it necessary to start the reform of the datasystem in the mid-1990s. The project was started in 1996 with a pre-study, in which the current state, problems, and objectives were briefly discussed. The actual project work concerning the technical reform of the data system was launched in autumn 1997.

11.1.2 Objectives

- Meet the needs and requirements of EU-FADN
- Integration of horticulture and 'pluriactivity' farms into the data system
- Take advantage of adp-technology existing on farms in data collection
- Develop procedures for data transfer based on data networks
- Use adp-based controls on different operational levels
- Implement a modern application for storing and processing the data

The data system is expected to meet the goals concerning the schedules (speed), reduce the unit costs in the long run (less manual work), improve the quality of the data (controls), and motivate farmers to participate in the bookkeeping (feed-back). A well designed and efficiently implemented solution for storing the data (e.g. the data warehouse concept) improves the reporting and increases the use of data.

[1] Agricultural Economics Research Institute, Finland.

11.1.3 Changes in the bookkeeping

In connection with the technical modernization of the data system, reforms have also been made in the bookkeeping system. A standard account scheme supporting the calculation concerning the different fields of activity of the holding will be introduced. Because of the large number of commercial bookkeeping programmes available on the market, technical interface will be determined for data transfer of data. In the valuation of fixed assets the technical current values (based on replacement values) will be taken into use, and planned deprecations are calculated as real terms. Like earlier, the bookkeeping includes inventories and labour input, and quantities will be recorded systematically. The bookkeeping also includes as an option the calculation of nutrient balances. Dual-entry bookkeeping will be used, and when appropriate, concepts and methods used in the business economics will be applied.

11.1.4 Operational levels of the system

The data system operates at different levels which produce and/or use the data of the system. The main levels are (1) farmer/farm, (2) deliverer of the data, and (3) MTTL. The farmer produces the basic data at the farm level. The deliverer of the data (local agency) is responsible for the data transfer from farm-level systems, checking the data, and preparing of the financial statements. The farm and the agency operate in a decentralized system. The agency transfers the data on a disc, through data network, etc. to the Research Institute, where they are read into the operational input system of the database. This system then updates the central database of the Agricultural Economics Research Institute.

The collecting and recording of the farm data are based on two main options:

1. on farms that do not have or do not want to use computers, a manual system is used. The farms deliver the account books to the agency (Rural Advisory Centre), where the data is recorded into the recording and control programme;
2. farms that have computers and a bookkeeping programme deliver all data in electronic form to the agency. The same recording and control programme is used in recording the data. The means of data delivery are forms, discs, data links, and Internet.

11.1.5 Architecture and tools

The storing and processing solution of the data is implemented as a relational SQL database. The system is operating in the local network as an open work station system build according to Client-Server architecture. The handling processes are divided into two parts both logically and physically: the programmes and database are on the server and the programmes are carried out at the work stations. The system contains the necessary applications for the processing needs.

User interface of the software conforms to the Windows 95/NT operating system, on which e.g. the planning of the screens is based. Sybase SQL Server was selected to the platform for the database. The modelling and description of the database have been carried out by Power Designer, and the programming by Power Builder. The other tools used in making the applications are Power Soft products, such as Infomaker in reporting.

Applications will be made for the use of the database for standard and special reporting, ad-hoc queries, analysis and forecasting, as well as for the transfer of data to other systems and dissemination of information. Routine search of data from the database is carried out by tools of user-friendly, menu oriented reporting applications.

11.1.6 Project plan and schedule

The project has been divided into main stages so that the general definition of the system and planning of the database were carried out in October-December 1997. The part of the data system to be used in data collection have been carried out in 1998 and it is intended to be taken into productive use in full in the beginning of 1999. Most of the applications for the use of the database will be carried out in 1999-2000.

11.2 Development of an income follow-up system

11.2.1 Background

The development of the incomes and profitability of farm enterprises is followed on the basis of the data delivered by farms included in the profitability bookkeeping of agriculture. Profitability bookkeeping is conducted by the Agricultural Economics Research Institute, and the data also forms the basic data on Finland in the FADN agricultural bookkeeping system of the European Union.

There is a delay of about one year in the completion of the results from the profitability bookkeeping. Due to the delay there is no data available on the very recent income development in agriculture, even if the development of both inputs and outputs and the level of aid is known on the basis of general statistics as well as data from the Ministry of Agriculture and Forestry.

However, there is a growing need for short-term income forecasts (1-2 years). Various kinds of aid measures constitute an increasing share of the incomes of agriculture (based on the total calculation of agriculture, for example, the share of aid in the incomes was over 40% in 1997), and the amounts and structure of the aid measures are under continuous change due to, inter alia, the aid arrangements for the transitional period and pressures to revise the common agricultural policy of the EU. The reform of the common agricultural policy will have an effect on the formation of market prices, and thus major changes can be expected to occur in the structure of the income formation of farms in the next few years. In addition, considerable short-term variation is typical for the price development on the single market. Consequently, it should be possible to estimate the effects of these changes on farms located in different support areas and specializing in different production lines so that the forecasts could be utilized when preparing the decisions on aid and the opinions on the common agricultural policy, and as background information for the discussion on the general income development in agriculture.

11.2.2 Current model for the income follow-up system

The development of the incomes of farms has been followed at the Agricultural Economics Research Institute by means of a static income follow-up system since the beginning of the 1980s. The system was created to produce background material on the development of returns and costs as well as profitability of farms for the income negotiations based on the Agricultural Income Act. This system was abolished along with the agricultural income system. However, in 1997 in connection with the negotiations concerning agricultural support it was noted that there is a need to reintroduce the system, and development work was started to update the system to correspond to the current structures of income formation.

In the income follow-up system a basic year is established as an average of the results of three subsequent years. This reduces the distorting effect of exceptional years. On the basis of the average result results at fixed prices are calculated for the years concerned so that the difference between the years contains nothing but the change in the prices of inputs and returns as well as in the amounts of aid. Consequently, the model does not include the structural development in farm enterprises or the adjustment of the enterprises to the price changes.

The income follow-up model indicates the development of the income formation and profitability product by product. Thus the farm groups based on farms participating in the profitability bookkeeping are established by selecting as homogeneous farms as possible into each group. The indicators for homogeneity used are the share of each product in the sales income, ratio between the number of animals and the arable land area as well as, on pig farms, the share of purchased fodder in the business costs. The farm groups consist of farms specializing in milk production, cereal production, beef and pigmeat production, raising of piglets, combined pig husbandry, and egg production, and these have been further divided according to the support area where they are located.

By means of the model income development can be estimated up to the present moment, and it is also possible to forecast the future development by means of e.g. the decided levels of aid. According to current estimates the system can be applied for the first time in 1999, when the results of the bookkeeping farms for 1995-1997 are available. Consequently, the results will only indicate purely the situation in agriculture after Finland joined the EU.

11.2.3 Development of the income follow-up system

In the current income follow-up system it is not possible to estimate the effects of the changes in the production structure and operating environment of agriculture on the income development of farms. In order to be able to estimate the income effects of the realised development, more components influencing the income development must be taken into account in the model. Factors explaining income development include, among others, changes in the environment, structural development, price formation and development of production technology.

Changes in the environment

The operating environment of agriculture is very different from that of other businesses. In addition to the framework imposed by the society, the business operations are dependent on the natural conditions, and the considerable annual variation typical of these influences the development of the economy of agriculture in a significant way. In developing the income follow-up model the changes in the natural conditions can be taken into account by estimating the yield level of the crops influencing the returns during the summer at the end of the spring sowing and after the development of the plants in the early part of the growing period. The yield estimate could be made on the basis of estimates based on the location data applications of the Agricultural Research Centre. The development of the location data application is not yet completed, but in the next few years the first yield estimates made at the end of June will cover all cereals, and estimates will also be made from areas. The yield estimates utilized in the model could be chosen, for example, according to the support areas.

Of the changes in the operating environment determined by the society the changes in the numbers of production quotas can be taken into account in the model. For example, a possible reduction in the milk production quotas for farms can be taken into account in the forecasts.

Prices

A separate model based on the earlier income development is established for estimating the development of the prices of sales products and production inputs. Changes in the demand and supply influencing the development of prices are taken into account as explanatory factors in the model, together with the effects of the foreign prices on the domestic price development as well as possible changes in the provisions concerning restrictions on the foreign trade in agricultural products resulting from e.g. the enlargement of the EU. Estimates by experts may also be utilized in preparing the price estimates, and these may replace the estimates calculated by the model.

Structural development

Analysis of the structural development may be based on estimating the development of the cultivated areas and numbers of animals, because these have a direct effect on the economic development through changes in the quantities of products sold and in the use of inputs. The development of the area under cultivation can be estimated on the basis of trend development, which depends e.g. on the number of farmers.

The development of the number of animals is also estimated on the basis of trend development. Explanatory factors may include the prices for animal material and meat, and the foreign price development and the effect of this on the Finnish meat market should be taken into account. The effect of the fodder prices on the numbers of animals can also estimated.

Development of production technology

In constructing the model an attempt is made to estimate the effect of the development in the production technology on income formation and development of profitability. The analysis may be based on, for example, the development of the input-output ratios calculated for the time series and, through this, the change in the quantities of inputs used. Factors explaining the development of the input-output ratio may include the development of input prices, development of production techniques (e.g. new harvesting methods for silage), entry of substitute products on the market (e.g. growth of the market shares of cheaper fertilizers coming from the east) and need for complementary products as the production techniques change (e.g. in connection with the increase in the baling of silage the storage costs of silage come mainly from the increased cost of plastic used, not in the form of fixed building costs).

Calculation of income forecasts

The data describing the development of incomes and costs needed in the income forecasts are usually obtained from general calculations concerning agriculture and statistical sources like the enterprise and income statistics for agriculture and forestry made at the Central Statistical Office, profitability bookkeeping and total calculation of the Agricultural Economics Research Institute, as well as farm model system monitoring the production costs. Data concerning the levels of agricultural aid are available at the Ministry of Agriculture and Forestry, and data on the development of prices comes from the price statistics of the Information Centre of the Ministry of Agriculture and Forestry.

The data collected is evaluated and checked, after which it is adjusted to the level of the established farm groups. The farm groups are established either in the same way as in the earlier income follow-up system, or so that an attempt is made to describe typical farms, in which case the production often consists of several sales products.

Changes in the operating environment, structural changes and changes in the technology are also taken into account in the model, and this makes it possible to draw up forecasts for a longer term than the current short-term forecasts. For example, a forecast for the medium term may include a policy analysis, which improves the practicability and coverage of the forecast. Consequently, the model may complement the sector model for agriculture forecasting the extent and income formation in the whole agriculture drawn up at the Agricultural Economics Research Institute.

Use of income forecasts

Income forecasts can be made by degrees as new data influencing the income formation becomes available during the year. The first estimate is made early in the spring, when the development of prices and production quantities and the level of aid in the year in question are known, in addition to the data on the previous years. Data may be completed by farmer inquiries to find out their intentions concerning the areas to be sown. The first estimates on the expected cultivated areas can be made on the basis of the inquiries and the yield level can be estimated on the basis of the trends. Estimates by experts can also be used to complement the estimates. The first estimate may be utilized e.g. in preparing the state budget as well as opinions on issues related to the implementation of the common agricultural policy of the EU.

The second estimate is made in the summer after the yield estimates are completed at the Agricultural Research Centre. In this connection the areas sown in the spring are known, and more information on the development of the prices and quantities is available. The results of the second estimate can be used as background information e.g. when making the decisions on aid for the following year. The last estimate is made at the end of the year when the final data on the yield levels of the year in question as well as on the price development, except for the last few months, are available. The model may also be used to correct the data from the previous year.

Researchers specializing in different production lines from the Agricultural Economics Research Institute together with researchers from other institutions according to the need will comment on the data and the estimates. The comments made by these experts may influence the estimates to be made.

12. Methods for forecasting income and evaluating policy scenarios

Hennie van der Veen [1]

12.1 Introduction

Decision making in agriculture requires reliable data. In many countries a Farm Accountancy Data Network (FADN) is composed of micro-economic data at farm level. In the Netherlands, data are collected for about 1500 agricultural and horticultural farms. The Dutch FADN is part of the FADN of the European Union. The sample survey is carried out in such way, that it is representative for the population of farms between 16 and 800 European Size Units (ESU). To achieve this, the sample is drawn with a stratification based on ESU, acreage, type of farming, age of the farmer, and region (Bouwman, et. al., 1997). Hence, each farm in the FADN represents a certain number of farms in the population, which number is called the weighting factor. By using these factors, the figures of individual farms can be aggregated to farmtype level. In addition to the information required by the European Union, a great number of financial, technical, environmental and socio-economic data is gathered at the participating farms. In addition, 1300 farms out of the total of 1500 are willing to provide information about their non farm income and their private spendings.

These efforts provide a large amount of historic data. However, policy makers are mainly interested in the current situation (monitoring) and the future situation (either short or long term). Due to the fact that the collected data are at best actual, estimations about income have to be made about the short-term future situation, and usually even about the actual situation (section 12.2.1). The future situation is at stake when policy scenarios have to be evaluated. Scenarios without policy interventions can be compared with the policy scenarios to judge the consequences for the farmers, the farming sector and the economy as a whole. In that case, a micro economic simulation model can be an attractive tool (12.2.2). Section 12.3 further describes current work related to the use of the methods and options to integrate them. This paper ends with some points for discussion.

12.2 Current methods at LEI

12.2.1 Current situation for estimations of incomes [2]

This section describes the experience at LEI with forecasting farmer's income and the profitability of the farm business. These forecasts deal with the income-situation in the current accounting year and are made a year (estimations) or 18 months (prognoses) before

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[1] Agricultural Economics Research Institute, P.O.Box 29703, 2502 LS, The Hague, The Netherlands.
[2] This section is based on Poppe and Jager, 1995.

final results from the FADN are available. Yearly, the forecasts are published in December, which implies that they are available before the accounting year closes. These figures get the attention of press and politics and a press conference is organized.

By definition, results from the FADN describe the past. Accounts cannot be made before the end of the accounting year, and then it takes approximately nine months before the final results of all holdings are available. Policy makers and other users of the FADN are however often interested in the actual and future situation. Therefore, the LEI, at the request of the Ministry of Agriculture, developed a method for updating the accounting data.

The method used for forecasting is an update of the accounting results as they are available for the last years. This update is based on group averages, and not on individual farms. At the moment of the prognosis e.g. 1997/1998, final results from the FADN for this group of farms are available for the years up to 1995/1996. The data on the profit and loss account as well as the income statement are entered in a large spreadsheet. For arable farming it lists for example all the crops and for the last final year their areas, yields, prices and output. For nearly all the crops, the FADN provides areas, yields and prices; however, the method of forecasting income would also work without the split of output into yields and prices. Added to these final results are the preliminary data for the year 1996/1997, based on approximately 60% of the holdings. These results are not taken directly from the FADN database as this 60% of the farms could be biased. Sometimes farms with the best administration (and better results?) become available first. Organizational reasons (temporarily lack of staff in a region) could also be a reason that data of the first 60% of the farms are biased. To correct such biases the preliminary data are calculated by taking the absolute increase or decrease for each variable (yield, prices etc.) for the farms available in the last final year (1995/96) and the previous year (1996/97). This change in the constant panel is added to the results in the final year to give the estimated results for the next year. Even then sometimes manual corrections are made for obvious errors (often in minor products).

For the prognosis no definite results from the FADN are available. The data on the cropping pattern are collected on the farms in the FADN. Yields come from the yield estimations of the Central Statistical Office. For prices the same method is used. For many products, price statistics are only available for the first months of the selling season. Two methods are used to solve this problem. For some products, simple regression formulas are used that estimate the relationship between the price (dependent variable) and the European harvest and the future market (independent variables). A second method is to interview by telephone some market experts in the trade and processing industry.

The method used to forecast the costs is almost comparable to the method for the output. A few remarks must, however, be made. For some input items the FADN does not provide a split of the costs in quantities and unit prices. The development in the price is then estimated on the basis of price statistics from LEI or the Central Statistical Office. For the year to be forecasted, price changes for all input items are based on available price statistics.

The rest of the forecast is straightforward calculation. The difference between the output and the input gives the profit of the farm. Note that in the Dutch FADN the costs for own (unpaid) family labour and all capital are calculated. By adding the calculated costs for own family labour and the difference between calculated and paid costs of capital to the net profit [1], family farm income is determined.

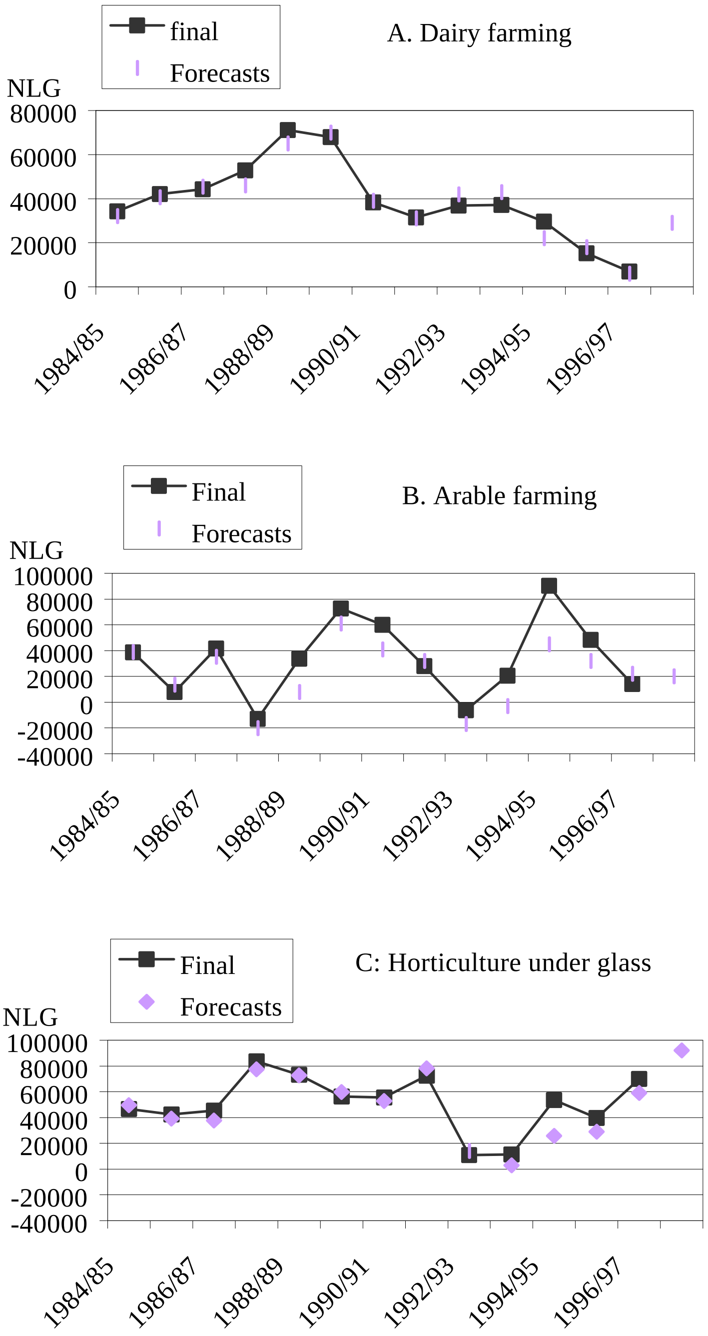

Figure 12.1 Forecasts and final FADN results compared: Labour income of the farmer

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[1] Which can be due both to a difference between the hight of interest rate, which is used for the calculated costs of capital and the interest rate, which is actually paid. and to the fact that the farm not completely financed by debts, which implies that part of the calculated costs of capital stays unpaid.

The split of the output and input into quantities and prices makes it possible, for old years and for the year to be forecasted, to calculate the changes in yields, prices, costs and the productivity of a group of farms. These calculations reveal interesting information because they make it possible to explain a change in farm income.

The method has now been used for about 20 years. All the forecasts made have been thoroughly checked by the final results of the FADN. Figure 12.1 compares the forecasted and final labour income of the farmer. The figure shows that the forecasts have been of acceptable quality. The direction in income development and the turning points have mostly been predicted well. However, it should be noted that for arabale farming, a difference of 1% in the profitability is equal to an income difference of ƒ 3.000 - ƒ 4.000. That is approximately 5 to 10% of the labour income per farmer.

12.2.2 Evaluation of policy scenarios[1]

LEI has developed a Financial-Economic Simulation model (FES) [2], which is a useful tool for policy evaluation. The functioning of FES is as follows. For individual farms in the Dutch FADN the financial economic development is simulated for every year of the simulation period (usually 5 to 10 years). Starting from the commercial balance sheet according to FADN, the model calculates the fiscal balance sheet, revenues and expenditures of the first year (see figure 12.2). To translate the individual farm outcomes to sector level, the weighting factor is used. This factor indicates how many farms are represented by this farm.

As figure 12.2 shows, many events happen in a year, which will now be described in more detail.

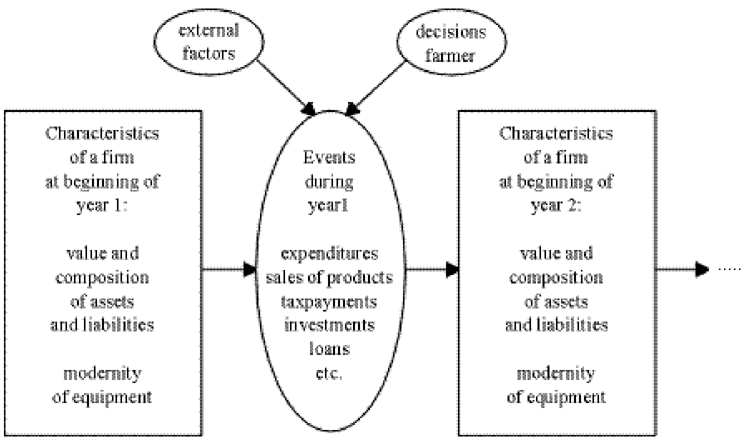

Figure 12.2 FES is a discrete-event simulation model

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[1] This section is based on Welten and Verstegen (1997).

[2] More information about this model can be found in Mulder (1995) and on the homepage of LEI; scenarios and models (http://www.lei.dlo.nl).

Revenues and costs

The revenues and expenditures are determined by adjusting the technical and economic results reported by the FADN for assumptions concerning the development of prices and productivity and other external circumstances like government intervention. The expected prices of products can be determined in various ways, like time-series analysis, expert views and demand-and-supply models. Prices are modelled as relative changes in revenues and not as absolute prices. These relative changes are determined for 50 product categories, and are the same for all firms. Firms that receive relatively high prices in year 0 (when the data of FADN are used), will for the whole simulation period receive high prices. This implies that relative differences in the individual performance in relation to the average results remain preserved.

Investment and financing

After calculating the operational cash flow in this way, potential investment opportunities are listed. Relevant investment options can be originated from the model itself by aging of the fixed assets (replacement investments). Other relevant investment options are not calculated in FES. It is however possible to determine them outside the FES-model. For example, in many applications of the model the question is answered whether or not firms are able to finance certain environmental or animal welfare investments. The level of those investments is exogenously determined as follows:

- translating environmental governmental policy into standards for firm management per type of farming;
- comparing those standards per type of farming with the actual situation per firm and determining which adaptations in the firm management should take place in terms of costs and investments and;
- determining the effects on returns of those possible changes (see Zaalmink et al., 1996).

Investment opportunities are compared with the available financial resources. If those are sufficient, investment takes place. Otherwise, the possibility of borrowing is considered. For this reason the behaviour of banks with respect to the financing of agricultural firms is modeled within FES. If cash flow, solvency and collateral are sufficient, financing and investment takes place. If relevant, the operational cash flow changes due to the investments made. For example, if an investment is made in an energy-saving option, then the costs of energy will decrease, while the costs of maintenance might increase.

Taxes

With the fiscal balance sheet, revenues and costs of the farm, non-farm revenues and the investments as input, the tax-claim is computed. The relevant parts of the Dutch tax system are for this reason incorporated in FES. After computing the tax bill, the year's end balances can be drawn up. On the basis of this balance and the modernity of the assets the viability prospects for the farm are calculated and the next year of the simulation period starts.

Stopping of farms

Besides the routine running in case the farm is doing well, the model incorporates specific behaviour in case of financial problems. If a farm is unable to meet the short-term financial obligations, arrangements are made to survive. Extension of payment is requested (possible every two years) and household spending will be cut (down to a predefined minimum level per household). In case this is not sufficient, an appeal to social security is made. In the model, a farm will go bankrupt if the social security loan exceeds $150.000. In addition to bankruptcy, farms can stop within FES if the farmer becomes 65 and has no successor, or the successor is unable to finance the take-over. Next to that, information about stopping farms is essential, including mortality chances and voluntary emigration chances.

The different events are all influenced by external factors, e.g. prices of outputs, inputs, interest rates, etc. Figure 12.3 lists the sources of these external factors.

External Factor	Source
Prices products	Statistical data, partial equilibrium models, expert views
Prices inputs	Statistical data, expert views
Wages	Collective loan arrangements, expert views, statistical data
Interest rates	Statistical data, expert views
Taxes	Documents tax regulation, information from officials
Loan policy banks	Documents banks, information from bank employees
Other policy measures	Policy documents, information from officials

Figure 12.3 Overview of data sources of external factors

The main drawback of FES is the fact that behaviour is not incorporated in the model. Basic assumption of the model is continuation of the farm with unchanged structural characteristics (Mulder, 1994). The firm stays at the same size with the same revenue and cost structure. This choice is a very justifiable point of view and leads to consistent results. However, it does raise many questions, especially in long term studies. Therefore, a more dynamic version of the model will be developed. As the research for such a version will take some time, the static version has to be used.

For some sectors, behavioural models have been developed at LEI; for the pig sector, the Strategic Decision Model and for the dairy sector, the expert system APPROXI. The results of these models can be used as input for FES. However, using both FES and behavioural models is quite complicated due to software design problems and can only be done for a few sectors.

FES has been used in many political discussions in the Netherlands. The results based on FES had a profound impact on these discussions and the ultimate policy. An example of a political discussion is the plan for reconstructing the Dutch swine sector. Some aspects concerning the pig production rights changed due to calculations with FES.

2.3 Current work at LEI

12.3.1 Combination of estimations of incomes and FES

Section 12.2 described the methods used at LEI for income forecasts in the short run and predicting income trends and viability with FES in the medium term. Combining the forecasting method with the simulation model could be attractive for various reasons.

- It could lead to information on the distribution of income in the short run.
- It could give information of groups of firms. The flexibility in relation to the composition of groups increases.
- It leads to consistency between the two types of publications and less embarrassing questions to explain differences.
- It could lead to better modelling of income cycles for the first simulated years since price and quantity indices are already input to FES.
- It would lead to efficiency and flexibility gains, by having less models and more researchers that are able to use the new, combined model.
- If somehow information would be available about investments, forecasts about other financial figures could be given e.g. balance sheets.

Studying the combination of the models also seems to make sense. The European Commission and the German Ministry of Agriculture have models (like the Rica Forecasting System in DG6) that create income forecasts or updates on the short run, by updating historic data from individual (!) holdings with indices (percentages change), that is to say: with a FES-like methodology.

However, a few points of concern have to be considered. First, information on the distribution of income would be very interesting. Due to the methodology of updating revenues and costs by an index for the change in the prices and quantities, the distribution automatically changes. Accidental excellent or bad results can be reinforced in the estimated year by being multiplied by the indices. The distribution of the income in the forecasted year might be converged or diverged away from the mean figures (depending on the height of the indices). It is however not quite clear whether this effect really occurs and hence influences the validity of the distribution. It is clear that this has to be tested.

Secondly, the weighting factors of the sample have to be changed. The structure of the Dutch agricultural sector changes every year, which implies that number of farms in every stratum based on size, acreage, type of farming, age of the farmer and region, changes. In addition to this, firms stop within the FES-model, however it might be possible to change this aspect of the model. Hence, the number of farms represented by a sample farm automatically changes. Even then, due to the simple fact that the model works with panel data, difference will occur between the forecasted and the final results.

12.3.2 Micro simulation model

Considerations concerning efficiency and quality have prompted LEI to start the development of a new microsimulation-model. The basic unit of analysis is the unit of decision-making, the individual firm. This model will be programmed in an object-oriented language. This implies that the model consists of different components, for example a balance sheet, tax calculations, energy requirement, a feed sheet, etc., which can be combined for a certain research question. Many of these components can be used from the new accounting network (BKH2000), which is now being developed in the Netherlands.

Programming in an object-oriented language provides many advantages that are related to quality and efficiency both from the technical side and the economic context of modelling:

- the components can be combined and recycled in many ways, since the definitions of the variables that are used in the various components, are equivalent. Agreements about this have to be made throughout the institute. The recycling of components increases the efficiency and the quality of research, since the different components are built and tested by experts;
- the interaction between the components is automatic (objects can be instructed to communicate with each other) and can be iterative. This is one of the drawbacks of the FES model. Interaction with other models is complicated due to software problems;
- combining well-tested and autonomous components facilitates interpretation of results. The conditions for this advantage are that either the components are based on the same economic theories, or the differences in theories do not lead to interpretation problems;
- the availability of and access to models at LEI will be more transparent throughout the institute;
- the maintenance is easier since less ad-hoc programming will take place;
- control of the components will be centrally managed;
- the transfer of the models within the institute will be easier. The components are all written in the same language. Hence, the usability will be improved, because more people will be able to work with the model (now model development and use is often the responsibility of one person).

12.4 Discussion

This paper illustrates that historical data from an FADN can be made more useful for policy makers by updating them with forecasts or by adding simulation models (like FES) that analyze policy alternatives (scenarios). FADNs are available in the EU-countries and further improvement of those data sets as well as more frequent use in new policy areas (like environment) appears to be worthwhile (Poppe et al., 1997). All Central and Eastern European countries are also running or establishing FADNs (Pohl, 1997). To support policy analysis and policy decision making, some of them might consider using FES-type models. The changes in the EU's common agricultural policy (e.g., Agenda 2000) and the effects of the EU-enlargement in the EU and in the CEE-countries could be analyzed in this way. Closer co-operation between research institutes and further improvement of the FADNs is therefore desirable.

Some points of further discussion might therefore be:

- do other countries have experience with income estimations? Why does not every country forecast incomes? Which methods are used and how reliable are those methods. Is the distribution of income forecasts valid?;
- do other countries use microsimulation models to get insight in the future situation? Which variables are relevant? In the Netherlands, the income and viability figures are often used, however for the EU supply or budget costs might be more relevant.

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13. The FADN as instrument for monitoring energy use and efficiency in the Belgian greenhouse horticulture

D. Van Lierde and L. De Cock [1]

13.1 Introduction

In the PACIOLI-project the attention has been focused on the use of the FADN's (**F**arm **A**ccountancy **D**ata **N**etworks) not only for the evaluation of economical aspects of the agricultural sector. There has also been stressed that by introducing innovations the scope of the FADN's could be strongly enlarged. One item, raised in this context, was the extension of the data model from a pure accounting model to a data model that also includes data useful for, e.g. the environmental policy. Different researchers have already stressed this during previous PACIOLI workshops and have shown examples of how this could be realised. Especially the mineral balances, the use of pesticides and the use of energy have been specialized (Poppe, K.J. and Beers, G., 1996).

A topical environmental problem at the moment in Belgium, is the energy problem, especially the energy problem in the greenhouse horticulture. Therefore it was examined in which way the Belgian FADN could be used in the investigation of this issue. In this paper the use of FADN data in the estimate of the energy consumption in the Belgian greenhouse horticulture will be explained. Main attention is paid on the processing of the data gathered in the FADN.

13.2 The energy problem in the Belgian greenhouse horticulture

Although the successive energy crisis of the early eighties are already over and done for a long time, the Belgian greenhouse horticulture of today is faced again with problems in relation to the use of energy. This time it is not the increase of the energy prices that cause problems, but the competition of the southern members of the European Community. These countries, with a fast developing horticultural industry, are less dependent on the input of energy for their production and have, e.g. therefore a significant cost benefit compared with the northern countries. These developments put a high pressure on the profitability of northern horticultural holdings (Taragola, N. and Van Lierde, D., 1996; Verhaegh, A.P., 1998). On the other hand, the conservation of the environment asks a decline in the use of energy in order to restrict the emission of greenhouse gasses and other harmful gasses, released by the combustion of fossil fuels (Verbruggen, A., 1996). At the climate conference of Kyoto (1-10 December 1997), Belgium agreed to restrict the emission of greenhouse gasses in 2012 to at least 8% below the level of 1990.

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[1] Ministry of Small enterprises, trades and agriculture, Centre of Agricultural Economics.

To carry out a good energy policy, it is necessary the government have a clear insight into the energy consumption of the greenhouse horticulture. The required information especially concerns:

- the total energy consumption of the sector;
- the energy consumption per subsector (vegetables, ornamental plants, etc...);
- the evolution of the energy consumption over the years;
- the regional distribution of the energy consumption;
- the distribution of the energy consumption over the individual holdings;
- the percentages of the different kinds of energy sources in the total energy consumption.

The availability of these data creates a large base for further research. The substantive research will especially concern the efficiency of the energy consumption on the greenhouse horticultural holdings and the evolution of this efficiency through the years. In the model the individual energy consumption of the holdings in the population is estimated. This individual approach makes it possible to aggregate the holdings of the population in different ways, e.g. regional aggregation, but also other aggregations according to the cropping plan, holding size, age of the farm manager, etc. The estimate of the individual energy consumption of the holdings in the population makes it also possible to define target groups of holdings, e.g. with the eye on the input and simulation of energy saving investments. In this context, the holdings with the highest energy consumption will be the most important target group. Further on, also the economical aspect of the energy consumption and the energy costs can be studied. Here special attention must be paid on the effects of the energy saving actions and of the selection of more environmental friendly energy sources on the profitability of the holdings.

Data necessary for the study of the economical aspects of the energy consumption and the energy cost were found in the Farm Accountancy Network of the Centre of Agricultural Economics, member of the European Accountancy Data Network. However there is little information available about the amount of fuels used in the Belgian greenhouse horticulture and on the share of the different kinds of fuels used for heating greenhouses. This is in contrast with other countries, as for example the Netherlands, where the greenhouses are almost exclusively heated with natural gas and where data on the energy consumption are mainly available from the N.V. Nederlandse Gasunie completed with data from the economic accounts of the greenhouse horticulture from LEI, based on data of the LEI FADN (Van der Velden, N.J.A. *et al*, 1996). An analysis of the Belgian accountancy network revealed that the accountancy network can be used for more than economical information alone and that it includes interesting information for other purposes as, e.g. the study of environmental problems. A few years ago, the Belgian FADN already started to include some data about the energy consumption on horticultural holdings. Recently this information was extended which enlarged the possibilities for the energy consumption research (Van Lierde, D. and Taragola, N., 1996). The development of a method where the data of the FADN could be combined with the data of the yearly Agricultural Census organized by the National Institute of Statistics (N.I.S.) makes it possible to extrapolate the data of the Farm Accountancy Network to the whole Belgian horticultural population. This was done in such way that most of the previous mentioned elements could be estimated.

13.3 Determination of the energy consumption based on the FADN data

13.3.1 Extrapolation model for economical characteristics

In 1996, 420 horticultural holdings were included in the network of the Centre of Agricultural Economics. From these holdings a lot of economical data are available. These pure economical data, are more and more completed with technical data such as, e.g. the amount of fuel used to heat the greenhouses.

To extrapolate the economical characteristics to the population, an existing extrapolation model can be used (Mineur, C. and Van Lierde, D., 1991). This extrapolation model divides the observation field and the sample in a number of aggregates based on the holding type and the economical dimension of the holding (measured in Standard Gross Margin or SGM). For each aggregation cell in the sample, the average values of the characteristics are calculated and then the weight of the cell in the observation field is assigned to these averages. In this way the weighted values of the characteristics are calculated. Despite the extrapolation model estimates most of the characteristics quite well for the holdings of the observation field, relative restricted aggregation faults are always present. So the weighted average glass area will slightly differ from the average calculated on the base of data of the agricultural census. This means that if the total energy consumption is calculated by using the economical extrapolation model, the consumption is slightly under or over estimated. Moreover, the extrapolation model is only valid to calculate energy consumption of glass area situated on the horticultural holdings belonging to the observation field. The area glass situated on the smaller horticultural holdings that are not represented in the observation field of the FADN and the glass area situated on agricultural holdings is not represented. To solve these problems the extrapolation model was adapted. This adapted method is thoroughly described in the CEA-publication 'Methode voor de bepaling van het energieverbruik in de Belgische glastuinbouw' [1] (Van Lierde, D. *et al*, 1998). In the present paper only the basic principles of the method are explained.

13.3.2 Adaptation of the extrapolation model to improve the calculation of the energy consumption

The energy consumption is mainly dependent on the cropping plan. The problem here is that in the agricultural census only the situation on the 15th of May is known. To indicate what crop is present on the 15th of May the farmer can only chose from a restricted list of crops that are mentioned on the census forms. For example for cut flowers he can chose between roses, carnations, chrysanthemums and other cut flowers. So the information that is available in the census concerning the kind of crop that is present in the greenhouse on the 15th of May is rather restricted, with no information on the cropping plan, plant data or energy consumption. In the FADN much more data are available on cropping plan, energy consumption, and so on. With the experience and knowledge available in the section 'Horticultural research' of the Centre of Agricultural Economics, it was possible to give a quite good estimate of the cropping plan (or cropping plans with the same energy demand) based

[1] 'Method for the determination of the energy consumption in Belgian greenhouse horticulture'.

on the restricted data available in the census. Although the information in the census is restricted, a good interpretation of the data can reveal a lot of information. For example, for a holding that mentions in the census a cultivation of tomatoes on substrate on the 15th of May, there can be supposed that this cultivation on substrate goes on during the whole year, or will be succeeded by a late cultivation of tomatoes or cucumber (when a substrate installation is present there are few other possibilities for the cropping plan).

Combining all these elements, 12 groups of crops were aggregated, identifiable in the census as well as in the FADN. Each group of crops corresponded with cropping plans with the same energy demand. In the FADN there are no data available for energy consumption per crop, only the total energy consumption for the whole farm is known. However, in the greenhouse horticulture the holdings are very specialized with a quite homogeneous cropping plan and these cropping plans on specialized holdings, according to the typology defined by the C.E.A. (Van Lierde, D., 1985), show high similarity to the selected groups of crops. For example holdings specialized in azalea grow almost exclusively azalea, so one can say that the energy consumption per m² of the holdings specialized in azalea equals the energy consumption per m² of azalea cultivation. The same can be done for other specialized horticultural holdings and the corresponding groups of crops. Only the holdings of the greenhouse vegetables and the holdings of cut flowers show exceptions. For the greenhouse vegetables three clearly to identify culture groups were defined, namely the holdings with cultivation on substrate, holdings with intensive heated crops and the holdings with other vegetables. For cut flower holdings, a distinction was made between holdings with roses and holdings with other cut flowers. The cultivation of roses is a very energy intensive cultivation and often uses extra light.

On the other hand data from the FADN show that on bigger farms, and especially in the sector of greenhouse vegetables, more energy consuming crops are cultivated than on smaller farms. The investment in a more performant heating system is mostly only profitable on bigger farms. So, 12 groups of crops were selected and as intensity of heating also depends on the dimension of the holdings. The holdings were divided into five dimension groups according to the economical dimension of the holdings (measured in SGM), divided into five dimension groups; the four dimension groups belonging to the observation field of the FADN and used in the economical extrapolation model, and a fifth dimension group that contains the holdings in the population that are smaller than the threshold of the FADN observation field. The energy coefficients of this fifth dimension group are equal to the energy coefficients of the lowest dimension group of the observation field. In total 60 energy coefficients (12 groups of crops, and each group divided into 5 dimension classes) were calculated to estimate the total energy consumption on each holding in the population. For every holding with greenhouses recorded in the census, the dimension of the greenhouse crops was calculated. This gave the total SGM and thus the economical dimension of the holding. Then the set of energy coefficients was chosen corresponding to the dimension of the holding. Next, and based on the data present for the holding in the census, the glasshouse area for each of the twelve groups of crops was established (for most of the holdings there was only for one group of crops an area). Finally these areas were multiplied with the corresponding energy coefficient and the total energy consumption for the holdings could be calculated(figure 13.1). Notice that as average values were used, the distribution of the coefficients in the sample was not taken into account. In a later phase of the research we intend to simulate this distribution.

To make the heating system work electricity is needed (burners, pumps, etc.). This electricity consumption is strongly correlated to the total energy consumption of the heating system. Based on this regression model, and as far as for every holding in the population the energy consumption for heating was estimated, the electricity consumption could be estimated. Finally the electricity consumption was converted into primary energy[1] and summed with the primary energy for heating. As an estimate of the energy consumption was made for every individual holding in the population, a summation of energy consumption can be made for some aggregates, e.g. summation of the energy consumption for one particular region, for different types of holdings, for different dimensions of holdings, and so on. This methodology offers numerous possibilities for further research.

Besides the energy coefficients for total energy consumption, energy coefficients per kind of fuel were determined based on FADN data (oil, natural gas, coal, and so on). These energy coefficients make it possible to estimate the part of the different kinds of fuel in the total energy consumption. Since these coefficients are averages per aggregation cell, the results for the individual holdings are of less meaning. They have only a sense after summation for aggregates.

According the above-mentioned methodology the total energy consumption in the Belgian greenhouse horticulture was calculated for the period 1980-1996. In the beginning of this period not all the data for the different kinds of energy sources were recorded in the FADN data-model, as at that moment it was thought that this information was of minor importance. At this moment however, it seems that for this kind of research the information on the data for all kinds of energy sources increase the possibilities of the research. To complete the missing data extra inquiries had to be done. Since the gathering of additional information afterwards is time consuming and expensive, it is recommended to aim at completeness when a data model is adapted to collect additional data in a particular field. Furthermore it is obvious that in this way the reliability of this data is improved.

13.4 Energy consumption on greenhouse horticultural holdings

In this paragraph the first results of the research are briefly discussed. More information and discussion of the results can be found in the CEA-publication 'Energieverbruik in de Belgische glastuinbouw' [2] (Van Lierde, D. and De Cock, L., 1998). According the estimates obtained with the model, the primary energy consumption for greenhouse heating in the Belgian greenhouse horticulture increased between 1980 and 1996 from 14.7 PJ to 24.4 PJ[3]. Supposing that only heavy fuel is used on the holdings, this corresponds with a consumption of 338,000 tons in 1980 and 584,000 tons in 1996 (excluding electricity). This primary energy consumption in the greenhouse horticultural sector represents 0.7% of the

[1] The primary energy is the total energy content of a fuel expressed in Joule. For electricity the primary energy is the amount of primary energy necessary to produce the electricity in Belgian power stations
[2] 'Energy consumption in the Belgian greenhouse horticulture'
[3] 1 Petajoule = 10^{15} Joule

total primary energy consumption in Belgium in 1980, in 1996 this increased to 1.0% (Van Lierde, D. and De Cock, L., 1998).

During the period 1980-1996 the energy consumption in the greenhouse horticulture increased by 66%. The area of greenhouses increased in the same period by only 20%, in 1996 there were 2,038 ha of glass area. This means that the intensity of the energy consumption (the energy consumption per m²) strongly increased. Based on the obtained data a regression model was built that shows that the energy consumption per square metre glass area is almost completely explained by the real fuel price (1980=100) and by the number of day degrees [1]:

consumption = *0.698643 - 0.002785*price + 0.0002220*degrees*

consumption = *energy consumption in Gigajoule useful heat [2] per m²*
price = *real price of the energy in Belgian frank per Gigajoule useful heat (price level 1980)*
degrees = *number of day degrees*

R^2 = *0.96*
T(price) = *-18.74*
T(degree) = *5.03*

This regression model shows that the real price and the number of day degrees can explain 96% of the variance in energy consumption per m².

The model makes it possible to correct the total energy consumption for differences in average outside temperature during consecutive years. So the real evolution of the energy consumption can be evaluated without the influence of differences in weather conditions. On the other hand the model indicates the influence of fuel prices on energy consumption. So it can give an idea of the possible effects of a price policy on the consumption of energy. Figure 13.2 shows the evolution of the energy consumption per m² glass area, corrected for differences in temperatures, between 1980 and 1996.

Since the energy consumption was estimated for each individual holding with crops cultivated under glass, a total number of 4620 holdings in 1996, it is possible to get an idea of the distribution of this energy consumption over the different holdings. When the holdings are sorted in order of increasing energy consumption, the energy consumption for the different deciles of the number of holdings is given in table 13.I.

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[1] The day degrees are calculated by substracting the average daily temperature from 16.5°C on these days of the year the average daily temperature is lower than 16.5°C. The summation of these differences gives the total day degrees of the year.

[2] The useful heat is the amount of energy that can be used for heating the greenhouses, this is the primary energy minus the losses of energy in the heating system.

Table 13.1 Percentage of the total energy consumption and the total cultivated area under glass according to the deciles of the number of holdings (sorted by increasing energy consumption) in 1996

Percentage of holdings	Percentage of energy consumption	Percentage of glass area
10	0,1	0,8
20	0,5	2,7
30	1,3	6,1
40	2,9	11,1
50	5,4	18,1
60	9,5	26,6
70	15,8	36,5
80	25,8	50,5
90	45,6	69,0
100	100,0	100,0

It can be noticed that the energy consumption is strongly concentrated on a relative restricted number of holdings. More than half of the energy consumption of the greenhouse horticultural sector is used on only 10% of the holdings. 75% of the total energy consumption is used on only 20% of the holdings with crops cultivated under glass. These 20% of the holdings represent together half of the total area under glass. To carry out an efficient energy policy it is recommended that the government focuses his energy saving actions on a restricted number of holdings; those holdings who use most of the energy. This is much more efficient than actions for the whole horticultural sector.

13.5 Energy efficiency in the greenhouse horticulture

Based on the results of the model the research was enlarged to measure the energy efficiency in the Belgian greenhouse horticulture. To measure the energy efficiency three indicators were calculated (De Cock, L. and Van Lierde, D., 1998):

Physical efficiency = *Primary energy/Physical production*

Environmental efficiency = CO_2 *emission/m²*

Economical efficiency = *Energy costs/Production value*

The first two indicators were used in analogy with Dutch research (Van der Velden, N.J.A. *et al.*, 1990). The necessary data for this additional research are collected on the base of data available in the FADN. To calculate the physical efficiency the amount of greenhouse horticultural products produced must be known. Since the greenhouse horticulture is characterized by a large diversity of products, the physical production of each of these horticultural products is expressed in his own unit, e.g. tomatoes in kg, lettuce in heads, roses in stems, potplants in pots, etc. To express the physical production of all these different products in a same unit, an indirect way of determining the physical production is followed. The mutation of the quantity is calculated by correcting the monetary turnover of the production for mutations in price. In this research the physical production is expressed on a base of the prices of horticultural products in 1980. Since the macro-economical estimates of the production values differ considerably between years, it seemed more indicated to estimate these characteristics using the data available in the FADN. These data were aggregated using the model that was developed to calculate the total energy consumption. In this way the energy consumption and production were calculated in similar ways. Also the energy costs were estimated in the same way.

To follow the yearly evolution of the energy efficiency, without the influence of differences in temperature between years, the primary energy consumption per m² of glass is corrected by using the regression model mentioned in section 13.4. For each of the three efficiency coefficients the value obtained in the different years was expressed as a percentage of its value in 1980 (1980=100).

Finally, the calculation of the environmental efficiency was possible because the model does not only calculate the total energy consumption but also estimates the percentages of the different kinds of energy sources in the total consumption. By taking into account the CO_2 emission coefficient of each energy source, the CO_2 emission per area unit glass could be calculated.

The evolution of the three energy efficiency indicators during the period 1980-1996 is shown in figure 13.3.

13.6 Possibilities for further research

The research in the domain of energy consumption and evolution of energy efficiency in the greenhouse horticulture is an important base for further investigation. The next step in the research will be to make an inventory of the energy saving actions in the greenhouse sector and to make an economical evaluation of these results. Further the model is an important base to use in all kind of simulations where hypotheses could be tested, hypotheses where certain farms invest in energy saving actions or where they change to more environmental friendly fuels as natural gas. The effect on the environment and the profitability of the holdings can be investigated.

Another ongoing possibility is an estimate of the total energy consumption in the agricultural and horticultural sector, thus not only restricted to energy use in glasshouses. The data necessary for this further research are already available in the FADN and will be extrapolated to the population by further adaptation of the data model.

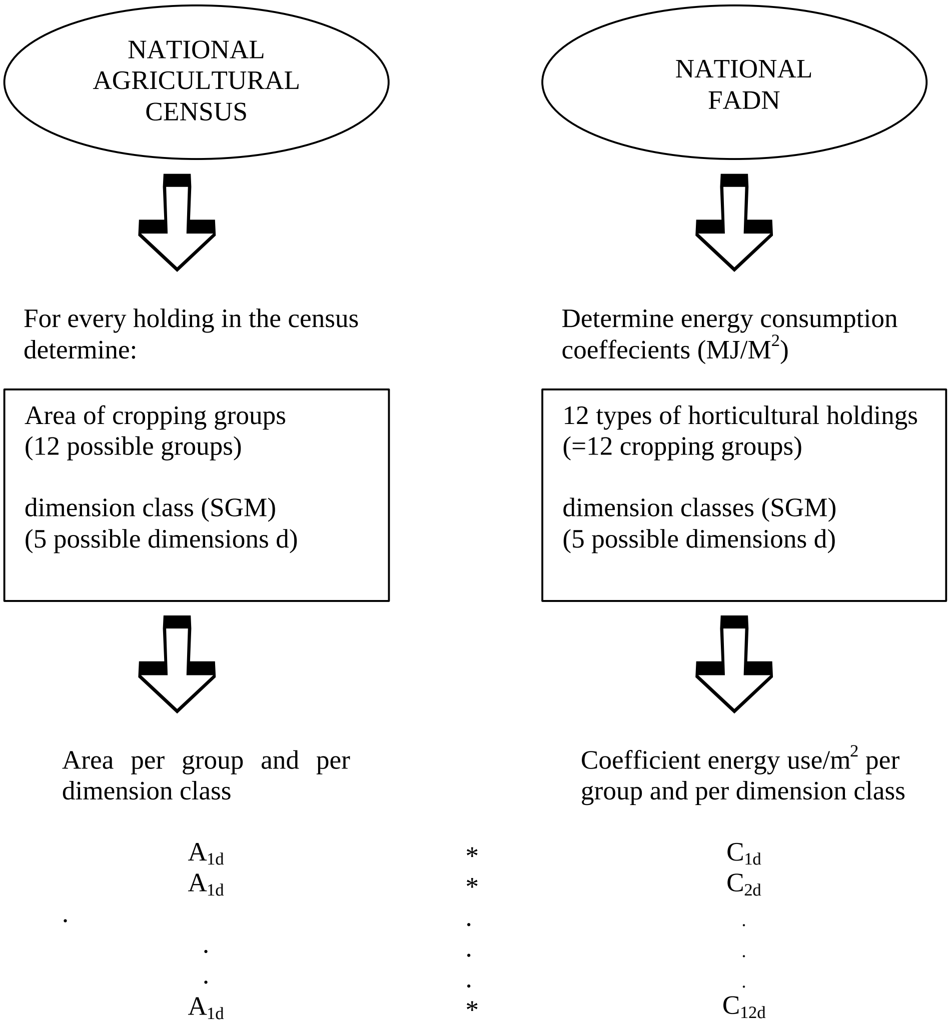
In the long run it must be possible to do some research on the Live Cycle Assessment (LCA), this is a method to estimate the global impact on the environment of a production, process or service over the complete live cycle of this production, process or service. LCA is more and more used in developing new products or production technique (Dewulf, W. and Van Raemdonck, W., 1998). LCA is also important in agri-ecological production chains, and FADN data play a very important role in this research (Meeusen-van Onna, M.J.G. and Poppe, K.J., 1996). Although in the LCA of greenhouse production energy consumption is very important, a lot of other data should be collected in the FADN. For the moment these data are not available in the Belgian FADN, so the data model must be adapted to make it possible in some years to do some research in the LCA domain.

13.7 Conclusion

The previous example of the calculation of the energy consumption in the Belgian greenhouse horticulture based on the data from accountancies shows again that the FADN is not only useful for pure economical research. By adapting the data model also data can be included that are of great value for research in the field of the environment. It is however important that if the data model is adapted to gather data in one particular research field one should aim for completeness of the data. The omission of what original is seen as less important, can give difficulties and inaccuracy when a later thorough study of the problem is made. Usually the collection of the missing data via extra inquiries asks extra efforts and costs.

The adaptation of the data model, the design and the development of the accompanying software and the collection of the extra data ask more work and thus extra costs. But, these investments and costs are more than compensated by the larger possibilities that these data offer for research purposes that are much wider than pure economical research. The always returning complaints of designers of models concern always the lack of enough and reliable data. Sometimes funds are released to collect data for one particular project, but in most cases there are only funds to develop the models. The models are developed and afterwards there starts a quest for data, wherever they can be found. Once the project is finished and the model is ready for operating, no funds are given anymore to adapt data collection and to maintain the data stream necessary for the functioning of the model. Funds are raised for new projects and model-builders are looking for new projects, leaving the functioning of their model to others which means in most cases that they are no longer used. So important realizations are completely forgotten to make room for new projects.

Policymakers who at the moment pay especially attention to '*sustainable agriculture*' must become aware that in order to dispose of '*sustainable results*' there is also a need of '*sustainable research*'. For this 'sustainable research' there is a need of *'sustainable data gathering'*. As in the consecutive PACIOLI workshops said and showed, the FADN's are an important source, not only for the economical research but also for research in other fields. A good data model can procure in a more efficient way, and for lesser costs, more data that are more reliable than when gathered separately for individual projects. It seems important that more investments are made in FADN's, so this basic instrument for research can be build out in a more efficient way.



Energy comsumption of holding i with dimension d (EC_i):

$$\mathbf{EC}_i = \mathbf{A}_{1d} * \mathbf{C}_{1d} + \mathbf{A}_{2d} * \mathbf{C}_{2d} + \ldots\ldots + \mathbf{A}_{12d} * \mathbf{C}_{12d}$$

Energy consumptio for aggregates are obtained by summing the energy consumption of the holdings that belong to these aggregates.

Figure 13.1 Extrapolation model for determining the energy consumption in Belgian greenhouse holdings, based on census data and data of the farm accountancy data network

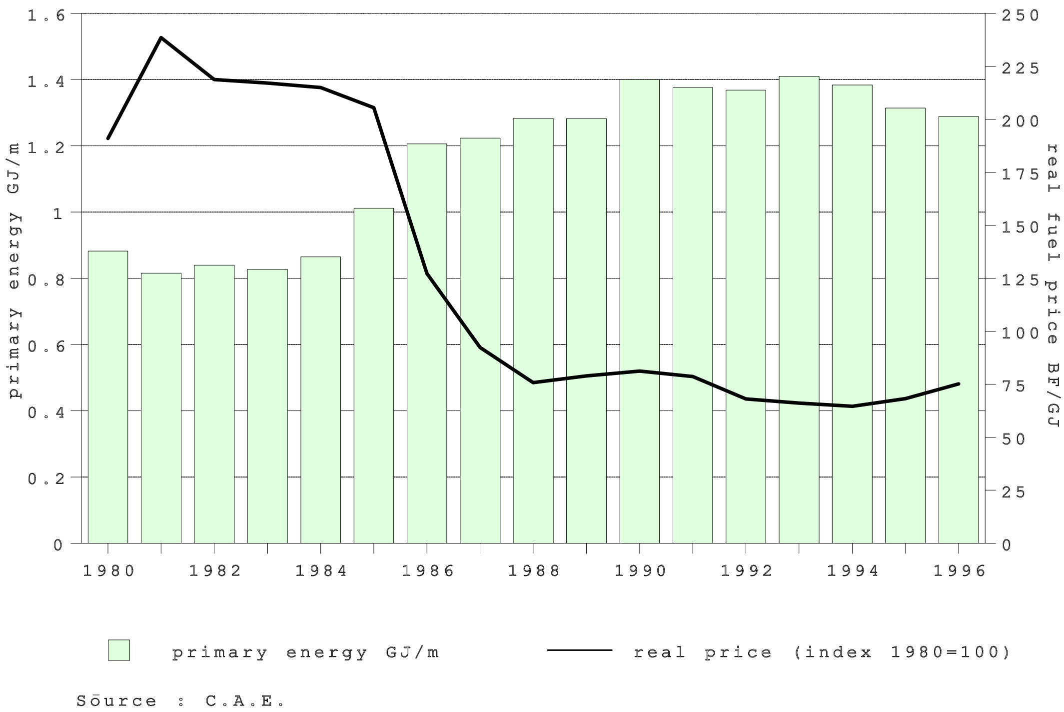


Figure 13.2 Evolution of the primary energy consumption per m², corrected for temperature effects, and the real price per unit useful energy (price level 1980) in the Belgian greenhouse horticulture. Period 1980-1996

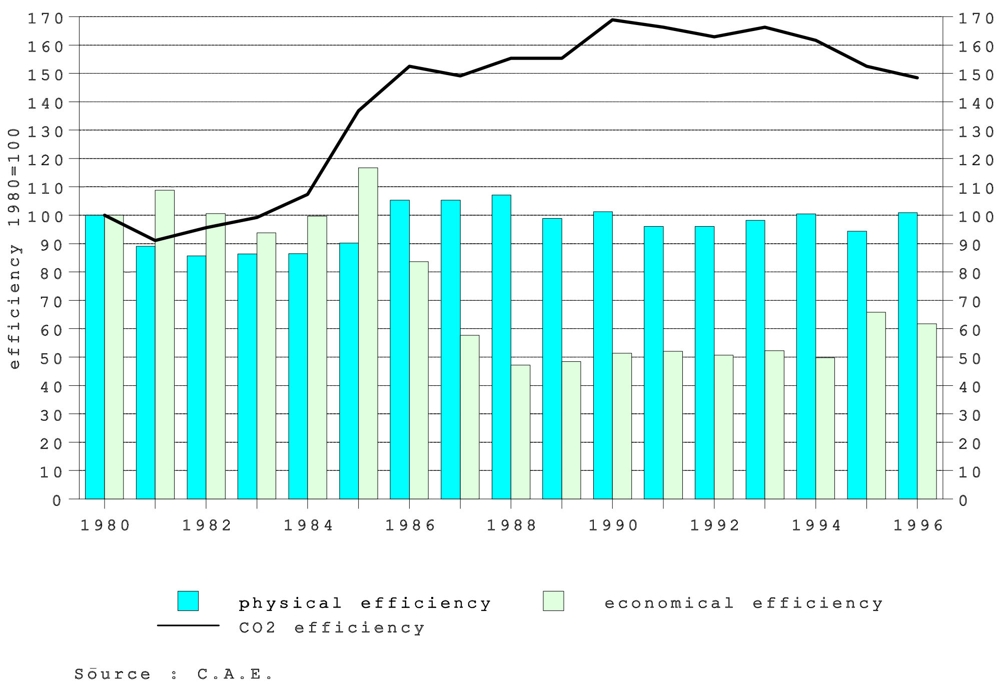


Figure 13.3 Evolution of the physical, economical and CO_2 efficiency in the Belgian greenhouse horticulture (1980=100). Period 1980-1996

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14. Use of the FADN for modelling relations between management and firm results at Belgian glasshouse holdings

Ir. Nicole Taragola [1]

14.1 Introduction

Since the beginning of the nineties profitability of Belgian glasshouse holdings is decreasing. Despite of this negative tendency at sectoral level a great variability of the financial results at individual firm level can be observed at the holdings belonging to the Farm Accountancy Data Network (FADN). This intrasectoral variability seems to be independent of firm type (Van Lierde, D. & Taragola, N., 1997a).

Research in the sector of Belgian endive and tomatoes (Taragola, N., 1993, 1997; Taragola, N. & Van Lierde, D., 1996b) and the sector of azaleas and begonias (Van Lierde, D., 1997) proves that innovative holdings able to produce high quality products at a competitive cost price still have perspectives for the future.

In order to survive in a world of growing competition it can be expected that the management abilities of the glasshouse growers will become more important (Taragola, N. & Van Lierde, D., 1998). These skills are not only significant at technical level but also commercial, financial and personnel management is becoming of growing importance at glasshouse holdings.

Research from Germany (Hinken, J. 1975, 1977) and the Netherlands (Alleblas, J.T.W., 1998; Boon, I., 1988; Bots, J.M., 1991; Niejenhuis van, J.H. et al., 1993, Ziggers, G.W., 1993, Trip, G. et al., 1995) gives evidence that the management level is an important factor in explaining intrasectoral differences in financial results. This means that within a certain sector the financial results of the holdings are greatly influenced by the management level of the firms. This leads to the hypothesis that it is more meaningful to focus on good and bad managers than on good and bad sectors.

Despite of the growing awareness of the importance of goals, objectives and personal characteristics of farmers, styles of farming, decision making processes and information requirements on the farm (e.g. Beers, G. et al., 1996) scientific research in this field is lacking in Belgium.

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14.2 Objectives of the research

Multiple objectives can be distinguished:

- get a picture of the management level of Belgian glasshouse holdings;
- provide insight into the relation between personal characteristics (age, education, personality, objectives, ...) of the firm manager, internal and external firm characteristics (firm type:vegetables or ornamental plants, economic dimension, modernity, governmental legislations, ...) , quality of the management process and the financial performance of the firm;
- prediction of financial success on the basis of non-financial criteria.

14.3 Research model

14.3.1 General management theories

The starting point of our research consisted of exploring a general management approach to management of glasshouse holdings. For this purpose general management theories were reviewed. The classical management theories are unified theories valuable for every situation. They can be divided into two categories depending on the management problem concerned.

1. *External relations or strategic management*: outline of objectives and strategies. Two important theories are the strategy theory and the environmental theory. The strategy theory focusses on continuity of a firm in a complex and changing environment. The development of a competitive strategy is not only important for big organizations but also for small enterprises including horticultural holdings. As an example of the importance of strategies at horticultural holdings one can refer to the analysis of different competitive strategies in the sector of tomato production in Belgium (Taragola, N. & Van Lierde, D., 1998). In the environmental theory the environment of the firm is considered as an 'independent' factor influencing the organization of the firm. By means of the information process the firm manager will be informed of the functioning and strength of external factors.

2. *Internal relations or tactical and operational management*: converting the strategies into middle and short term plans, including the management and execution of the processes in the organization. Important theories are the scientific management, the human relations theory, the management process theory, the decision theory, the revisionism, the neo-classical school and the contingency theory. The contingency theory is a theory used in recent research. According to this theory the right behaviour of managers is depending or 'contingent' on a number of variables, e.g. size of the firm, used technology, environment ('insecure' and 'turbulent' versus 'predictable' and 'stable') and individuals (managers have to adapt their management style to the characteristics of their employees). As a consequence actually the >unified= classical theories are loosing more and more ground.

14.3.2 Management of Small and Medium Enterprises (S.M.E.)

Most of the management theories describe the management of big enterprises. The Belgian glasshouse holdings however are familial S.M.E.=s. An important difference to big enterprises is that the firm manager is not only responsible for the management of the holding but is also the owner of the holding. The owner-manager has a central position in the management process and is not only responsible for all management functions (production, personnel, financial, marketing),... but is also involved in executive activities.

Because of the dominating influence of the firm manager according to different authors management research of S.M.E.'s needs a specific approach (Donckels, R. et al., 1997). The decision of the firm manager to start or take over a holding or to extend his holding is greatly influenced by his personal values, attitudes and objectives. Researchers have to be aware of the duality between the family and the holding. Familial objectives are not always in accordance to business objectives (Donckels, R. & Frohlich, E., 1991).

14.3.3 Personal characteristics of the firm manager

The personal qualities of the firm manager are a critical factor in explaining the success or failing of a company. Results of S.M.E. research show that the most important causes of bankruptcy are due to personal characteristics and shortcomings at the level of the management. Critical success factors are the educational level (in particular management training) and the years of experience of the firm manager before starting up a firm (Claessens, D., 1982, Donckels, R. et al., 1997).

Besides the personal traits also personal values, attitudes and objectives are important in explaining the management and financial performance of the holding. Elhorst (1990) remarks that prudence is called for judgement of the management capabilities of the firm manager on the basis of the financial performance of his firm. A low financial result is not always an indication of a low management quality, because other than financial objectives can be important for the farm manager. The importance of objectives of the firm manager is also investigated by Alleblas (1988).

14.3.4 Research model

On the basis of the contingency theory and theories of S.M.E. management a research model is set up permitting to determine the relations between the management process quality, firm and firm manager characteristics and financial performance of the firm. The model is presented in figure 14.1.

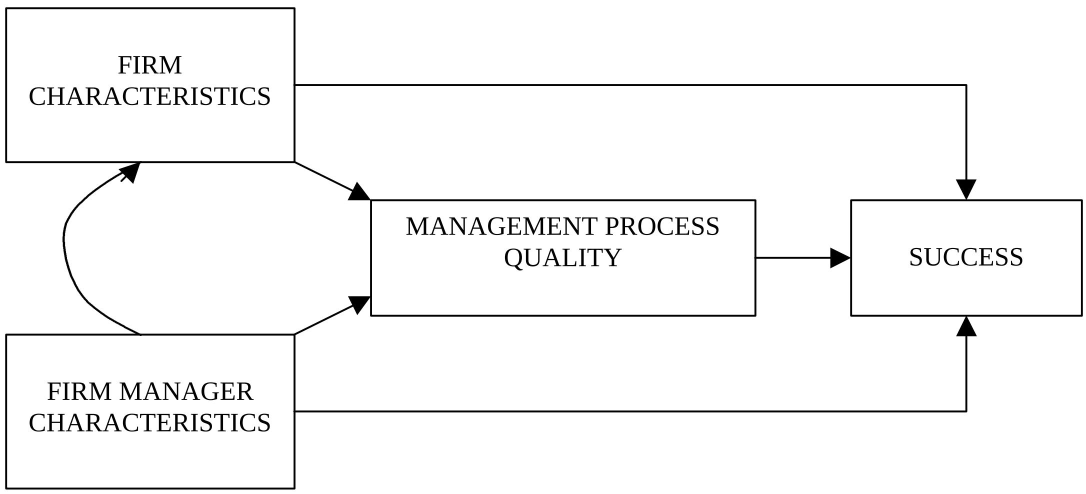

Figure 14.1 Conceptual model of the relations between firm characteristics, firm manager characteristics, quality of the management process and success

14.4 Operationalization of the research model

14.4.1 Firm characteristics

The firm characteristics can be divided into external and internal characteristics. External characteristics can not be influenced by the firm manager. The environment of the firm is an important factor influencing the strategic management and the financial results of the firm. Examples are price developments, governmental legislations, environmental planning,... One can suppose that most of the external characteristics are identical for holdings of a certain firm type located in a certain area.

The internal characteristics however are firm dependent. Internal characteristics are firm type, firm size, modernity of glasshouses, installations and machinery, infrastructure, place of business, year of starting up, life cycle stage (entry, growth, consolidation or exit), solvency, presence of a successor, ... These data must be collected at firm level.

14.4.2 Personal characteristics of the firm manager

Personal characteristics of the firm manager can be divided into biographical, social and psychological characteristics. The biographical variables like age and level of education can be measured in an easy way. This is the reason of their presence in most research. An important variable explaining the success of S.M.E.'s is the experience of the firm manager before starting up the holding (Donckels, R. et al., 1997; Vandenbroucke, A.M. et al., 1997).

The measurement of social variables such as personal values, attitudes and objectives of the firm manager is based on questionnaires. Instruments measuring the social characteristics of firm managers were developed by several researchers in the sector of S.M.E. and agriculture (Alleblas, J.T.W., 1988; Bamberger, I. et al. 1990; Ziggers, G.W., 1993). Gasson N. and Errington (1993) divide the farmers' objectives into four main groups; instrumental (gain, income), intrinsic, expressive and social objectives are distinguished. This classification of objectives was also used by Ziggers (1993).

A third important group are the psychological characteristics. Researchers in the S.M.E. sector (Claessens, D., 1982; Donckels, R. et al., 1997) found that following personal qualities are characteristic for good entrepreneurs: self-confidence, originality (innovative, creative), conscientiousness, oriented to the future, extraversion, taking of risks, flexibility,.... Ziggers (1993) uses the terminology 'competent entrepreneurship'. In many research the personal characteristics of the firm manager are measured by means of self assessment (e.g. Boon, 1987). However the only method to measure personal characteristics in an objective way is the use of standardized psychological tests.

In the 'Edinburgh Study of Decision Making on Farms' (Willock, J. et al., 1998) the NEO-Five Factor Inventory or NEO-FFI (Costa & McCrae, 1992) was used succesfully; significant associations between personality traits and business, environmental and stressed behaviour of the farm manager were found. The results of the research indicate that business oriented behaviour is associated with NEO-Extraversion, NEO-Openness and NEO-Conscientiousness in the personality domain. Environmentally oriented farming behaviour is associated with NEO-Extraversion and -Openness. Extraverts are lively, active, talkative, optimistic individuals. At the other end of the continuum is the introvert who is characterized by reserve, independence and shyness. An open individual is characterized by imagination, intellectual curiosity and preference for variety. Those at the opposite end of the continuum are more conventional persons with a narrower range of interests. The ability to plan, organize and self achieve are the domains of conscientiousness. At the other end of the continuum lies the more easy going carefree individual.

As the NEO-Five Factor Inventory is also available in the Dutch language (Hoekstra, H.A. et al., 1996) the possibility of using this method in our research, in cooperation with psychologists, is considered.

14.4.3 Management process quality

In order to determine the quality of the management process a diagnosis instrument is developed. The questionnaire is set up on the basis of literature and consultation of experts. Remarkable is that also some horticultural growers are involved in the development of the questionnaire. In figure 14.2 the structure of the questionnaire is presented. In the diagnosis instrument three management processes (strategic management, tactical management and operational management) and four management functions or areas of application (production management, commercial management, personal management and financial management) are represented. An advantage of the structure is that down and across scores can be calculated permitting to evaluate each of the management processes and management functions.

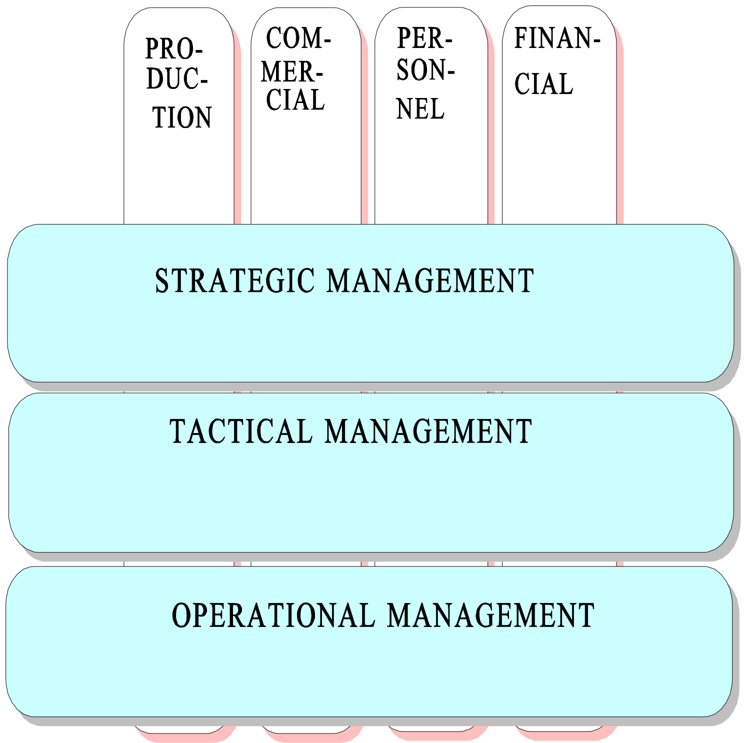

Figure 14.2 Structure of the diagnosis instrument for measurement of the quality of the management process at firm level

14.4.4 Success

The success or financial performance of the holdings is measured by means of financial indicators. Preference is given to financial data over a longer time period. These data must be collected at firm level.

14.5 Appropriateness of the FADN for modelling the relations of the research model

14.5.1 PACIOLI and RICASTINGS project

One of the objectives of PACIOLI is the stimulation of the use of FADN data. Interviews with the stakeholders within the framework of the RICASTINGS project indicated that the cost efficiency of the FADN can be improved if more use is made of the data (Bont de, C.J.A.M., 1998). The use of FADN data in our research model is an opportunity to increase the value and the cost efficiency of our FADN.

14.5.2 Type Y FADN; low marginal costs of collecting additional data

One of the conclusions of the PACIOLI 2 workshop, consisting for a great part of the analysis of the process models and stakeholders of the European FADN's, is that two archetypes of FADN's can be identified within the European Union, labelled type X and Y (Poppe, K.J. & Beers, G., 1996). The Belgian FADN is a Y type, which means that the data are collected by the own staff, leading to relatively higher costs but also to data with a higher value (Van Lierde, D. & Taragola, N., 1996). Usefulness of the data in the Y system is higher, especially for research. As the marginal cost for collecting additional data is relatively low, the FADN seems to be an appropriate instrument for our research.

14.5.3 Sample size

A great part of the empirical research published in the field of management and decision making is based on a small sample of holdings. This implies that the reliability of the statistical analysis is often very low. In PACIOLI 2 it was mentioned that accounting is not a favourite pastime of farmers. Also filling out of questionnaires does not seem to be a very popular activity of farmers, leading to low response rates in many research. In order to draw conclusions with a sufficient reliability in our research the sample consists of 150 glasshouse holdings, which is higher than the number mentioned in other research (Alleblas, 1988: 65 holdings; Boon, I. 1988, 29 holdings; Bots, J.M., 1991: 8 holdings; Ziggers, G.W., 1993 : 39 holdings).

14.5.4 Sample representativeness

The holdings belonging to the FADN are selected on the basis of a stratified sample plan (Van Lierde, D., 1986 b). The holdings of the population and the sample are stratified according to firm type and economic dimension allowing to estimate the profitability of the different firm types with the same degree of precision. The determination of the firm type is based on a classification system for Belgian horticultural holdings (Van Lierde, D., 1986 a). In the classification system the European Farm typology is adapted to the Belgian situation. Especially for glasshouse holdings the most common types of glasshouse cultures (for example azaleas) are represented. Every year the sample plan is actualized in accordance with recent evolutions of firm structure and dispersion of firm incomes.

As in our research the relation of firm characteristics (firm type and economic dimension) with personal characteristics, management process and financial performance will be investigated, the sample of holdings in the FADN seems to be useful.

14.5.5 Indicators of firm and firm manager characteristics

In the workshop PACIOLI 5 (Beers et al., 1998) the participants discussed the content of the new Farm Structure Survey of EUROSTAT. From his experiences the representative of EUROSTAT (Selenius, J.) stated that questionnaires must not be too long in order to guarantee the quality of the answers.

An advantage of the use of the FADN in our research is the availability of a set of indicators on the firm structure (area, modernity of glasshouses and installations, investments, cultivation plan, ...). Also some characteristics of the firm manager (e.g. age, education, year of starting or taking over of the firm) and his family (e.g. professional activities of the spouse, number of children) are already available in the FADN. Because of the presence of these data in the FADN the questionnaires in our research can be shorter, facilitating the task of interviewers as well as respondents.

14.5.6 Financial indicators

An important purpose of the research is to model the relation between the quality of the management process and the financial performance of the firm. However in many research problems dealing with the collection of financial data are mentioned.

For many researchers fiscal data are the only source of information indicating the financial performance of the firm. In exploring the relation between management and financial result at holdings producing pot plants Bots (1991) and Ziggers (1993) had to be satisfied with fiscal accounting data, which were the only financial data available on the holdings. The researchers had to correct the data by themselves (calculated interest on equity, calculated wages for the firm manager and his family, correction of non-farm output and input,...). Also the same problems were mentioned by Boon (1988). Moreover the researcher was obliged to relate the results of a management inquiry conducted in 1987 to financial data of the years 1983 to 1985 because more recent data were lacking.

Other researchers do not dispose of financial data at all. This is the case in many S.M.E. research. In this case direct questions asking for the income level or class of income must be included in the questionnaire. In the research of Hornaday and Wheatley (1986) the relation between managerial characteristics and the financial performance of small businesses was investigated. Questions dealing with financial data asked the respondent managers to select figures that were 'closest' to the data from a set of tables. In the STRATOS project, conducted by an international team of researchers (Bamberger, I. et al., 1990), the relation between the objectives, values and strategic orientation of the firm manager and the financial result of the firm was investigated. However objective financial data of the firms were not available. Consequently the data used in the research were subjective data delivered by the respondent manager. The question arises if subjective data are a good alternative for the lack of objective data. An answer to this question was given by prof. De Schoolmeester, D. (1997; Vlerick School voor Management, University of Ghent). Under his supervision a research was conducted in the Flemish sector of textiles which lead to the conclusion that a subjective interpretation of the income does not correspond to objective income data (Vandenbroucke, A.M. et al., 1997). Accordingly objective financial data are preferred to subjective data to measure the financial performance of a firm.

It may be clear that an important advantage of the use of the FADN in our research is the availability of reliable financial indicators.

14.5.7 Longitudinal data set

A characteristic of the Belgian FADN is that there is no rotation system of the holdings belonging to the sample, contrary to the system in the Netherlands. This means that in Belgium a holding can stay in the FADN for a long time. This system has its advantages as well as its disadvantages.

The reason for the rotation system (replacement of the holdings in the sample every five years) in the Netherlands is the avoidance of the 'learning effect'. This means that it is supposed that holdings belonging to the sample for at least five years will have better financial results than the other holdings of the population. However it seems impossible to prove that the financial results will become better because of the membership of the FADN.

Moreover in Belgium bookkeeping is more common at horticultural holdings. Farms are obliged to have an account for management purposes in order to get interest subsidies for new investments. According to the Census of May 15th 1997 of the National Institute of Statistics 1.212 of the 1.684 holdings, or 72 percent of the holdings specialized in ornamental production (pot plants, azaleas, cut flowers and other flowers) declare to have a bookkeeping for management purposes. At holdings specialized in production of glasshouse vegetables this is the case at 745 of the 969 holdings, or 77 percent of the total.

An advantage of the Belgian system is the availability of a longitudinal data set, allowing to follow the evolution of technical and economic parameters over a longer time period. The lack of a longitudinal data set is a problem mentioned by Alleblas (1988), who did not dispose of a longitudinal set of financial data in the Dutch FADN. The holdings observed in his research were belonging to the FADN sample only for a short time period. For this reason only the relation between management and output per unit of area could be investigated. However the financial result of a holding is not only determined by the output, also the input per m5 and especially the output/input ratio is of importance. The 150 glasshouse holdings selected for our research are belonging to the FADN sample for at least five years (a great part of them even ten years or more!).

14.5.8 Process-content interactions

Many management studies focus on either process or content issues, but not on both of these areas. However some researchers have argued that the interaction of process and content should be explored (Olson, P.D. & Bokor, D.W., 1995). The FADN seems to be the ideal instrument to investigate these interactions as most variables representing the content of management decisions (e.g. investments, cultivation plans,...) are already available in the data set. A central part of our research consists of determining the quality of the management process based on interviews of the respondents at a certain moment. However the use of FADN data makes it possible to determine the association between the quality of the management process and the content of the management decisions made by the firm manager during a longer time period of at least five years. An answer can be given to the question of the necessity of a high quality management process as a guarantee for good management decisions.

14.5.9 Quality of the collected data

The interviews will be conducted by the bookkeepers, who visit the holdings frequently during the year. It can be expected that the relationship between the bookkeeper and the firm manager, based on trust and confidentiality, will improve the quality of the answers.

14.6 Conclusion

Modelling relations between management and firm results needs the collection of a wide range of data at firm level. As filling out of questionnaires is not a favourite pastime of many farmers problems of data collection are mentioned by many researchers. Consequently research conclusions are often based on small samples leading to a low reliability of the results.

Another obstacle is the problem dealing with the collection of financial data. For many researchers fiscal data are the only source of information; others do not dispose of financial data at all.

An advantage of the use of the FADN in research models is the availability of a longitudinal set of indicators on firm structure, characteristics of the firm manager and his family and financial performance of the firm. The marginal cost for collecting additional data is relatively low. Also process-content interactions can be investigated.

It may be clear that the use of the FADN for research purposes gives a lot of advantages. A stimulation of the use of FADN data in research models is not only advantageous for the researcher concerned but also for the FADN. The use of FADN data in research models is an opportunity to increase the value and the cost efficiency of the FADN. The concerted action of PACIOLI, bringing together scientists responsible for the development of FADN's and users of FADN data seems to be a step in the right direction.

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15. Quality management [1]

Gunnar Larsson [2]

9.1 Introduction

The FADN managers and the stakeholders have indicated that the quality in FADN is not sufficient and the quality in different Member States is not documented. Hence, when producing data a lot of time may be spent on how to measure and estimate statistical characteristics. When using data a lot of time may be spent on how to interpret data. In both cases financial resources are wasted. Harmonization and standardization in FADN can increase cost effectiveness. This makes it possible to improve quality and/or reduce costs! This is the background to this proposal on Quality Programme for a new farm return.

First of all, quality has to be defined. The most relevant norm for definition of quality is the ISO 8402, which in fact, is used explicit or implicit by all statistical organizations. This norm states that: '*Quality is the totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs'*.

This definition of quality can be used for formulation of a broad *quality concept* for the new farm return. Although the FADN provides not only statistics but also, and more important, a database for policy research, the European Statistical System provides an excellent reference for quality management, also because FADN data have as much as possible to be comparable with statistical data.

If information on quality and on cost is available for all phases (or almost all) of the statistical production process, it is possible to design an optimization model. This leads to more effective management of follow-ups, data editing, imputation, etc. This kind of information would be the appropriate base for allocation of the budget.

Below a summary of the different parts is given concerning quality guidelines, yearly quality reports, training of staff, exchange of information and standardization of documentation. A more detailed description with references can be found in a working paper.

9.2 Quality guidelines

A precondition for a successful quality work is a well-defined quality concept, and that goals are set for each quality aspect. The quality concept proposed for a new farm return is built on the recent developed quality concept for statistics from the European Statistical System and focuses on seven main components:

- relevance;
- accuracy;

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- timeliness and punctuality;
- accessibility and clarity of the information;
- comparability;
- coherence; and
- completeness.

Each of the main quality aspect can be divided into a number of sub-components. The quality aspects described below can be used as input for standards and recommendations on definitions, statistical methods, quality controls etc. in a new farm return.

Below the main aspects/areas are pointed out for which detailed quality guidelines can be worked out in a new farm return.

Classification of users and the strategic importance of the users

In PACIOLI 2 the classification and importance of the FADN stakeholders were discussed. In order to compare between Member States the following subjects were analyzed: Provision of data, Finance, Determination of contents and Users of the data. This is a tool for describing stakeholders. Other sources for describing users of FADN data are the survey and the interviews in this feasibility study.

Methods to measure users' needs

The relevance of the FADN and areas for improvement have to be measured on a regularly basis. Different methods and sources can be used, for example: publication sales, frequency of references to FADN material balanced score card, and number of enquiries. By asking users to grade services and products along a number of different items it is possible to measure what quality aspects are of the most importance for them. By the use of Quality Satisfaction Performance (QSP) models it is possible to put numerical values on the satisfaction, so called *customer satisfaction index*, and to calculate the relative importance of different quality factors. Depending on user category different kind of methods can be used and different kind of information asked for.

Sampling errors

The procedures for selecting farms according to the different stages of probability/ non-probability sampling and calculation of sampling errors (for example the variances and the coefficient of variations for the most important statistical measures). Also the principles for describing the sample fractions for each stratum and the balance of the sample within each stratum compared to the population have to be worked out.

Non-sampling errors

Principles for evaluation and calculation of frame errors (over and undercoverage according to threshold misclassification), measurement errors (reporting units, medium and interviewers), processing errors (due to data capture, data codification, editing etc.), non-response errors (reasons for non-response, patterns of non-response, unit-and item non-response rates, rate of absence form administrative files, non- response rates for different stages of substitution, weighted response rates, methods for adjustment etc.)

Standardized way to collect provisional data

Without a standardization it will not be possible to achieve comparability between Member States (an important task is to evaluate the accuracy of data with different concepts for data collection).

Information on production processes

Data for description of the national production processes (for example dates for data collection and quality checks) and the EU production processes (dates for transmissions, quality checks, adjustments, availability in database, and publications).

Dissemination processes

Forms for dissemination of statistics (paper dissemination, general digests, CD's, Internet, etc.), additional documentation (see 9.5), clarity of the publications and the information services in Member States and at EU level.

Comparability over time

Description and evaluation of direct changes (in for example laws, new regulations, and new methods for data collection) and changes in structure (for example mergers/demergers of farms).

Comparability over space

Description and evaluation of divergences of the national statistical concepts from European concepts. An example is differences between Member States in reference periods. Those differences disturb the comparability. The main reason for differences in reference periods are differences in farmers accounting years to some extent depending on taxation rules.

Capital cost is an important part of production costs. Inventories and valuation of machinery and buildings, models for calculating depreciations heavily influence the results. Measuring methods for labour input, definition of AWU, pricing of stocks etc are other important issues.

Coherence with other statistics

Coherence of FADN statistics with Farm Structural Surveys, IAHS and EAA. Probably the coherence between FADN statistics and FSS is fairly good, but the recalculation in FADN of type and size of farms can cause differences between FADN and FSS.

The need for comparisons and linking between FADN and IAHS can be an important question in future. An important task is to harmonize definition of holdings and income sources. Non farm income in IAHS can perhaps be coherent with farm income in FADN!

In principle FADN statistics can be coherent with EAA. If the FADN sample is big enough and representative FADN data could be grossed up to macro level.

Definitions on a farm, typology, AWU and other basic concepts ought to be co-ordinated between DG VI and Eurostat. A task force is proposed for

working out quality guidelines for FADN. It could also try to improve the harmonization in agricultural statistics.

9.3 Yearly quality reports

Most of the information asked for in such a quality report can be used as indicators of quality and relative easily derived from the processes for production of statistics, for instance from the selection and implementation plans. However, for some of the quality aspects special evaluation studies have to be conducted (mainly for quantification of the non- sampling errors) in order to be in a position to give quantitative assessments of the quality. There is a strong link between the quality of statistics and the resources available to produce them. An assessment of costs should be kept in mind during the quality evaluation process. Therefore, some of the requested information can be gathered on a yearly basis, while other information has to be collected on a multi-yearly basis.

Costs for fulfilling the needs for quality measurement in each Member State have been estimated to 12 man days each year (routine costs) and to 65 man days if all the information should be collected a specific year (intermittent costs).

At the end of the year Member States deliver input to A3 including:

- results from user satisfaction surveys;
- progress in quality work (contents, accuracy, timeliness etc.);
- selection plans and reports on implementation.

A task force should be installed to work out the content and routines for the Quality Report for FADN.

9.4 Training of staff

An important quality aspect is organization of training in the member states of the persons working in the collection, checking, processing, analysis and transcription of bookkeeping data for farms in the FADN sample. This may involve field workers, accountants, IT staff, agricultural economists and managers. Exchange of experiences from the quality work in FADN between the member states is also an important tool for harmonization. The following activities could support the training of staff and exchange of information:

- a handbook for FADN courses for training of staff in the member states can be worked out. The courses can be led by a person from A3 and national FADN experts. Two or more member states could suitably co-operate in courses;
- workshops in connection to FADN Committee-meetings concerning quality work in FADN can be a useful tool to achieve a learning organization;
- compliance audits are organized to foster the exchange of information, to identify strong and weak points of the national FADN and to check if the member state applicates the EUs FADN instructions. A compliance audit could be organized for a member state approximately every 5 years (like visitation committees of universities). The audit team could be a mix of 3 to 5 experts from DG VI, other member states' FADNs and a local (non-FADN) expert. An audit could take 3 to 5 days (depending on the size and complexity of the national FADN).

9.5 Standardization of documentation

Common complaints from users concerning the services have been related to documentation (metadata), because of insufficient or non-existing documentation.

For the users of FADN data it is essential to have information on data quality. This could be obtained by maintaining a *data dictionary* with well- structured documentation, easy accessible for users.

To be able to document statistics in a standardized way, a standard set of metadata (data about data) and paradata (process data) could serve as an instrument. Such a set of data gives the opportunity to use standard labels and texts when documenting data. This implies the needs for standard classification of data contents and standard labels for methods for measurement, but also standards for explanatory notes etc.

An electronic system for documentation facilitates the burden for producers for documentation and provides user of databases with direct access and up to date information.

A standardized system for documentation should aim for:

- user friendly interface;
- flexibility concerning revision, up-dating of information;
- flexibility concerning systems for production and dissemination registers/ databases;
- completeness of information for producers and to satisfy users needs.

Two parts of the documentation system can be separated:

Product system documentation - A tool for the producers of the statistics for organizing data throughout the different steps of the production process (data collection, data processing, estimation, analyzing, system descriptions (data flows, data models etc.). This kind of documentation has the purpose to serve the staff that produces the statistics with sufficient information.

Observation system documentation - A system for documenting the final data sets from the FADN (for dissemination) that satisfy the needs for information for the user of the statistics.

The system for documentation could contain:

- product descriptions (administrative information);
- publication plans and publication catalogues;
- quality reports;
- observation system documentation;
- production system documentation;
- a classification database.

A simple computerized tool, similar to PCDOK in Sweden can be created in order to facilitate the documentation. The tool should be technical simple and embedded in for example Microsoft Word for Windows.

The technical part of the system should be compatible with modern PC- based environments. Powerful relational database management systems are now available (for example Access and SQL-server). If the SQL standard is chosen, certain parts of the metadata are highly structured and can easily be stored in the SQL databases. Less structured parts of metadata can be treated as free text. The electronic tool for documentation can be designed to support formalization of variable description tables, so that user could automatically be transferred to SQL databases.

Internet offers great possibilities for users to get access to data and metadata through a numerous software products.

9.6 Quality control, quality assurance and TQM

The above proposal for measuring the quality is similar to *quality control*. The quality is checked after the production. The statistics can then be either cancelled when the expected quality level (expressed by standards etc.) is not reached or accepted with few direct actions for improved quality. Types of problems are noted and give the possibility for future improvement of quality.

The proposed work out of quality guidelines is close to *quality assurance,* where the aim is to produce statistics with a constant (high-) level of quality. Adapting the production process, the work environment, and improving communication it is generally assumed that the achieved quality level is higher. Standards for quality assurance exist in many countries, and have now become popular under the label ISO 9000.

Further than quality assurance, *Total Quality Management* considers all aspects that may contribute to satisfy users needs. Aspects that, for instance, concern team work, training of staff and exchange of information. One of the fundamental rules in TQM is to create an environment for continuously quality improvement.

Quality assurance and TQM could be further steps, after realizing the proposed quality control. ISO 9000 and TQM, although practices by some of the FADN participants, seems at the moment not feasible for the total EU FADN.

16. 'De Facto': an integrated software program for the Belgian FADN

Ir. Dirk Van Lierde [1]

16.1 Introduction

The developments in agricultural engineering and agricultural policy make that in farm accountancy the data flow increases continuously. The sphere of interest of researchers and policymakers constantly extends, increasing the demand for extra data. To process this data flow more easily and to make a maximum of data available for research, it is a necessary requirement to develop software packages that give the accountants the possibility to introduce the basic data directly into their personal computer. In this way the data can be processed in a more efficient way, more data can be transferred to the central data banks and the control of the data becomes better. A few years ago the Centre for Agricultural Economics already started with the development of such software for his FADN (Van Lierde, D. & Taragola, N. 1996a). At the start of the project only few resources were available and in the following years this resources were even reduced. Nevertheless, to give the project a chance to succeed, there was chosen for a resolute other approach of the project. In this paper this process will be shortly explained.

16.2 The starting position of the accountancy network

The processmodel of the Belgian FADN regarding the collection and the processing of the accountancy data shows large similarity with this of other FADN's (Van Lierde, D. & Taragola, N., 1996b). As shown in figure 1 there are provincial offices were accountants collect the data on participating farms. The accountant processes the data, controls the data and processes them to semi-gross results and writes them down on a file sheet. These file sheets represent in fact the data model of the accountancy. In the Central Office in Brussels, specialized personnel introduce these file sheets in the mainframe computer. It is only from then on the data can be further processed by the computer. All the programs written for the mainframe are based on the datamodel. After the data are entered in the mainframe computer control programs are run and errors are corrected. After this corrections the individual farm results can be drawn up. After closing all the accountancies of the FADN other (mainframe) computer programs can be used for p.e. the conversion of the national fiche to the EC-fiche, the calculation for the profitability reports, the composition of databases with economic criterions, etc.

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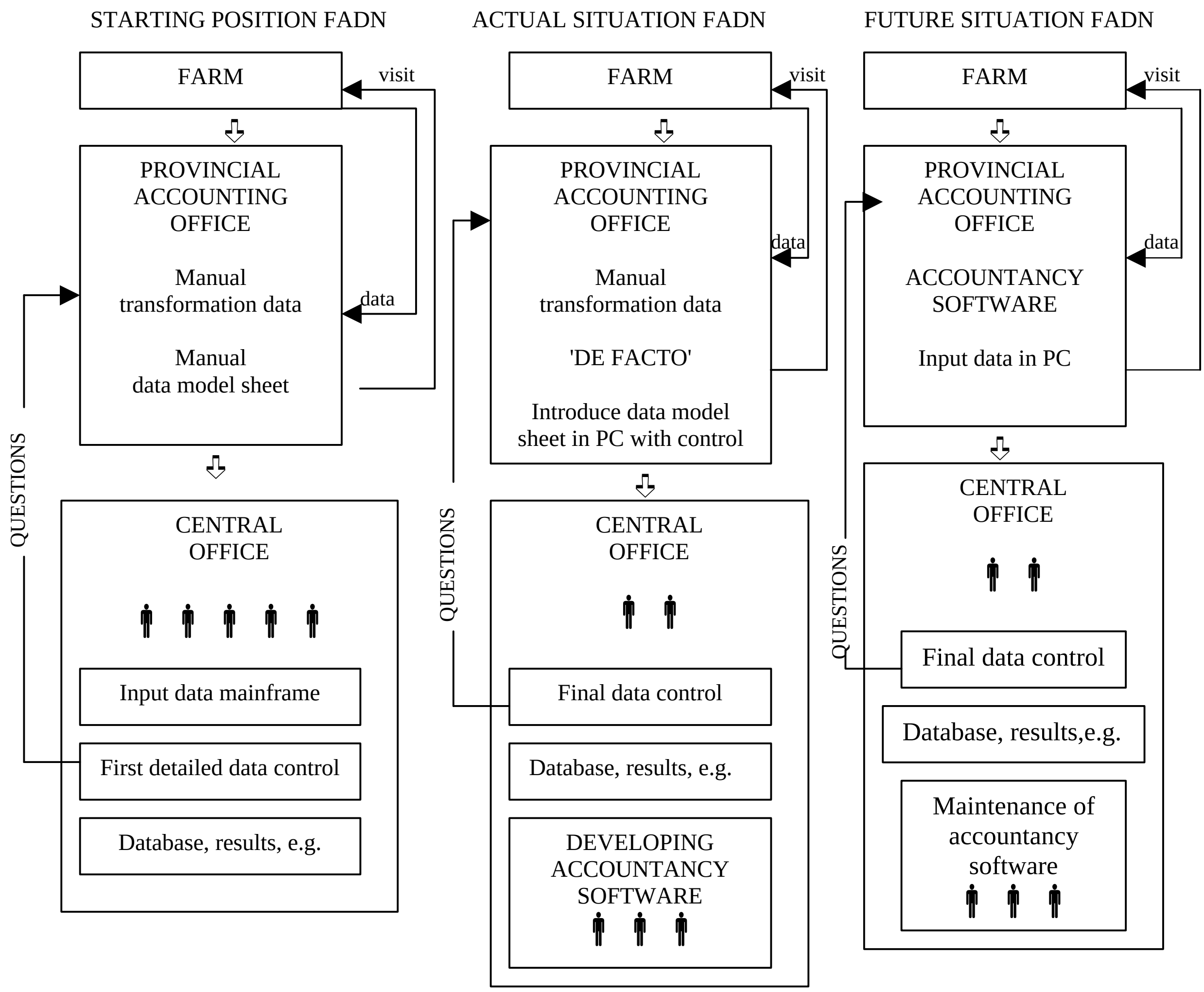

Figure 16.1 Organization of the Belgian Farm Accountancy Data Network at three different times : the starting position, the actual situation and the future situation

Since in the accountancy books kept by the accountants much more data are available than finally registered on the file sheets (data not recorded in the datamodel and thus not available for research), there was decided to develop a software package that offered the accountant the possibility to introduce all the accountancy data in a personal computer. In this way much more data should be available for research, and this method offered the advantage of a better control of the data at the source. A prerequisite for the software package was that it would offer the possibility to reconstruct the actual used datamodel, this is necessary to execute the existing (mainframe-) computerprograms. Later on, after the new software packages are operational and used by the accountants, new databases and datamodels can be developed. Only at that moment the existing (mainframe) computerprograms can be replaced by new software, software that can use the information available in the new datamodels in a more efficient way.

16.3 Developing the accountancy software

With restricted resources the Centre started with the development of the software of the accountancy programs for PC. The aim was to develop flexible software that can easily be adapted by the user to new developments in the collection of data without reprogramming the software (in this case the only user that can adapt the software is the Central Office, this guarantees that all the accountants have the same program functions). The software must be user-friendly, must control as much as possible the data at the moment they are introduced in the personal computer and alert the user on errors. So at the end the developed program must offer the possibility to send the collected data in an adapted datamodel to the Central Office. The software package was divided in a number of modules; the first module was the module dealing with the livestock. In this module a choice is possible between the individual follow-up of animals (p.e. milk cows, suckler cows) or the follow up of the animals as a group (p.e. pigs, sheep). The analyses and the programming of this module were going quite fluent so after a relative short period the testing of the program could start. As was expected the testing of the module asked much more time. Especially the re-testing each time the software was adapted was time consuming because by modifying the software sometimes new (and unexpected) errors could turn up. Soon after starting up the project the available resources were once again reduced. Especially the withdraw of the computer-analyst was 'rather unfortunate'.

In spite of all this a 'beta version' was released and tested by a number of accountants. This testing gave satisfying results and although the program is not completely bugfree yet, the system was used the following year by all the accountants. For this purpose instructions were written (in Dutch and French) and information sessions were organized for the accountants in order to teach them how to work on PC and how to use the software package. This education of the personnel was a task of the Centre itself. The availability of the module 'livestock' was the ultimate argument for liberating funds to buy personal computers for the accountants. The introduction of the new system in nine provincial offices with more than sixty users of the program caused severe logistic problems. The small developing team of the Centre itself had to solve all of these problems. Although other modules were already partially developed it seemed not indicated to continue developing the modules. There were simply not enough people dealing with the project to achieve it.

Under these circumstances it was necessary to change the strategy. First of all a part of the personnel that at the moment is used on the Central Office for the running of the accountancy network, had to be recuperated for the accountancy project. This meant that the activities of the Central Office had to be rationalized, and to assure the good functioning of the FADN part of the work actually executed by the staff of the Central Office should be executed by the accountants in the provincial offices. Especially the introduction of data in the mainframe and the control activities in the Central Office offered opportunities to decentralize. Therefore, the project 'DE FACTO' was started. For the development of this project only a minimum of personnel (1.5 effective) was used, so the rest of the staff could guarantee the good functioning of the accountancy network.

16.4 The project 'DE FACTO'

As the available resources for developing accountancy software were insufficient, other resources must be found. The only possibility for this was to transfer a part of the activities of the Central Office to the provincial accountancy offices. There was decided to develop a software package that gives the accountants the possibility to enter the semi-gross results directly in their PC, to control these data, to send them to the Central Office and to integrate the data of existing accountancy modules in the system (see the actual situation of the FADN in figure 1). This program was called 'DE FACTO', Data Entry for Farm Accountancy with Control and Transfer Operations. 'De facto' is Latin and means 'it is a fact, something has been proven to be possible by just realising it as a fact'. This name was chosen for his symbolic meaning, the program 'DE FACTO' shows indeed (de facto) that the development of an accountancy software for the Belgian FADN is possible. If the necessary resources are available the development of the project will be successful. Such investments can be earned back many times by the new possibilities that are offered for research and policy purposes. Another, more practical, advantage of choosing a Latin name is in a country like Belgium, with three official languages, evident.

The development of 'DE FACTO' gave us the opportunity to give an additional training to a member of the staff in computer programming so he will in the future be able to follow up the project of developing accountancy software at the software firm. Further there must be noticed, that the introduction of the program 'DE FACTO' was only possible because, as a result of the development of the module 'livestock', a computerpark was bought for the accountants. Finally there must be noticed that two versions must be developed, namely one for the Agricultural farm accountancy network and one for the Horticultural farm accountancy network. Both programs have the same framework but rely on two different datamodels so the programs and the controls are completely different.

In short the different possibilities of the program 'DE FACTO' are explained.

16.4.1 Data-entry

- The accountant no longer needs to fill in the semi-gross results on file sheets; there is no need to enter the data of the file sheets in the (mainframe) computer in the Central Office. This means a saving of personnel.
- The software package was developed in this way that the layout of the old file sheets was completely followed. This excluded adaptation problems for the accountants.
- the program has as output to the Central Office the datamodel that is used in the (mainframe) programs.
- Because no file sheets have to be filled in, errors are avoided by copying the data from the accountancy files to the file sheets, errors are avoided by the introduction of data from the file sheet to the computer by the personnel of the Central Office (illegible data, typing errors, etc.). Such errors are difficult to discover and so very time consuming.
- The program can be easily adapted to extra accountancy data. For example : at the moment there is asked for the units of chemical fertilizers per crop, these data were not available on the former data file sheet.

16.4.2 Control of the accuracy of the accountancy data

The data that were entered in the PC, are subjected to a thorough control in the provincial offices, so the data sent to the Central Office contain only few errors. This simplifies the work of the Central Office and release resources that can be used for the development of the accountancy package. A part of the controls takes place at the moment the data are introduced in the PC. These controls are quite restricted. A much more extended control program is executed after all the data of the farm are introduced in the program. This control program replaces the controls that for the moment are done at the Central Office.

Control at the data entering stage

- The interface is developed this way that a number of controls are executed at the moment the data are introduced by the accountant. For example, the accountant can only enter existing codes and the cohesion between the introduced data is controlled;
- During the introduction of the data the accountant receives information on the screen that gives him the possibility to test the accuracy of the data that he introduces. So for the crops p.e. all the costs and yields per hectare are calculated and displayed on the screen, also the average prices of the products are shown. This makes a first control of the introduced data possible and that at the moment of introducing the data.

Control after the closing of the accountancy

When all the accountancy data of the farm for a financial year are introduced, the accountant can select in the selection menu an item that executes a control program. In this control program a series of controls are executed and the accuracy of the accountancy data is tested. The controls that indicate an error or that indicate some data that must be checked more thoroughly are saved in a file and can be viewed one by one by the accountant. The accountant can see on screen (or print) a description of the test, he also can see all the values of the data that interfere in the test.

The controls are divided into three levels. The levels go from fatal errors to errors that indicates that the data are probable wrong, or are divergent from normal values and need a further control. The three levels are shown on the screen in four different colors. Fatal errors always indicate data that are really wrong and that have to be corrected before the financial year can be closed definitely (p.e. the total costs and yields must always be correct). The other controls ask for a thoroughly investigation by the accountant, if the data appear to be correct then the accountant must enter an explanation for that test in the P.C.. This explanation goes also to the Central Office where it permits a better evaluation of the data.

The control program counts a lot of tests (more than thousand). A lot of these controls test if the values of the data are situated in an interval of acceptable values, p.e. if the litres milk per milk cow are not to high or to small. To control all this a lot of limits must be entered each year by the Central Office. Besides the program is developed this way that for every item that is controlled four limits are available, namely two data for the minimum and two data for the maximum. The largest minimum and the smallest maximum give the interval wherein the data should normally be situated, if this is not so a suitable explanation must be given (p.e. due to bad climatic conditions a yield can be lower than a normal value). If the data are smaller than the smallest minimum or greater than the greatest maximum then the test becomes a fatal test and the data must be adapted (p.e. the price per litre milk is 100 BF or 2.5 ECU, this is a real mistake that should be corrected, the accountant probably forgot to enter a figure when he entered the number of litres).

If no fatal errors are left, and if for all the other tests that remain a suitable explanation is given then the program offers the possibility to draw up the datamodel for the particular farm and the data can be sent to the Central Office.

16.4.3 Transfer of data

At this moment the conception of the transfer part of the program is very simple. When the accountant selects this option in the selection menu the program checks if no modifications are made at the datafiles after the last execution of the control program. Moreover there is checked if for each control that rests an explanation is given and if there are no fatal errors left. If these conditions are accomplished the program transforms the accountancy data into the datamodel, this is saved in an ASCII format. This file is together with the error files copied on a diskette that is sent to the Central Office by mail. The use of diskettes does not give big problems. In the Central Office there is a program that registrates the diskettes that enter (and thus the identification numbers of the farms in the FADN). It is sufficient to read the incoming diskettes in the diskette drive to registrate them.

In the near future we expect to send the datafiles to the Central Office by Internet. This supposes that in each accountancy office telephone lines of good quality are available and that each accountancy office has his connection to the Internet provider.

16.4.4 Integration with the accountancy modules

At the moment the module 'livestock' is already operational for the second consecutive financial year. After the closing of the financial year the data in relation to the livestock that are collected in this module can be imported in the program 'DE FACTO', so the accountants do not have to copy the data themselves. It is the intention to proceed in the same way with the new accountancy modules that will be developed. After the introduction of each new module the data from this module will be imported automatically in the 'DE FACTO' datamodel. After the introduction of the last module all the data should be provided by the modules and the program 'DE FACTO' will, de facto, disappear.

When developing the accountant modules we aimed for making the different modules as universal as possible. This means that the modules are flexible enough so its functioning can be adapted without interfering in the software (there are however restrictions!). The software is driven by data from databases; by changing the parameters in these databases the working of the software can be adapted. So when the module 'livestock' was developed a datamodel for animals was drawn up. This datamodel contains all the possible events that can occur with an animal in the accountancy system. In the module 'livestock' there are no submodules for the treatment of p.e. milk-cows, fatting-cattle, sows, fatting pigs, broilers, etc. For all these animals the same program routines are used; this routines reflect the events that can happen in the 'accountancy' life of an animal p.e. purchase, birth, giving birth, dying, sale, figuring in stocks, etc. The way this events are handled is different for commercial cattle (for fattening) or productive cattle (producing milk, wool, youngsters, etc.). Animals can be followed as individuals or in group. All this events are programmed in a universal way, this means that the program is not written for a specific category of animals but is written for a datamodel 'animal'. The datamodel 'animal' is only meaningful if one uses a good codification table for the different kinds of animals. These codes are stocked in an external database together with encoded information for the softwareprogram. It is this encoded information that contains the information for the software, so the software can present an adapted layout on the screen and can process the collected data in the right way. The external database with the codes contains the denomination of the category of animals, contains indications whether this category of animals is treated as individual animal or in group, if the animals belonging to this category can give birth, under what conditions this animal can pass to another category of animals, etc. The database also contains information to control the data that are entered by the accountant. It contains for every category of animals information about the normal weight and value (p.e. the weight and value of individual animals are tested dependent on the age and the race of the animals). The database contains also information on the maximum number of youngsters per litter, the minimum age for giving birth, etc. The data in the databases provide the possibility of controlling the data at the moment the accountant encodes them. This improves the quality of the data and facilitates the task of the accountant. In the former system this kind of errors was only detected when all the data were processed in the Central Office, many weeks after the accountant dealt with the data. Finally the module of course executes all the calculations so the accountant can save a lot of work and time.

So it is possible to drive the program without changing the software. One can add new categories of animals, change the properties of this categories etc. without intervention in the software. This would make us rather independent from the developers of the software. Of course the right to modify the databases is strictly reserved to the Central Office so the program works in all accountancy offices in the same way.

At the moment the situation for the accountancy software is as follows:

- the module 'livestock' is operational but it is still necessary to make the module bug-free;
- the modules in relation to the inventory of buildings, machinery, loans, etc. are ready to be tested on a limited scale as 'beta version';
- the modules 'cropping plan' and 'sales and purchases' are developed, but it will still ask a lot of work to test the modules before they can be tested as 'beta version'.

So at the moment a lot of personnel are necessary especially for the testing of the modules. Later on, when the software become operational for the whole accountancy network, a lot of personnel will be needed to introduce the software and to assist the accountants in their first steps using the new software. Besides the development of new software replacing the actual mainframe software will require a lot of efforts.

16.5 Conclusions

The development of software packages for the Belgian FADN is an essential requirement if one wants to have at his disposal a maximum of accountancy data that will be used for research and policy purposes. This requires however an important investment, in practice it was found that the necessary resources were not available. Already at the beginning of this project the Belgian FADN was confronted with a reduction of the (restricted) resources that were provided for the project. Especially there was a lack of staff for the testing of the software and to introduce the system in all the accountancy offices. Therefore we changed our strategy and the project 'DE FACTO' was developed. With this project we aimed at a release of staff for the activities at the Central Office of the accountancy network, nevertheless assuring a further functioning of the accountancy network with maintenance of the quality of the data. This liberated resources that can be used for the development of new accountancy software. At this moment this stage is reached and from now on a further development and testing of the accountancy software should take place. The accountancy software consists of different modules that are introduced step by step. When the modules are introduced the data that are collected in this modules are integrated in the actual data-model via the software package ' DE FACTO'. The ultimate goal is that this package will, de facto, disappear on the moment that all the modules are operational (see the future situation of the FADN in figure 16.1). All the tasks of the 'DE FACTO' software will then be taken over by the different modules. When this is realised still remains the development of the new databases and of the new applications, replacing the mainframe software, for the accountancy system.

The experiences of the Belgian FADN show that it is not always possible to follow the shortest way to develop new projects. The project 'DE FACTO' (Data Entry for Farm Accountancy with Control and Transfer Operations) illustrates this very well. The project has to liberate the necessary resources to develop another more direct project. The project 'DE FACTO' illustrates (at least we hope) that this is possible.

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17. Dynamic Inquiry of Accountancy Data via Internet

Sami Ibrahim and Stephan Pfefferli [1]

17.1 Introduction and Definition of Problem

Approx. 30 accounting and trust agencies across Switzerland produce 4000 commercial annual accounts for farms - accounts which are analyzed centrally at the Swiss Federal Research Station for Agricultural Economics and Engineering in Tänikon (FAT). The results of the Central Analysis of Accountancy Data (ZA) are published annually in 5 printed reports (FAT 1997a-d, FAT 1998). Often, over a period of many years, the users of this data must select information from these reports and enter it into their databases or calculation programs for further processing. With the creation of a dynamic web site (ZA-Web), FAT will put the results of accountancy data of groups of farms at the disposal of Internet users who will be given the opportunity to address dynamic inquiries to the web server, to look at the results in form of HTML-pages, and to download data onto their own computers for further processing.

17.2 Overview of the Application

The system differentiates between 3 categories of users. Depending on the group of users, the inquiry capacity will be either extended or restricted. The system users and their authorization are listed in the following table 17.1

Table 17.1 System Users

Anonymous Internet Users	Restricted inquiry of selective data (arouse interest)
Authorized Internet Users	Inquiry of the database with the accountancy results of the accountancy data of groups of farms
Intranet Users	Identical to that of authorized users, with extended functionality

Illustration 17.1 shows the method applied to process user inquiries.

1. The user fills in a HTML-form and sends the inquiry to the server.
2. The web server launches a common gateway interface (CGI) program.
3. The CGI-program processes the inquiry parameters received and retrieves the data required from the database by means of a SQL inquiry.
4. The database supplies the data requested to the CGI-program.
5. The CGI-program fills the output data into a new web document or makes a file for transmission to the user.

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6. The web server transfers the new HTML-page back to the user or sends the result file to the user, provided a file was made for the transfer.

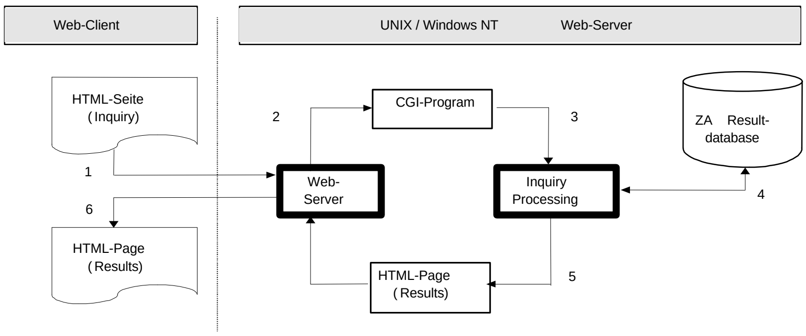


Figure 17.1 Method of processing Internet inquiries

The application has the following interfaces:

- User (administrator and Internet user)
- Database interface

Illustration 17.2 shows the various system users as well as the interface to the database via Open Database Connectivity (ODBC). The customer database is separated from the result database in order to allow a flexible solution to develop. This permits storing of the result database in a Unix system at a later point.

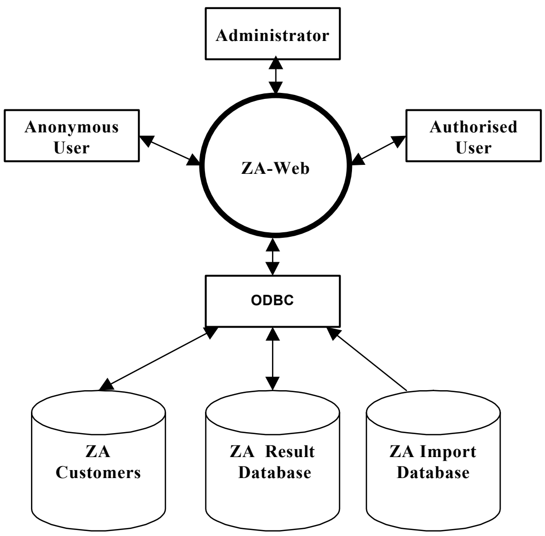


Figure 17.2 Context Diagram

17.3 The Result Database

The result database comprises the following three dimensions: year, group of farms and characteristics. Besides the results of single years, the average of several years can also be stored in the database.

17.3.1 Groups of Farms

The presentation of the results of the Central Analysis of Accountancy Data are made for groups of farms. The formation of groups of farms is based on combinations of the following criteria:

- regional affiliation (plain region/mountain region);
- zone affiliation (re.: illustration 17.3);
- area size (re.: illustration 17.3);
- farm Type (arable farming, dairy farming, animal rearing, etc.);
- production method (conventional, integrated or organic farming);
- type of ownership (owner/tenant farm).

A customary presentation of the results (FAT 1997a) by groups of farms is shown in illustration 17.3. The publication of the results is made for more than 100 different groups of farms.

17.3.2 Characteristics

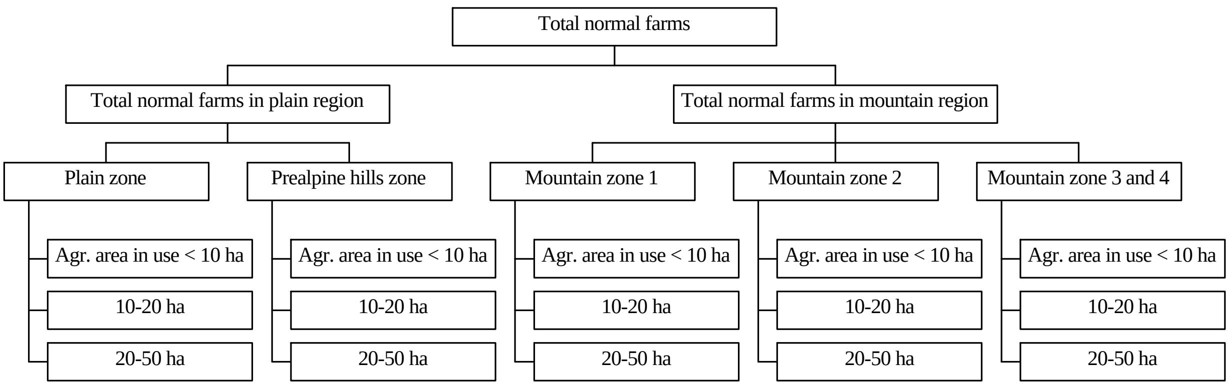


Figure 17.3 Farm groups by zones according to difficult production conditions and Area classification

The user will find approx. 300 characteristics per group of farms in the fields of land use, live stock, labour and family, accounting balances, gross profit, production costs, main results, production branch results, and overhead costs. Per characteristic and group of farms, the average of all farms and, in part, the characteristics of the number of observations as well as the average per observation are available.

17.4 Prototype

A prototype was established in order to achieve the following goals:

1. to enhance the description of the requirements for this complex application;
2. to determine the feasibility and to examine whether the consistency of the reports published to date meets the requirements of a publication in the Internet;
3. to test selected development tools and web technologies with regard to their usefulness for the development of the application;

17.4.1 Configuration

- Development Tools
  - Microsoft InterDev. 1.0
  - Microsoft C++ 5.0
  - Rational Rose 4.0
- Database
  - Access 7.0
- Web-Tools
  - Microsoft Internet Peer Server 3.0
  - FrontPage 98
- Operating System
  - Windows NT 4.0

17.4.2 Data Basis

For the realization of the prototype, the data published in the Report on Basic Elements on land use (FAT 1997a, table A) was selected. This report presents the data grouped by farm type and zones with difficult production conditions. The transfer of this data from the database of the Central Analysis of Accountancy Data to an Access Database was carried out by means of a conversion program.

In the prototype, the attribute 'Unit ' was not used, because it is identical for all characteristics (Aren). The field 'MCD' contains a key for all data imported from the database of the Central Analysis of Accountancy Data. To simplify the programming of SQL-statements, the most important parts of the field 'MCD' were filed under separate fields.

Table 17.2 Land use data according to farm type and zones with difficult production conditions

Name of table	Land use
Purpose	Comprises all data which are part of a particular evaluation report. The data of this table corresponds to the data of table A of the report on basic elements (FAT 1997a).
Indices	**Primary Key** Field: Code Number, ascending
Relations	**Evaluation criteria** Field: valuation [Evaluation Code] to Field: Land use [Evaluation Code] **Area classification** Field: Area classification [Area classification Code] to Field: Land use [Area classification Code] **Regions** Field: Regions [Regions Code] to Field: Land use [Regions Code] **Characteristics** Field: Characteristics [Characteristics Code] to Field: Land use [Characteristics Code] **Groups of Farms** Field: Groups of Farms [Groups of Farms Code] to Field: Land use [Groups of Farms Code] **Statistical Values** Field: Land use [Statistical Value Code] to Field: Statistical Values [Statistical Value Code]

Table 17.3 Structure of table 'Land use' for land use data

Column Name	Type	Size	Description/Remarks
Code Number	Number (Long)	4	Identification key provided by Access
Characteristics Code	Text	20	Characteristics Code = Name of variable in the description of the table of the ZA in the Unix-system.
MCD	Text	14	Key for imported data
Year	Text	6	Year for the corresponding value
Value	Number (Long)	4	Value of the characteristics
Evaluation Code	Text	4	Organization of groups of farms for a particular evaluation criterion
Region Code	Text	2	Geographical Region
Group of Farms Code	Text	2	Code for farm type or Zone with difficult production conditions
Area classification Code	Text	2	Code for area classification
Statistical Value Code	Text	2	Code for statistical value

17.4.3 Data Model

The table 'Land use' comprises the normalized data of the land use of groups of farms, organized according to farm type and zones with difficult production conditions. The description of the various elements of the 'MCD'-field of this table is achieved through relational comparisons with six other tables (illustration 17.4). This makes the entire display of the descriptions pertaining to the values in this table possible. Most of these attribute tables can also be used for tables on other areas (e.g. balance sheet data).

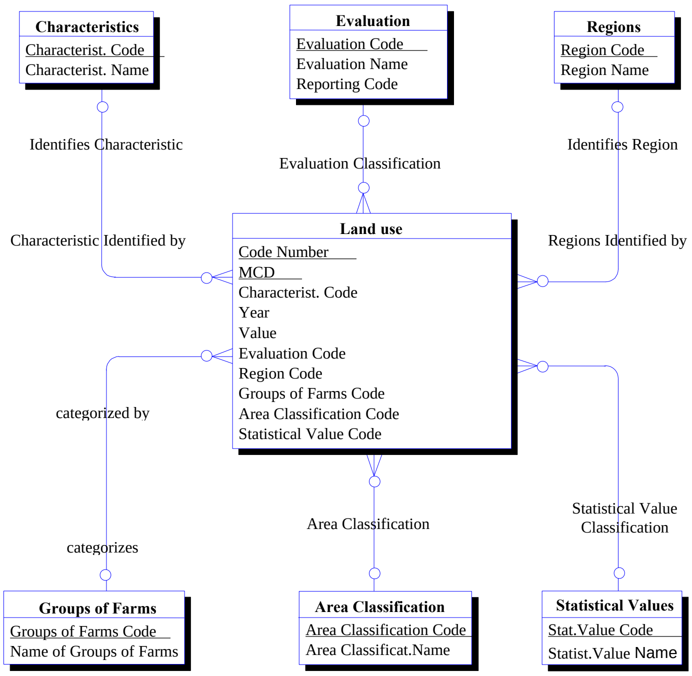


Figure 17.4 Data Model for Land use

17.5 Summary

In future, the results of farm groups of the Swiss Central Analysis of Accountancy Data should be available for Internet inquiries. Data should be accessible for downloading onto PCs for further processing. To this effect, an application is being prepared which will allow users making dynamic inquiries via Internet access to the Result Database of the Central Analysis of Accountancy Data. With the aid of a prototype, the Swiss Federal Research Station for Agricultural Economics and Engineering in Tänikon (FAT) is currently developing solutions to meet the requirements towards such an application and testing the appropriate development tools and web technologies.

References

Results of the Central Analysis of Accountancy Data. Swiss Federal Research Station for Agricultural Economics and Engineering, CH-8356 Tänikon:

FAT,. *Report on Basic Elements 1995*. 309 pages, (German), 1997a.

FAT, *Report on Selected Groups of Farms 1994/95*. 207 pages, (German), 1997b.

FAT, *Main Report on Test Farms 1996.* no. 19. 223 pages, (German/French), 1997c.

FAT, *Report on Organical Production Farms 1996*. 28 pages, (German/French), 1997d.

FAT, *Cost Account Report 1997.* 98 pages, (German/French), 1998.

18. Turning a data model into software; explanation with the Dutch FADN as an example

Krijn J. Poppe[1]

The creation of new software for a renewed Dutch FADN has been explained with the following transparancies:

Transparency I

ACCOUNTING 2000: RENEWAL OF THE DUTCH FADN

TRIGGER FOR INNOVATION:

SPAGHETTI-SOFTWARE
- High Maintenance costs
- Inflexible

Transparency II

TRENDS WITH STAKEHOLDERS

- From farm-type to sector (Agri-Horticulture).
- More physical data
- Actual in stead of historic (Quarterly, Questionnaires)
- More competition
- Hard to predict specific policy research questions

Transparency III

THE PROJECT

[1] Agricultural Economics Research Institute, P.O.Box 29703, 2502 LS The Hague, The Netherlands.

Introducing New working methods for FADN

'Accounting 2000'
FADN→ Farm Information System
With Up to date information

Tranparency IV

PROJECT MANAGEMENT:

Management by LEI

Outside Consultants for expertise

Internal Input to do the work and learn

Investment (ƒ 8 million.)

Transparency V

STAGES working methods IT-Development:
- Information strategy planning (Quick Scan/feasibility study)
- Business area analysis: information/data analyses
- Business System design (administrative and information system)
- Technical development and construction

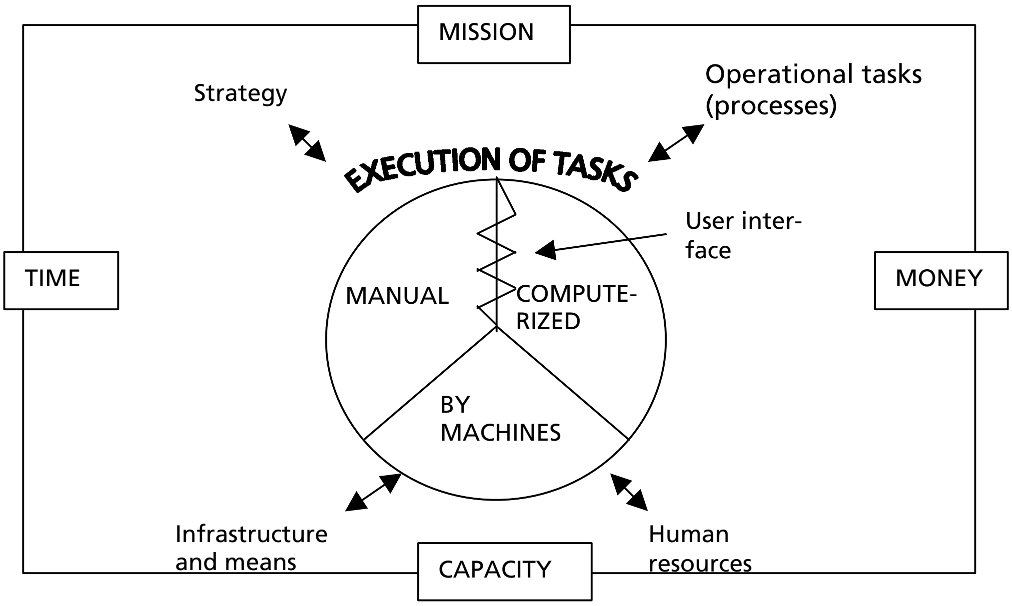


Figure 18.1 Influences on the design of the execution of tasks
Source: Based on Vellekoop & Meesters, Hoevlaken.

Developing information systems can be divided into four major steps:

- *information strategy planning* (also called a quick scan or a feasibility study). In this stage the mission and strategy of the organization are translated into the strategy for the information systems. If for instance the analysis of the strategy of DG6 learns that policy topics are changing more rapidly, this asks for more flexible information systems. In the strategy planning stage the major activities (functions) of the organization are described, as well as the main data items ('objects'), which results in business areas (like data management, policy analysis);
- *business area analysis*: the detailed analysis of all the activities (processes) and data that are part of a certain business area. Central is the 'what-question': what data are needed and what activities are carried out. How this is done (by hand or a computer-device) is not important, and an error-free world is assumed. This makes the analysis easier and results in a model that is stable over time, as it is not dependent on technology but only on the strategy of the organization in relation to its environment
  Data modelling is an important tool in this step. In the case of relational data bases a conceptual data model (entity relation diagram) is created;
- *business system design*: a detailed design of the procedures and data in a certain business area, with an eye to the working methods that will be installed. Choices of technology options, in relation to expertise available, are important. The 'how-question' is central (figure 1). Sometimes alternative procedures for the same process are developed (e.g. sending data on paper or by Internet). For computers the system design and the screen dialogue are important issues. For manual tasks, handbooks with instructions have to be written. The assumption of an error-free world is abandoned in this stage, and prevention methods (like control programs, instructions for back ups) are designed for man and machine;
- *technical development and construction* (followed by maintenance): this step involves the realization with activities like purchasing hard- and software (if available on the market), installing and programming.

Transparency VI

Results Information Strategy
Client oriented:
Management contract
Balanced Score Card (as a service level agreement)

Decentralise software

Be actual based on EDI (monthly, quarterly)

Don't aggregate data items (use cheap data storage and processing capacity)

Stronger central data management (re-use)

Uniform but flexible:
The new system will be constantly changing

Transparency VII

Effect on IT:

Make tools to support the constantly changing system

- datadictionairy with constantly changing data items and documentation (meta data)
- screen-generator for constantly changing data entry methods (new data items, EDI)

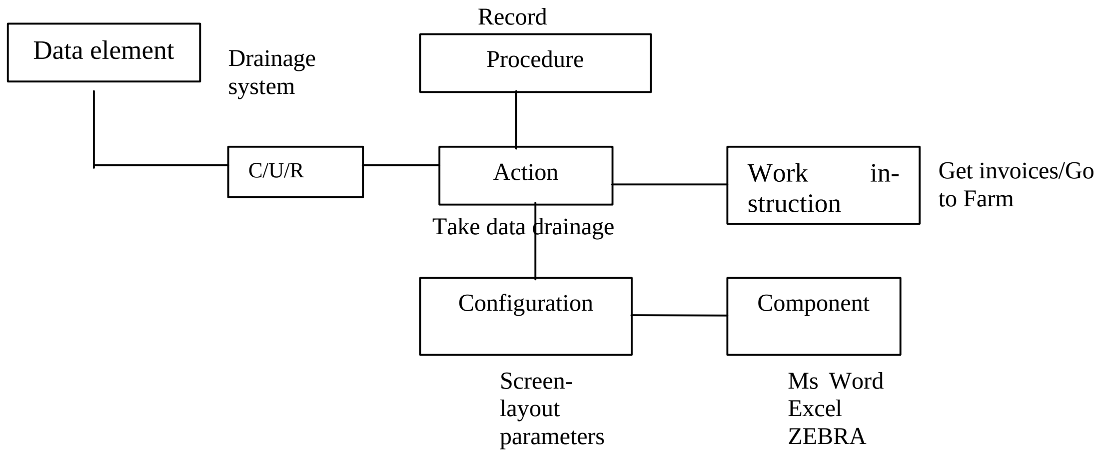
Choice for Object oriented programming and database (Gemstone database, Visual works)

Data entry directly on the database (one network with ISDN lines or GSM portables to 16 regional offices)

Transparency VIII

TOOL TO SUPPORT BUILDING PROCEDURES:

ARTIS: Agricultural-economics Research Tool with Information Induced Software (data management)
PAUW (procedure management)



Transparency IX

BUSINESS AREAS:

* Product management
* Selection and recruiting
* Data gathering
* Data recording
* Information production.

Transparency X

Progress (November 1998)
Central software: ready
Data gathering:
    procedures nearly ready for EDI banks.
    Manual with data recording
    Rest to be developed next years

Data recording:
    System design available
    procedures for test are under construction
    Introduction next spring for the 1999 uniform calendar year

Information production:
    System design nearly finished
    Construction starts this month
    Initial definition of all reports in 1999
Product management: low profile

19. Fss and RICA: an attempt at integration

Carla Abitabile [1]

FSS and Rica: an attempt at integration has been presented with the following transparencies:

Transparency I

SCENARIO: COMPLEXITY OF INSTITUTIONAL FRAMEWORK

National Statistical System include all the institutions dealing with (official) statistics: Ministry, Regions, Provinces, Istat, Inea, etc

Co-ordination of Agricultural Statistics: *Official Protocol* between Institutions.

Origin of the Protocol: *European Decision* (81/518) to improve the quality of (Italian) agricultural statistics

Since 1998 Inea (Rica) inside the Protocol

Transparency II

National and European level
- S run by National Institute of Statistics (ISTAT)
- U. reference: Eurostat

- ca run by National Institute of Agricultural Economy (INEA)
- U. reference: Commission - DG VI

Local level
- S run by Regions, Dpt. of Statistics
- CA run by Regions, Dpt. of Agriculture
- athering made by Farm Associations and/or others
- since 1998 agr. competencies (accountancy) from Regions to Provinces

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[1] INEA, Instituto Nazionale de Economia Agraria, Via Barberini 36, 00187 Rome, Italy.

Transparency III

FSS and RICA: IT'S TIME FOR INTEGRATION

1993 (since)	the reorganization project of Italian RICA: improve representativeness through integration
1996	the new needs for National accounts: EC Reg. 2223 (SEC 95)
1996-1997	EU incentive for integration: FADO, TAPAS

Transparency IV

FSS and RICA: WHY A 'GLOBAL' SOLUTION

harmonization of national statistics

co-operation among Public Institutions:

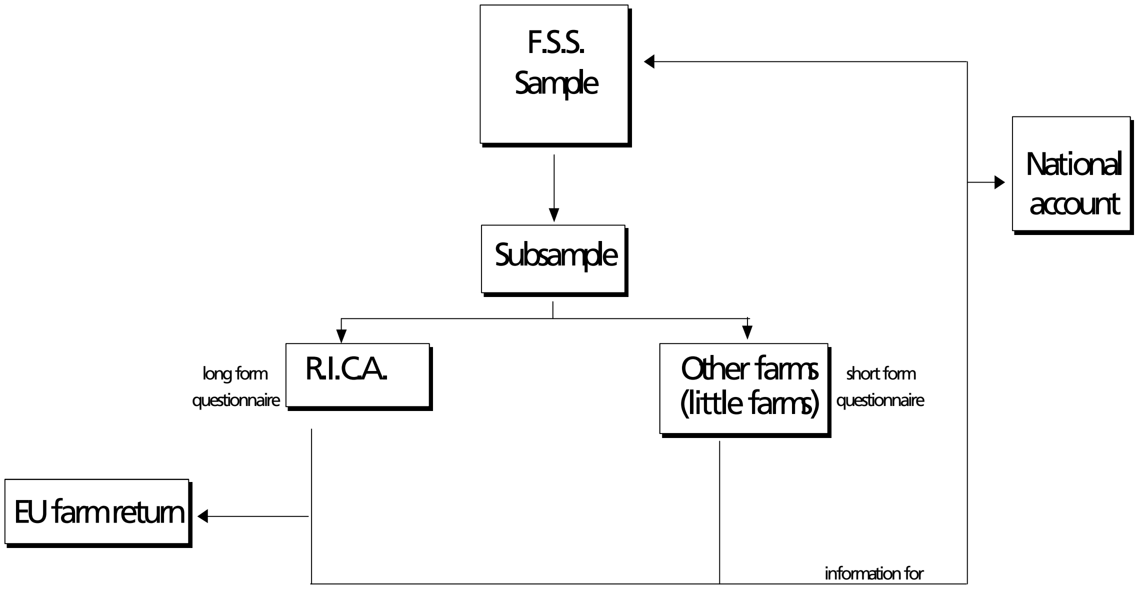
- common use of available resources (costs reduction)
- better quality of data (share quality program)

better guarantee of representativeness

decrease of farm visits

Transparency V

FSS and RICA: INTEGRATION DESIGN



Transparency VI

METHODOLOGICAL ASPECTS

The FSS sample (90,000 farms) is post-stratified for: region, altimetric zone, farm type and esu

A random subsample is drawn (24,000 farms) by a proportional criterion

The subsample → RICA (18,000)
→ others (6,000)

Transparency VII

DATA GATHERING

RICA
- EC farm return - compatible
- actual questionnaire + data for national accounts
- chronological
- very detailed
- for 'professional' farms

Other farms

- Rica - compatible
- compact questionnaire
- by interview (1 or 2 visits)
- for 'simple' farms and/or farms with existing documentation

Transparency VIII

OPEN ISSUES

Funding: from available sample to random sample = new funding flows

Organizational/Institutional:

need for a new organization for all the phases of the system at a local and national level (e.g. regional permanent gathering networks)

Methodological:

- FSS statistical design based on structural variables → bias for an 'economic' sample
- necessity to reach common definition (e.g. farm) and methodology

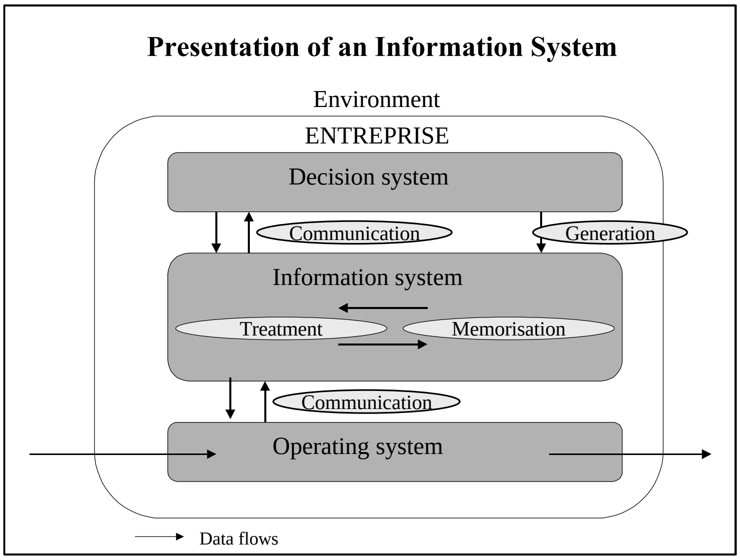
Transparency IX

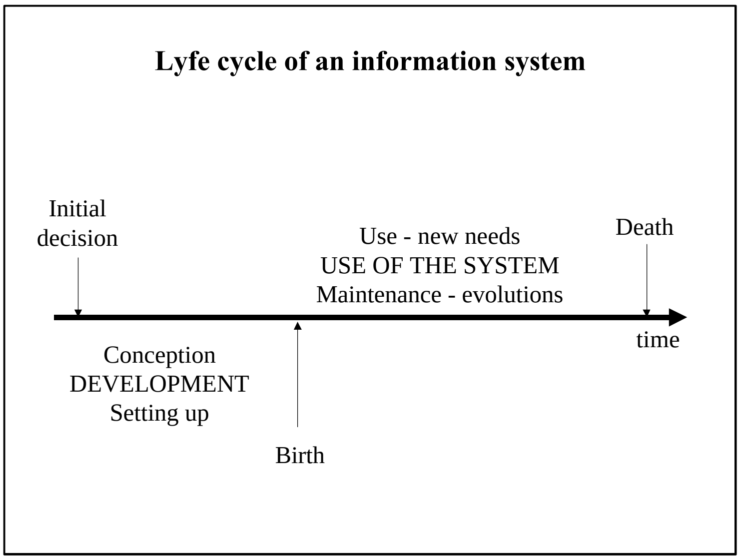
INTEGRATION DEADLINES

1998-1999	Experimental survey (3,000 farms with short-formquestionnaire). Representativeness only at national level; test for questionnaire and organizational model
1999-2001	Gradual integration of regional samples (farms from FSS); new funding flow
2002	New sample (farms from 2000 Agricultural census). Representativeness at both national and regional level for a 24,000 farms sample.

20. Data modelling introduction

Jérôme Steffe[1]





[1] Eseignant-chercheur en Economie & Gestion de l'Entreprise, P.O. Box 102, F 33175 Gradignan Cedex, France

The designing of an information system must take into account future evolutions

The information system is designing at one moment

The firm system always evolves

Costs for designing and setting-up of an information system are very high

↓

Necessity to design an information system to meet :

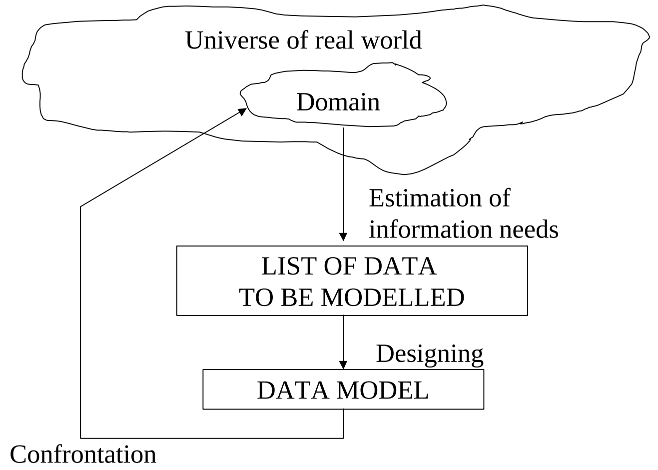
- actual demand

- future demand

The developments phases in the building of an Information System

Phase	Stage
General Aim	CONCEPTION
Preliminary study	CONCEPTION
Detailled study	CONCEPTION
Technical study	REALISATION
Software production	REALISATION
Setting up	REALISATION
Maintenance	MAINTENANCE

The data model : an abstraction of a part of the real world



Data model definition

"the data model is the representation of all data of the domain, and their interactions. The modelling does not take into account technical aspects of information storage or access, and does not refer to any process"

Aim of the data model

To group and to structure the data (from the data dictionary) to model the objects of the domain.

Concepts used in the data model

- attribute
- entity
- association

Definition of an « attribute »

“An **attribute** is the modelling of an elementary information”

Examples :

- name : Durant, Schmit...
- firstname : Georges, Lucia...
- town : Paris, Bonn ...

A data will always be modelled in one attribute but one attribute can model several data

Examples of entities

PRODUCT
Code of the product
Name of the product
Unit of the product

COW
Number of the cow
Name
Birth date
Death date

Definition of an « entity »

"An **entity** is the modelling of a set of concrete or abstract objects, which have the same nature and the same attributes"

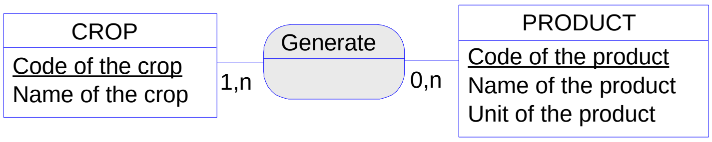
Formalism :

Name of the entity
Identifying property
Property 1
Property 2
___
Property n

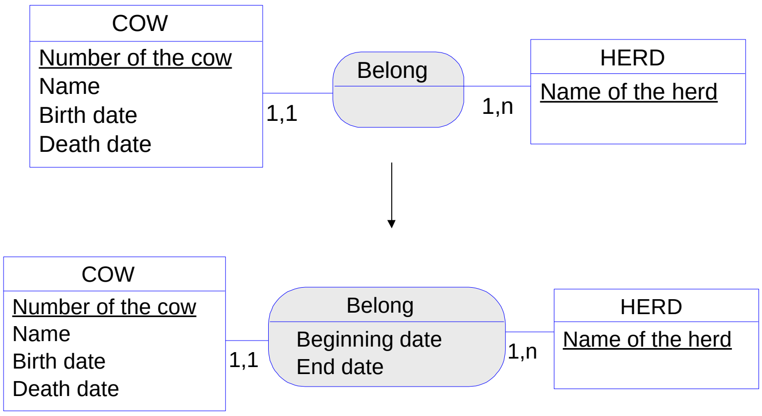
Definitions of an « association »

"An **association** models a set of relationships (of the same nature) between two or more entities"

Formalism and example :



Other examples of associations, including time management

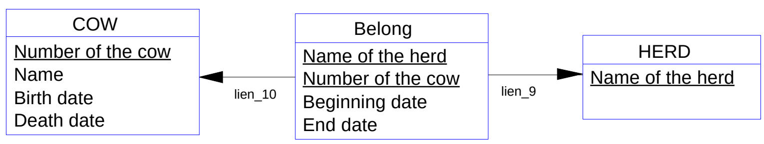


Generation of the database

The data model automatically generates the database :

Model	Database
attribute →	Field
Entity →	Table
Association →	Table or nothing

Example of the generation of the database



Data modelling objectives

- to represent a part of the real world
- to eliminate data redundancy
- to allow the integration of new information

↓

Necessity to design a « non static » model

↓

Necessity to reach a high degree of conceptualisation

How to design a « non static » model

- The definition of an attribute must be as general as possible

- Necessity to define a type for the definition of an entity

Demonstration on the following example :

Data dictionnary :

- exploitation number
- farm name
- crop name
- crop code
- number of hectares in the wine area “Medoc” per accounting period
- number of hectares in the wine area “Saint-Emilion” per accounting period
- number of hectares in the wine area “Graves” per accounting period
- accounting period number
- beginning date of accounting period
- end date of accounting period

First solution

NUMBER OF HECTARES PER WINE AREA

Identifying number
Number of hectares in Medoc
Number of hectares in Saint Emilion
Number of hectares in Graves
Number of accounting period
Beginning date of accounting period
End date of accounting period

HECTARES PER CROP

Identifying number
Number of hectares for corn
Number of hectares for wheat
Number of hectares for wine
Number of accounting period
Beginning date of accounting period
End date of accounting period

FARM

Exploitation number
Farm name

Problem of the modelling : data redundancy

Second solution

FARM
Exploitation number
Farm name

ACCOUNTING PERIOD
Number of accounting period
Beginning date of accounting period
End date of accounting period

NUMBER OF HECTARES PER WINE AREA
Identifying number
Number of hectares in Medoc
Number of hectares in Saint Emilion
Number of hectares in Graves

HECTARES PER CROP
Identifying number
Number of hectares for corn
Number of hectares for wheat
Number of hectares for wine

Problem : impossible to add a new wine area or crop

Third solution

ACCOUNTING PERIOD
Number of accounting period
Beginning date of accounting period
End date of accounting period

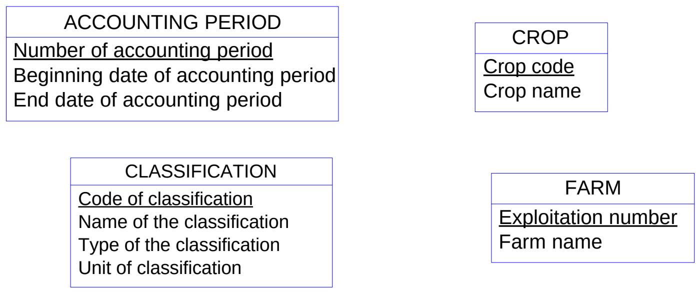
CROP
Crop code
Crop name

WINE AREA
Code of wine area
Name of wine area

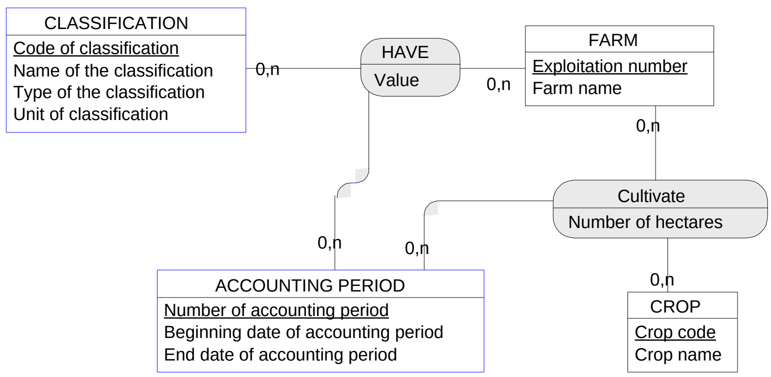
FARM
Exploitation number
Farm name

Problem of the modelling : impossible to add a new classification

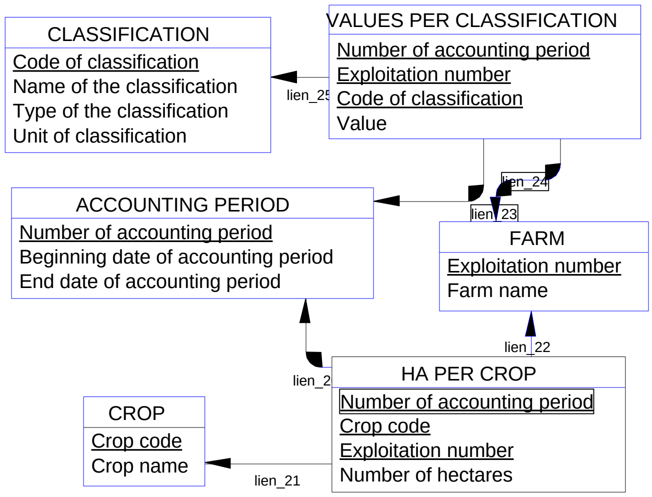
Final solution



Stage 2 : modelling of associations



Stage 2 : generation of the database structure



Conclusion : assets of the final modeling

- All data of the dictionary are modelled

- There is no data redundancy

- New information can be integrated in the model and in the database without any change in the structure

Conclusion

- Necessity to integrate evolution in the designing of a data model

- Impossible to add new data in the data model

21. Questions and Answers

Participants were invited to raise any subject they would like to discuss and others are invited to comment or provide help.

The following topics were discussed:

- privacy FSS data and FADN data is so high;
  - how high are privacy requirements and will it influence IT architecture and lead to high costs?;
- providing data to researchers with little expertise? This could damage one's reputation;
- treatment of quota in accounts, also with an eye to the discussion on the future of the milk quota under Agenda 2000;
- G.I.S.: experiences with sample data/privacy aspects;
- fixed costs are high for some farmers. Methodologies for calculating fixed costs and harmonization of them.

22. Follow-up

The workshop PACIOLI 6 was very stimulating, thanks to the participants and the local organization. During the workshop the participants discussed the future of PACIOLI in general and the need for a PACIOLI 7. We intend to increase the number of participants and participating countries. In September 1999 a large congress on information technology in agriculture will be held in Bonn (Germany) and it may be useful to organize a follow-up of PACIOLI during or right after this congress. During this congress there may be possibilities for acquisition.

The follow-up RICASTINGS, the feasibility study of a new EU farm return, was also thought of importance for the timing of PACIOLI 7.

Time and location will depend on the future strategy of the EU-FADN and the topic(s) of PACIOLI 7. The workshop management agreed to discuss PACIOLI 7 more in detail at the beginning of 1999.

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