

A link between the International Farm Comparison Network (IFCN) and global equilibrium models

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Introduction

The globalisation of the economy and the on-going liberalisation of agricultural trade policy may lead to a considerable re-allocation of agricultural production worldwide. Economists usually try to predict such changes by applying general or partial equilibrium models. The direction and extent of supply and demand changes is highly dependent on the demand and supply elasticities applied. The elasticities are either based on econometric analysis, theoretically sound assumptions, or expert judgement. A farm-level view is usually not included in such a type of analysis.

The International Farm Comparison Network (IFCN) is a farm-level based research approach on a world-wide scale. Its results are potentially beneficial for trade modelling. At the same time, there are potential benefits for IFCN from linkages with trade models.

This paper

- provides a short presentation of the vision, the current status and the selected results of the IFCN and
- examines the scope for co-operation between the IFCN and trade-models to the mutual benefit of both parties.

The International Farm Comparison Network (IFCN)

Background, Motivation and Vision

Until the late 1980s, international farm comparisons were only carried out on an ad hoc-basis, mainly within the scope of Ph.D.-studies, some of which were performed by the authors of this paper (Isermeyer 1988; Deblitz 1994).

The results of these comparisons were recognised as being useful. At the same time they revealed the following problems:

- required data was either not available at all or not available in the scope required to perform total cost analysis
- available data did not allow costs to be differentiated into their price and their volume components to explain cost differences
- available data was usually not comparable across countries
- available data was very often outdated
- the organisational framework of the studies was not designed to be sustainable

The main conclusion from these experience was that the establishment of an own database for international farm-level comparisons is more efficient than the adjustment of existing databases. As a consequence, in 1991, the network of the European Dairy Farmers (EDF) was founded to explore the feasibility of on-going farm comparisons in the European dairy sector. EDF is a club of individual dairy farms, the data of which are analysed on an an-

nual basis. Despite solving the above-mentioned problems, a number of challenges remained:

- The possibility for generalising results was limited because individual farm data were used
- The analysis was limited to dairy and to Europe
- Data collection and cost allocation were not checked by experts
- There was no possibility for simulating farms into the future

The International Farm Comparison Network (IFCN) was founded in 1997 to finally overcome the problems of the past as outlined above (see Hemme, 2000). The vision of IFCN is ‘to improve understanding of farming world-wide’. This implies the provision of facts, data and information in a structured, harmonised, comparable, long-term and sustainable way across countries world-wide.

Strategic approach and methods

The IFCN is a world-wide association of agricultural scientists, advisors and farmers. Within the framework of this co-operation, farms and agricultural production systems are defined that are typical for their region. Their economic situation is analysed, and the farms can be projected into the future. For the most important agricultural products and production regions in the world, the IFCN shall provide answers to the following questions:

- How is farming done (farming systems, production technology)?
- What is the level of variable and total production cost?
- What are the reasons for advantages and disadvantages in competitiveness?
- What is the future perspective of agricultural production at the locations considered?

Since 2000, we have been proceeding strictly in a branch-wise manner. In the first step, the Dairy Network was established. Those organisational and financial arrangements that proved to be successful in ensuring a sustainable network development were transferred stepwise to other agricultural branches. The IFCN Beef branch was launched in 2001, the IFCN Cash Crop branch in 2004. In each of the networks, the participating researchers from abroad become members of a consortium that works on an agreed annual schedule. The group meets once a year in a conference to discuss results, prepare common publications and decide on the future projects of the network. The overhead costs at the IFCN co-ordination centre are financed through consortium fees, research projects and sponsoring from agribusiness companies and institutional partners.

At present, the IFCN Dairy network includes partners from more than 30 countries that account for more than 80 percent of world milk production. The IFCN Beef network comprises 15 countries, and the IFCN Cash Crop network started in 2004 with researchers from 12 countries. It is planned to extend the activities to sheep and pig production.

Although it is able to provide advice to policy-makers and actors in the supply chain, IFCN is not supposed to judge (in the sense of ‘good’ and ‘bad’) or to design policies. IFCN aims to understand the past and present situations of farms, to project their future and to create knowledge to help to validate/develop farm policy, technology and management strategies. In this way, IFCN can be seen as a navigation system in the rapidly changing global agricultural sector.

For each location, models of typical farms are established and analysed using internationally harmonised methods. The application of harmonised methods is essential because our experience has shown that existing data sets – if there are any – show significant differences from country to country, regarding methodology applied, extent of data sets (physical and financial figures), and availability of up-to-date figures. The IFCN data for the typical farms is compiled in co-operation with local farmers and advisors. The definition of the farms follows a distinct pattern and is based on regional statistics, accounting data and expert assessments. A standard questionnaire is used in all countries allowing a very detailed specification of physical and financial farm and enterprise data. Data is generally collected on the whole farm level and – where necessary – whole farm figures are allocated to single enterprises for cost and enterprise analysis. Furthermore, the local experts cross-check results and discuss farm level strategies to adapt their farms to a changing technological, economical and political environment.

Status quo analysis, for example total cost of production, as well as analysis of economic consequences of policy changes and farm adjustments is carried out by using the simulation model TIPI-CAL¹ (10 year projection cycle), and results are returned to the local experts for assessment. TIPI-CAL is an Excel-based spreadsheet accounting and simulation model. It is multi-period, dynamic-recursive and can be operated in a deterministic or stochastic mode. With TIPI-CAL, an annual analysis is performed, the focus of which is on returns, cost, profitability and productivity of the enterprises mentioned above. A number of additional modules linked to TIPI-CAL allow policy, farm strategy and risk analysis. TIPI-CAL is shareware for all IFCN partners and clients. Regular model training is offered by the IFCN Centre.

Selected results

In order to illustrate the work of the IFCN and to help in the identification of possible areas of co-operation with GTAP, selected results from the latest Dairy, Beef, and Cash Crop Reports (Hemme et al. 2004, Deblitz et al. 2004, Pleßmann et al. 2005) are presented in the following figures. For each figure, a short explanation is given. The possible linkages between IFCN and GTAP are described and summarised in the chapter ‘Perspectives for co-operation between GTAP and IFCN.’

Global product information

Figure 1 shows the bilateral trade-flows of beef for the most important beef exporters in the year 2003. This map is one of many compiled within the IFCN using secondary data from FAO, UN-Comtrade and IFCN results and can be used for a quick overview of beef production and trade world-wide. Other maps comprise the status quo, development and changes in inventories, production, prices, costs and live trade. Our experience has shown that the combination of farm-based data and in-depth analysis of the related commodity markets is necessary to fully understand the development of certain agricultural branches.

Total cost and returns analysis

Figure 2 shows the total cost, returns and profitability of milk production for 86 typical farms from 31 countries in the year 2003. Values are expressed in US\$ per 100 kg energy corrected milk (ECM). Farms are characterised by the country abbreviation (for example US for United States), the average number of milk cows on the farms and in some cases the abbreviation for the regions. US-2400TX is a 2400 cow farm in Texas. Five cost levels can be observed:

- < US\$ 18: Poland, Argentina, Pakistan, Vietnam, New Zealand, Western Australia and the larger farms in Brazil and India and the smaller farms in Chile, China and Australia (Victoria)
- US\$ 18-28: Estonia, Czech Republic, Bangladesh, China, Thailand, the smaller farms in Brazil and India and the farms UK-183, US-2400TX and US-1720CA
- US\$ 28-35: Spain, Denmark, Ireland, UK; Hungary, most US-farms and the larger farms in Germany, The Netherlands and Israel
- US\$ 35-45: Austria, France, Sweden, and the smaller farms in The Netherlands and Israel
- > US\$ 45: Switzerland, Norway, Finland, Canada and the small German farm

Cost component analysis

Figure 3 shows the total cost of wheat production for a North Dakota and an East German crop farm on a per ha and per ton basis. While cost per ha are about three times higher in the German farm, the cost per ton are the same for both farms due to the high wheat yield of the German farm. The figure further shows the decomposition of a part of the operating cost (fuel cost) and direct cost (nitrogen fertiliser cost) into its volume and price components. While fuel costs and nitrogen cost per ton of wheat are very similar in both locations, the analysis shows large differences between prices and volumes used. The price differences are mainly caused by differences in tax and environmental policies. If Germany would apply the same policy as the USA, the German wheat farm would have a cost advantage against the US farm.

Baseline projections

Figure 4 shows a stochastic baseline projection for a German 80-cow farm and a New Zealand 246-cow farm from 2002 to 2010. A farm-level baseline can be described as ‘the projection of a chosen indicator under the present and most likely policy, market and technology framework conditions for a defined period of time’. The baseline is usually used to obtain information about the likely future or as a reference system to analyse changes of the above-mentioned framework conditions. Adding stochastic information to the baseline helps to assess the risk involved and provides information on how probable the development considered is. Stochastic variables were: milk price, cull cow price, calf prices, heifer prices, grain price, soybean meal and compound feed price, milk yield and culling rate. The indicator chosen here was the Net Cash Farm Income (NCFI). The results mainly show that the ‘protected’ market environment of the German farm leads to much less volatility in results than the ‘free market’ environment of the New Zealand farm.

Policy impact and supply reaction analysis

Figure 5 shows the economic situation of typical EU beef farms in the year 2003 compared with the situation in 2005/2006, respectively. The figures show the total returns, (split into beef market returns and beef market returns plus government payments) and the cost from the profit and loss account (cash expenses and depreciation). It shows that in the situation with payments coupled to the production (before the current CAP-reform), in most farms a part of the payment had to be used to compensate a loss that would have occurred without the existence of the coupled payments. In the situation with decoupled payments (after implementation of the CAP-reform), the payments may not be allocated to the beef enterprise anymore. This leads to dramatic changes in profitability, showing that without adjustments in most of the farms the beef production would become unprofitable. As the farms are not forced to produce beef anymore to receive the payments, one could conclude that all farms shown here in an unprofitable situation should stop beef farming. This preliminary conclusion, however, could be altered once further restrictions and conclusions such as cross-compliance requirements are included in a more profound analysis.

Farm strategy analysis

The reform of the agricultural policy of the EU provides new options for the development of German crop farms. With the decoupling of direct payments farmers can quit crop production without losing the payment. Four different farm strategies under the new political framework conditions have been analysed for a typical 260 ha crop farm in West Germany with cash crop production (see **Figure 6**). If the farm continues crop production without adaptations there will be a negative return to management² over time. The same result is achieved if the farm quits production and set-asides the land. In this case the farm will have costs to keep the land in a good condition (cross-compliance regulations). A positive return to management is achieved, however, if the farm either quits production and rents out the land to a neighbouring farm or takes over additional land from a neighbouring farm. In these scenarios, the remaining farm continues to produce cash crops on the extended acreage while moving towards a low-input strategy. This allows the farm to operate on the additional land without extra machinery cost and achieve a positive return to management over time.

Time series analysis

In the very beginning, every IFCN branch has to focus on cross-country and status-quo comparisons. The disadvantage of a status quo analysis is that it is only valid for the year considered. Due to domestic productivity and price changes, as well as to changes in exchange rates, results between years may differ significantly. **Figure 7** shows the first attempt for a time series analysis for identical farms of the IFCN Beef branch. The chart shows identical farms for the years 2001 (where available), 2002 and 2003. Values are stated in US\$ per 100 kg carcass weight and show the total cost and the total returns of the beef enterprise. Though just a few years are reflected, the rapid change of results can be shown with a few examples. There are relatively large variations in costs and returns resulting from national price and cost developments as well as from changes in the exchange rate to the US\$. In the U.S.-feedlot a switch from an entirely unprofitable situation in 2001 and 2002 to a very profitable situation in 2003 can be observed. When comparing the Western European farms with most of the other countries, it becomes clear that the competitive situation (total costs) gradually worsened from 2001 to 2003 due to the revaluation of the Euro against the US\$. The example of the Argentinian farms demonstrate the effect of the financial default in 2002 when cost and prices measured in US\$ dropped by more than 70 percent compared to the previous year. And finally, the Australian farm

shows a decrease of cost and returns in 2003 despite the revaluation of the AU\$ against the US\$ which is a result of the drought that hit the country in 2003. These results underline the necessity of doing regular (annual) analysis within the framework of the IFCN.

Next steps

More countries, more farms, more product-branches

Further growth of IFCN in all existing product-branches, as well as the opening of new product branches, is envisaged. New product branches (pig and poultry, sheep) require a committed person in the IFCN centre and a funding for at least two to three years. For all product groups the primary country focus will be on global players in terms of production and trade, but smaller countries are welcome to participate. The definition of typical farms will be performed using a standard operating procedure for all countries, more focussed on statistics. The number of farms per country is limited for the Reports, but each partner is encouraged to increase the coverage of the network in his country by adding more farms, thus increasing representativity. Of these, a number of farms will be selected by the partners and the IFCN centre for the international comparisons. Databases will gradually replace the presently prevailing Excel-based data management.

Modelling supply reaction on policy, technology and market changes

Policy and technology impact analysis has so far mainly been focused on the income effects of changing framework conditions. Yet we observe an increasing interest in using the IFCN for the assessment of supply reactions, too. For this purpose, linear programming will be introduced in the crop module of the model TIPI-CAL. With the help of the IFCN panels in different countries, an analysis will be made of how realistic the LP-results are and how the supply response projections on the farm level can be further improved. For the livestock branches, the feasibility of linear programming and other tools will also be checked.

Time series analysis

Once a product branch is in operation for a number of years, time series analysis can be performed for identical farms (see previous chapter). As farm structures usually change towards larger units over time, the typical farm data is frequently updated to reflect the changing structures. These farms can still be considered typical but one could argue they are not identical anymore and can't be compared in a time series analysis. On the other hand, when looking at the total cost of production of a typical farm, others would argue that the results can be compared because the figures reflect the reality in terms of structural change. This issue will be discussed more deeply in the IFCN product branches.

Supply chain issues and sector analysis

The access of IFCN to world-wide data banks and to commodity-specific expertise in processing and trade allows elaboration of maps and background information to be added to the farm level analysis. Within the annual special studies and country pages of the Reports, topics such as farm structures and their development, traceability in the supply chain, quota markets in the EU, legal framework conditions for genetically modified crops were and will be addressed.

Perspectives for co-operation between GTAP and IFCN

The International Farm Comparison Network (IFCN) aims at improving the access to farm level information for the future-oriented assessment of regional production and trade on a world-wide level. The IFCN does not attempt to replace equilibrium models, since the world's agriculture can never be reflected through the farm-level analysis of just a few typical farms per country. It is rather an attempt to add valuable information to higher-aggregated models in order to improve their ability to reflect the 'true world of farming'. At the same time, GTAP and other equilibrium models could provide IFCN with valuable information and data to widen IFCN's scope from a farm-level focus to a sector and market level perspective.

Presumably, the possible benefits of a co-operation between GTAP and IFCN can be identified in two fields: Data exchange and expert based partnerships.

Data exchange

The IFCN costs of production and benchmark analysis can serve as an important input for the GTAP model. Information on price and volume components on cost items can help to assess supply reactions when framework conditions change. Once supply reactions can be simulated with the IFCN tools, they can serve as a model input for GTAP. Before that, panel-based estimation of supply response (to policy changes) in typical farms can be used for the same purpose. Finally, TIPI-CAL could calculate 'exit thresholds' for typical farms in the case of drastic price changes.

On the other hand, the quality of farm-level projections of the IFCN is highly dependent on the projections of prices that can only be supplied by highly-aggregated equilibrium models such as GTAP. To a certain extent it seems to be possible to organise an iterative procedure on supplying information from one network to the other.

Expert based partnerships

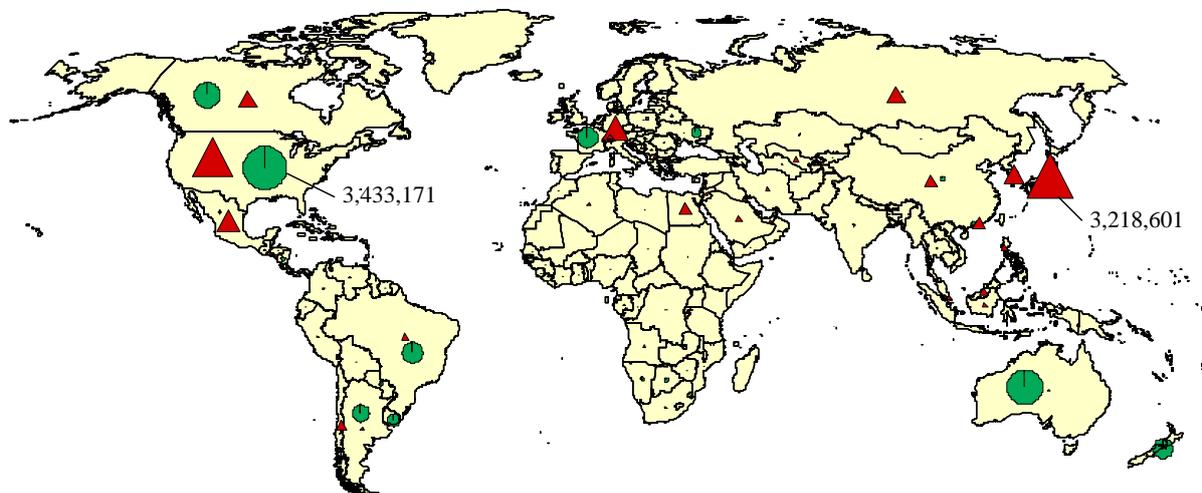
The experience in the IFCN shows that the networking benefit is not just on the side of internationally comparable data. Over time it appears that bringing people together in a structured and regular way enables each participant to gain significant knowledge and background information on the data, production systems and information generated in the network. In other words, personal meetings and exchange between the participating experts open the 'black-box' behind the figures.

Bringing experts from GTAP and IFCN together could result in the following benefits:

- Better understanding of the driving forces of farm responses (for GTAP)
- Differentiated view of various farm types and their reactions (for GTAP)
- Better understanding of production systems and technologies relevant for future farm development (for GTAP)
- Better understanding of general market trends and likely price developments (for IFCN)
- Better understanding of how policy changes directly or indirectly influence input and output prices (for IFCN)
- Development of methods and interfaces to link GTAP and IFCN models and results

Figures

Figure 1. Main beef exporters and importers, average of the years 2001-2003 (Values in 1,000 US\$)



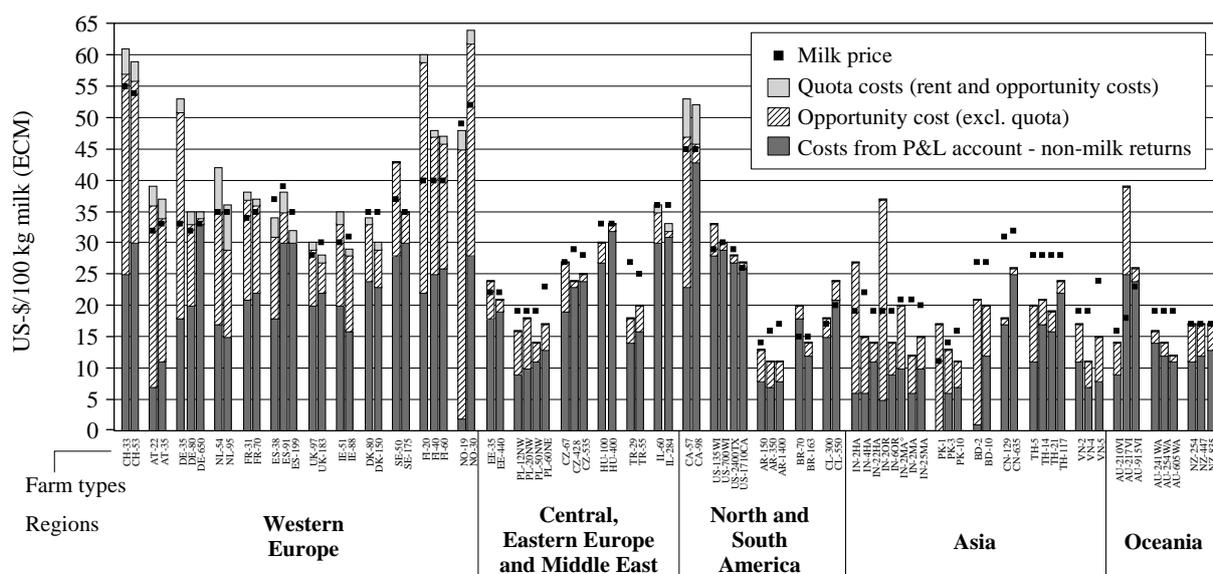
* Value of imports / exports of the following items:
Meat of bovine animals, fresh, chilled or frozen, with bone in; beef and veal boneless;
beef dried salt smoked; beef preparations; homogenised meat preparations;
sausages of beef and veal; fresh, chilled or frozen edible offals of cattle.

● Exports
▲ Imports

Values in 1,000 US\$
Source: FAOSTAT

Source: Own illustration based on FAOSTAT

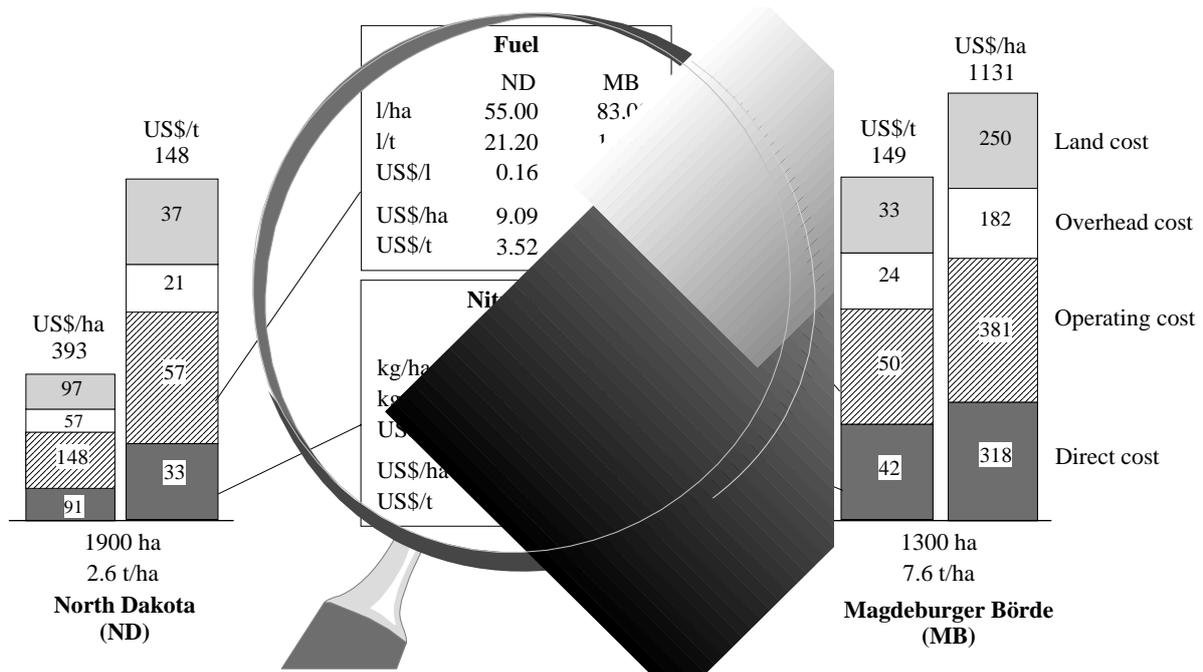
Figure 2. Total cost, returns and profitability of milk production 2003 (US\$ per 100 kg ECM milk)



Source: IFCN Dairy Report 2004.

Source: IFCN Dairy Report 2004

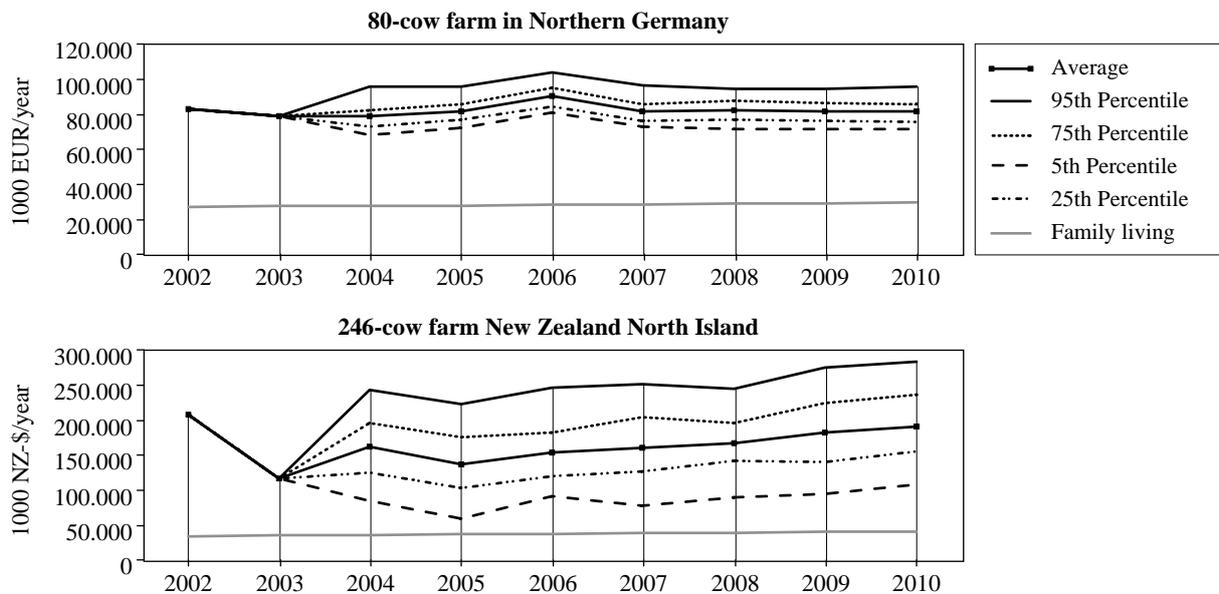
Figure 3. Wheat production in Germany and the U.S. – cost component analysis



Source: Own calculations of IFCN Cash Crop.

Source: Own calculations of IFCN Cash Crop

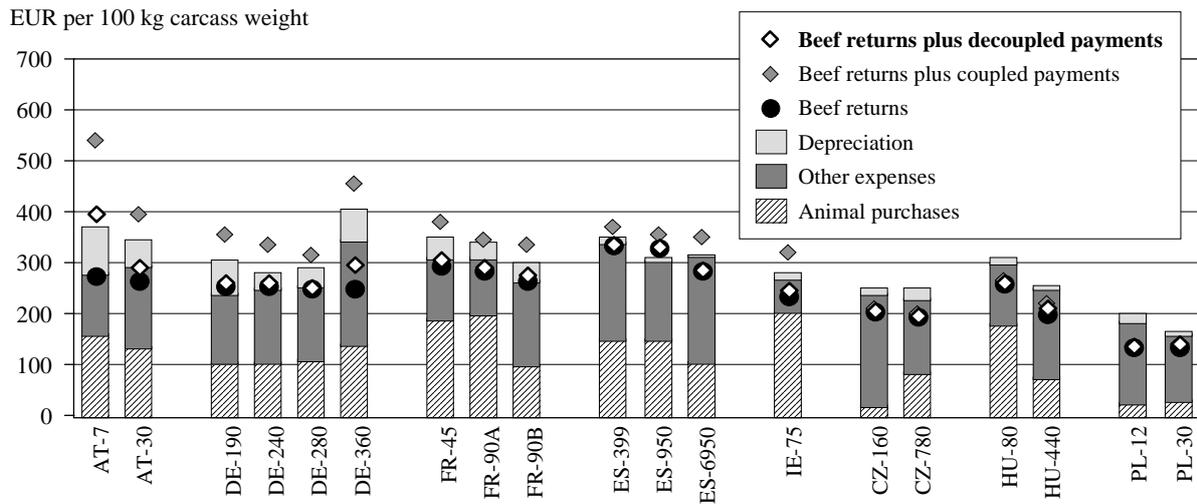
Figure 4. Stochastic baseline projections of typical dairy farms in Germany and New Zealand (Net cash farm income)



Source: IFCN Dairy Report 2004.

Source: IFCN Dairy Report 2004

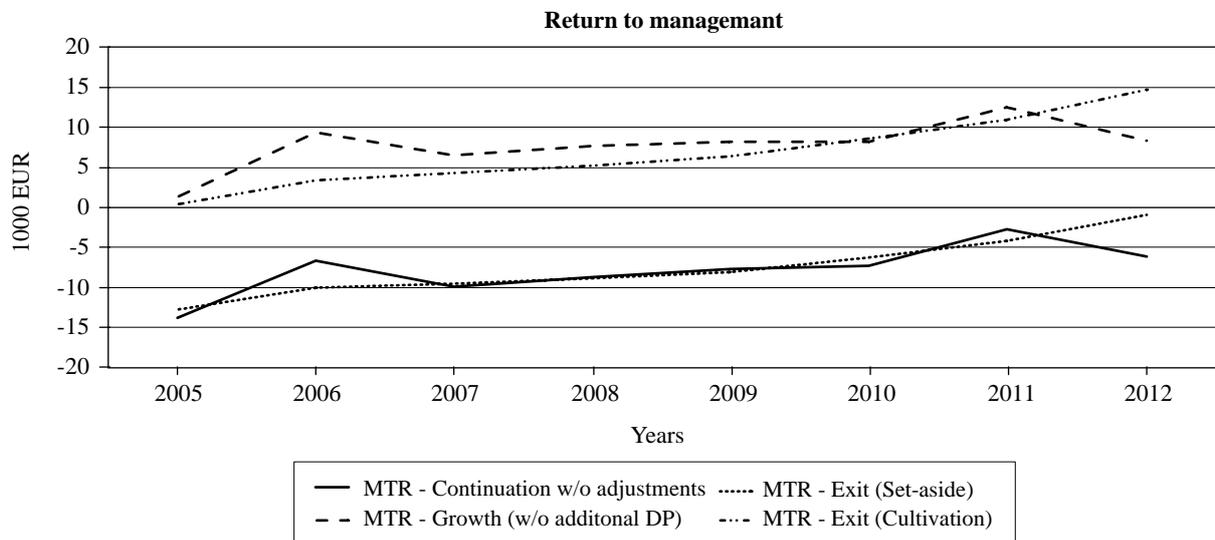
Figure 5. Impact of the CAP-reform on typical beef finishing farms in the EU total cost, returns and profitability of beef production



Source: Own calculation IFCN.

Source: Own calculations based on IFCN Beef Report 2004

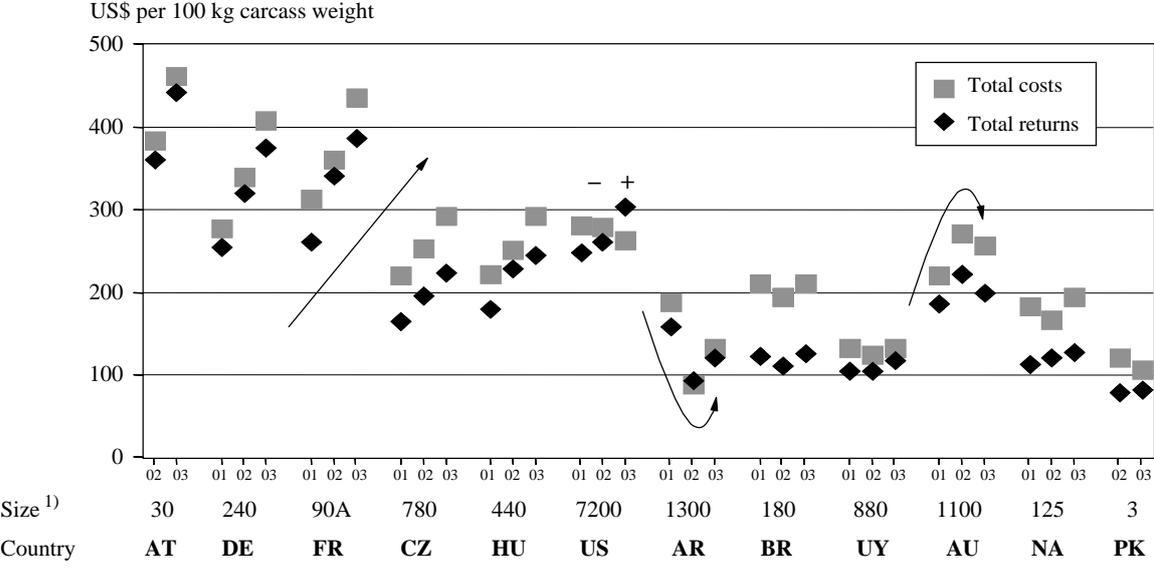
Figure 6. Farm strategy analysis for a typical German crop farm after the CAP-reform – return to management



Source: IFCN Cash Crop Report 2005.

Source: IFCN Cash Crop Report 2005

Figure 7. Time series analysis of identical beef finishing farms – total costs and returns



1) The size indicates the total number of finished cattle sold per year.
 Source: Own calculations based on IFCN Beef Report 2004.

Source: Own compilation based on IFCN Beef Report 2002, 2003, 2004

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¹ TIPI-CAL: **T**echnology **I**mpact and **P**olicy **I**mpact **C**alculations

² Total returns minus full economic cost (cost from the profit and loss account + opportunity cost).