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# ASSESSING THE 2003 CAP REFORM IMPACTS ON GERMAN AGRICULTURE

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**Abstract**

The impact of the 2003 CAP reform on the German agricultural sector is assessed using the farm group model FARMIS. Two implementation schemes are analysed: a standard scheme based on fully decoupled payments derived from historical references, and the German implementation based on payment levels derived from regional premium plafonds. The analysis shows that allocation and supply effects of both decoupling schemes are similar, but that the schemes differ with respect to their effect on income. Additionally, the schemes have different impacts on factor prices: while in the case of the standard implementation rental prices for land decline, the German implementation induces prices for grassland to increase.

**Keywords**

2003 CAP reform, decoupling, farm group model, FADN

## 1 Introduction

The 2003 CAP reform, in particular the decoupling of direct payments, represents a significant change of the economic environment for German farms. It is of interest to gain knowledge about the general impact of the reform and the different impacts of the options for national implementation. In this paper two scenarios are analysed: the first is a standard implementation scheme with fully decoupled payments where the level of entitlements is determined based on historical references. This scenario is based on the original reform proposal and will therefore be called Single Farm Payment (SFP). The second is the German national implementation scheme with fully decoupled payments which are not based on historical but on regional references. It will be called Regional Model (RM). The reference for both scenarios is the prolongation of the Agenda 2000 package.

The analysis is done using the farm group model FARMIS and focuses on the impacts on factor allocation, supply and income. These effects are displayed on sector- and regional level and partially on farm type level as well. The paper is structured as follows. The first part provides a description of the farm group model focussing on the structure and recent extensions like the implementation of land, entitlement and milk quota markets. Subsequently, the application of the model to the 2003 CAP reform is outlined and results are presented. A description of ongoing and further development of FARMIS with regard to policy assessment at EU level rounds off the paper.

## 2 The model

### 2.1 Model structure and data

FARMIS is a comparative-static process-analytical programming model based on FADN[1] data, with individual farm data being aggregated to farm groups. The core of FARMIS is a standard optimisation matrix which contains in the current version 27 main activities of crop

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1 Farm Accountancy Data Network

and 15 activities of livestock production. The matrix restrictions cover the areas of feeding (energy and nutrient requirements, calibrated feed rations), intermediate use of young stock, fertiliser use (organic and mineral), labour (seasonally differentiated), crop rotations, and political instruments (e.g. set-aside, quotas). Key characteristics (see also Figure 1) of FARMIS are (BERTELSMEIER et al., 2003 and BERTELSMEIER, 2004):

- Improved aggregation factors allow a representation of the sector's production and income indicators (OSTERBURG et al., 2001).
- Input/Output coefficients of all activities are consistent to information from farm accounts.
- A positive mathematical programming procedure is used to calibrate the model to the observed base year levels.

The national FADN includes farm accounting data of about 11 000 farms with roughly 8 500 different variables. FARMIS uses farm groups rather than single farms, to ensure confidentiality of individual farm data but also to increase manageability and increase the robustness of the model system in face of data errors which may exist in individual cases. Homogenous farm groups are generated by aggregation of single farm data. Standard stratification criteria for the establishment of farm groups are region (NUTS II), farm type (e.g. field crops, milk or grazing livestock, etc.) and farm size (criteria for size depend on farm type, e.g. size of field crop farms refers to ha UAA). Generally, stratification of farm groups is flexible and can be adjusted depending on the specific policy to be analysed. The current stratification used for policy impacts analysis for Germany is based on 434 farm groups. FADN data of at least two consecutive years are used in order to enhance the stability and significance of the results.

Part of the information needed to define the coefficients for the activity-based optimisation matrix is directly available from the farm accounts, e.g. production levels, physical yields and corresponding output prices. Activity-specific input coefficients however generally need to be generated as the respective information in the farm accounts is aggregated. To this end, in the first step input coefficients like fertiliser, fodder, and machinery are set based on a normative approach. Based on information from farm management handbooks, the use of input factors of each process is determined either in relation to yields (e. g., input of feed or fertiliser) or in relation to structural characteristics (e. g., use of machinery). In a second step these normative input coefficients are adjusted according to corresponding monetary accounts in the accounting data of the respective farm group. This is trivial in cases of single inputs and corresponding farm accounting data, resulting in a simple correction factor. The consistency problem gets the more complex the more coefficients have to be matched with a single account. It is especially complex if coefficients, which are used in the model, are in physical units, like fodder or fertiliser, and data provided in the farm account is of monetary nature.

**Figure 1: Structure of FARMIS**

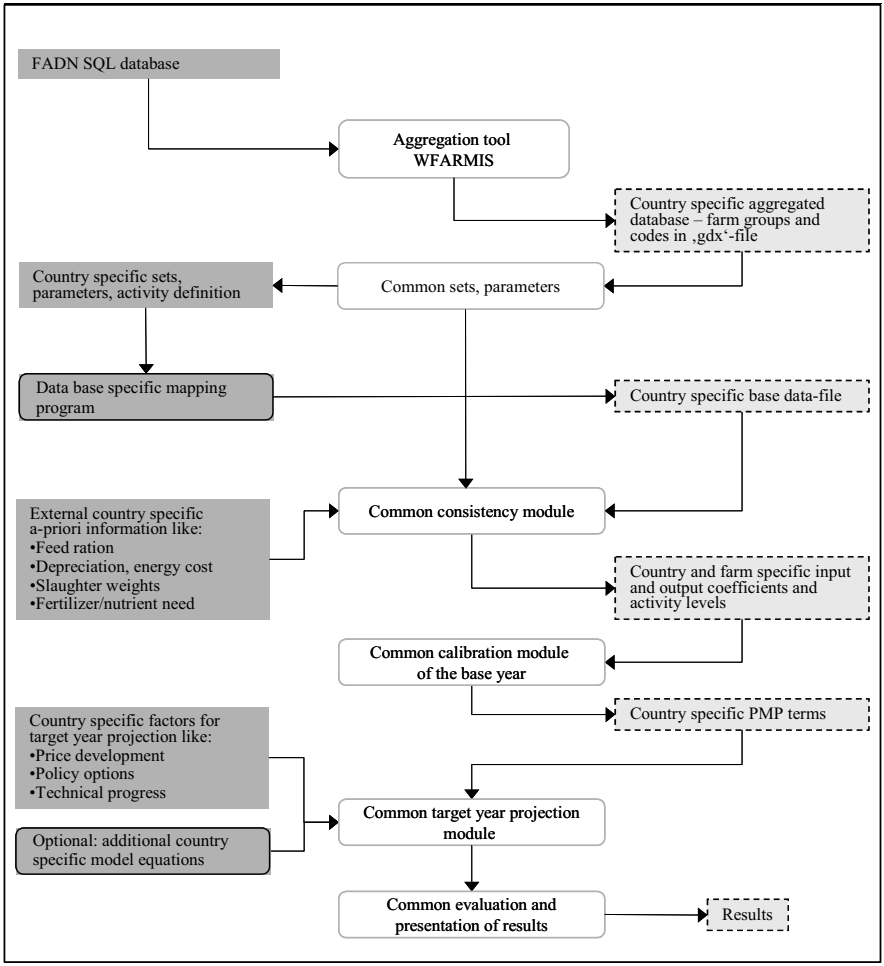



Figure 1 shows the structure of the model FARMIS. The basic concept is to have a generic model, irrespective of the data base used (national or EU FADN), based on common definitions of sets, variables and parameters. The main interface comprises a data base specific programme, translating the raw date to basic model input data. This structure allows data base specific modelling if desired by the user.

A positive mathematical programming procedure is used to calibrate the model to the observed base year levels, with non-linear terms standardised to external elasticities. In the linear part of the objective function, farm income[1] minus (opportunity) costs for land and labour as well as the interest on borrowed capital is maximised.

1 Farm income here refers to net value added. Costs of fixed factors have to be covered irrespective whether they are owned by the farmer or not.

The policy simulation process (ex ante analysis) proceeds in two steps. In the first step a reference scenario is established for a target year in the future, usually assuming that the present agricultural policy will continue. Furthermore, estimates on changes in general farm structure (i. e., distribution of farm size classes) and technical progress are used as external model inputs. The development of producer prices for agricultural products is often defined by the policy framework of the reference scenario and complemented by price forecasts of other models. In the second step, alternative policy measures are specified e. g., through additional activities and restrictions or changes of matrix coefficients. The outcome of the optimisation can be compared to the result of the reference scenario and allows statements on the impacts of different policy options.

***Milk quota and land market***

The milk quota market is implemented as rental market where farm groups act in defined trading zones (BERTELSMEIER 2004). These trading zones are based on NUTS I level and in some cases on NUTS II level. The marginal rate of return to milk production, compared to the quota price, is the decision criterion to lease in or to lease out milk quota. In the projection part of the model, either a simultaneous or an iterative optimisation of the farm groups is used for modelling quota trade in the target year, depending on the number of farm groups that have to be optimised in a trading zone.

The transfer of land in a leasing market, differentiated between grassland and arable land, as well as the transfer of premia entitlements are implemented into the model in an analogous manner (BERTELSMEIER 2004). The total of all leasing activities must equal zero in a region and the corresponding shadow prices are interpreted as regional rental prices for land. Rental prices are calibrated to the observed factor prices of the base year.

Clearly, land trade in FARMIS is a stylised and very simplified way of modelling the land transfer. However, it should be acknowledged that the land market is very complex and not all aspects can be implemented in this type of model.

2.2 Technical implementation

In order to ensure a convenient data handling the German FADN data as well as the EU FADN, data are structured and organized within a relational SQL database, which serves as main source for the farm model (Figure 1). Additional data such as regional vectors or sectoral information were added to the SQL structure to be consistent with the farm group structure (GOCHT, 2004). Further, an aggregation program has been developed to group farms and generate include files for the model, which is completely written in the programming language GAMS (General Algebraic Modelling System). The aggregation tool is a Windows-styled program, which enables the user to produce farm groups and export the weighted datasets into a GDX file or alternately into text files, which then can be loaded into the GAMS Modelling System. To improve the quality of the aggregation, the program can handle multiple years and identify identical farms. If more than one year is used, weighting factors for each farm group are adjusted to the decreasing population in the FADN database.

## 3 Analysis of 2003 CAP reform impacts in Germany

FARMIS was used to assess the impacts of policy changes due to the 2003 CAP reform. The analysis focuses on the impacts on supply, income and income distribution and the rental prices for land and quota.

### 3.1 Scenarios

For the analysis two scenarios, based on the Single Farm Payment (SFP) and the Regional Model, are chosen, and their results compared to the continuation of the Agenda 2000, taken as the Reference. To assure comparability both scenarios and reference are determined with regard to the target year 2012. Price responses to the modelled impacts on quantities are estimated using GAPsi, a partial equilibrium model developed and maintained by the Institute of Market Analysis and Agricultural Trade Policy of the FAL. Price changes for milk, beef and calves were modified based on expert judgements of the Federal Ministry of Consumer Protection, Food and Agriculture. The following price changes compared to the Reference are assumed:

- a drop of the price for rye due to abolishment of rye intervention,
- a further decrease of the price for milk due to lowered intervention prices,
- an increase of the price for beef by 10 %-points and
- a decrease of the prices for calves and young cattle.

Further specifications and assumptions of the scenarios are given as follows:

**Reference: Agenda 2000**

The reference scenario represents the situation in the year 2012 that had been realised if no changes had been made to the Agenda 2000 package.

**Scenario 1: Single Farm Payment (SFP)**

Direct payments are fully decoupled and farmers receive a Single Farm Payment based on historical references like area and the number heads of eligible animals.

**Scenario 2: Regional Model**

The second scenario represents the German implementation of the Luxembourg Agreement in the target year. In Germany, the Regional Model will be introduced stepwise, and 14 regions with different payment levels are distinguished. During a transition period payments for grassland and arable land are harmonised and the share of individual payments will be reduced stepwise. The scenario used in FARMIS is based on the regulations valid in the final stage of the Regional Model and therefore represents a pure regional model.

### 3.2 Impacts on land use and production

Table 1 shows the relative changes at the sector and the regional level in comparison to the reference. Regarding these results it is apparent that the scenarios do not differ much regarding the impact on **land use** and production. Exemptions are the impacts on the amount of fallow arable land and grassland. Other changes are mainly induced by the price reduction of rye, decoupling as well as criteria and size of eligible areas. The main predictions of the model are:

Reduction of the total acreage of cereals: The area use for cereal production will decrease by 8 to 10 %, caused by lower rye production and the increase of set-aside and land abandonment in less favoured areas. Due to better natural conditions the reduction in the western part of Germany (4 – 7 %) is lower than in the eastern part (12 – 4 %).

The area of protein crops will decrease by around 10 % despite the production incentive due to a coupled premia of 56 €/ha.

The area of food oilseeds will decrease by 6 to 8 %, while the area of non-food oilseeds will increase by 27 %. Compared to the reference where non-food is produced on set aside areas production will take place on land without set-aside obligations and therefore partially substitute food oilseeds. This is mainly caused by rather similar prices for food and non-food seeds and the production incentive of 45 €/ha for energy crops on non set-aside areas.

A slight increase of potatoes and sugar beet acreage is predicted. In the case of sugar this is caused by a decrease of the intensity of production. The level of production is not affected due to quota restrictions.

The area of silage maize will decrease by 8 % in the SFP scenario, but only by 6 % in the case of the Regional Model. Due to decoupling silage maize production will loose its competitive advantage compared to other arable fodder crops, which were not subsidised in the former premia regime. The amount of land used for production of other types of arable fodder plants will increase by about a quarter, but lower intensity levels will be realised.

Despite the reduction of beef production, the grassland use will increase by 1.5 % in the case of the Regional Model. This is mainly caused by the use of formerly unused grassland which will be reactivated to access additional payments.

The area of set aside and fallow land differs between both schemes. While the total of obligatory set-aside does not change at all, set-aside areas for non-food production decrease by three quarters under terms of the SFP and will disappear at all under the conditions of the Regional Model. The remaining set-aside area will increase by 48 and 65 % respectively. In the case of the SFP about 2 % of arable land will fall idle. This happens mainly on sandy soil regions in eastern Germany. In the case of the Regional Model the amount of fallow grassland and fallow arable land will be reduced to almost zero compared to the SFP. The area will be managed according to the minimum standards required for the activation of entitlements.

**Milk production** will not be affected by the reform in terms of the assumed price changes. Part of the farm groups do not fulfil their reference quantity and but their quota will be transferred to other farms within the regions defined in the German scheme for quota trade.

The strongest adjustments are predicted for **beef production**, although no specific price-policy measures are introduced. Bull fattening and suckler cow husbandry, previously favoured by high production-related premiums, will be reduced in the case of both de-coupling schemes. Bull fattening will be reduced by 26 % on average, whereby the adjustments in the North and South will be lower. The number of suckler cows will go down by 28 to 30 %, whereby the adjustments in the North and the Centre are substantially more pronounced than in the other regions[2]. Beef production will be stabilised by the constant supply of cow meat as well as the expansion of heifer fattening. Therefore the reduction of total beef supply (-15 %) is less pronounced than the reduction of bull meat production. The adjustment reactions occur despite the assumption of a rather favourable development of beef prices. The results are rather sensitive to levels and relations of beef and calf prices.

Changes of suckler cow production might be overestimated, because some Laender are planning to introduce specific measures within agri-environmental programs or Pillar-II (less favoured area allowance) favouring land dependent livestock systems. Other branches of meet and poultry production will be not much affected by the reform, because feed prices won't change at all due to rather constant prices for energy and protein feed. It can be concluded that scope and allocation of production will be significantly affected by de-coupling, but the type of de-coupling, either the SFP or the Regional Model, will not induce significantly different allocation effects.

2 If agri-environmental measures with a minimum cattle density are applied, suckler cow holding could be stabilised (agri-environmental measures are not specified in the model). The compensatory allowance for less favoured areas, considered in the model as area premium, has no obvious effect on suckler cow production.

## Table 1: Change of livestock production, land use and income

| | | Sector | | | North | | Centre | | South | | East | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Scenario | | Reference [1] | SFP [2] | RegMod [3] | SFP | RegMod | SFP | RegMod | SFP | RegMod | SFP | RegMod |
| **Livestock production / land use** | | abs | % | % | % | % | % | % | % | % | % | % |
| Fattening bulls | Tsd. heads | 2217 | -26 | -26 | -26 | -25 | -36 | -35 | -21 | -21 | -39 | -39 |
| Suckler cows | Tsd. heads | 460 | -30 | -28 | -36 | -41 | -36 | -38 | -28 | -27 | -25 | -16 |
| Cereals | Tsd. ha | 6504 | -10 | -8 | -6 | -4 | -6 | -5 | -7 | -7 | -14 | -12 |
| ... Rye | Tsd. ha | 762 | -23 | -21 | -20 | -16 | -18 | -18 | -22 | -20 | -25 | -23 |
| Protein crops | Tsd. ha | 235 | -13 | -11 | -6 | -3 | -5 | -4 | -8 | -7 | -15 | -13 |
| Oilseeds | Tsd. ha | 1323 | -6 | 2 | -2 | -1 | 1 | 1 | -3 | -3 | 2 | 4 |
| ... Food | Tsd. ha | 1008 | -8 | -6 | -3 | 0 | -1 | -1 | -6 | -5 | -11 | -9 |
| ... non-Food | Tsd. ha | 315 | 27 | 27 | 4 | -7 | 11 | 12 | 11 | 4 | 34 | 37 |
| Set-aside | Tsd. ha | 811 | 0 | 1 | -3 | 16 | 17 | 28 | 22 | 50 | 118 | 129 |
| ... With non-food production | Tsd. ha | 315 | -75 | -100 | -4 | -100 | -62 | -100 | -37 | -100 | -93 | -100 |
| ... Without non-food | Tsd. ha | 496 | 48 | 65 | -3 | 16 | 17 | 28 | 22 | 50 | 118 | 351 |
| Maize for silage | Tsd. ha | 1019 | -8 | -5 | -5 | -2 | -20 | -4 | -9 | -6 | -8 | -8 |
| Other arable fodder crops | Tsd. ha | 784 | 29 | 26 | 26 | 27 | 36 | 36 | 33 | 29 | 26 | 21 |
| Sugar beets | Tsd. ha | 410 | 4 | 4 | 3 | 4 | 4 | 4 | 4 | 4 | 5 | 6 |
| Potatoes | Tsd. ha | 282 | 3 | 5 | 3 | 5 | 3 | 3 | 3 | 4 | 1 | 5 |
| Permanent grassland | Tsd. ha | 4275 | 0 | 2 | -1 | 0 | -2 | 0 | -1 | 1 | 2 | 6 |
| Agric. used land (UAA) | Tsd. ha | 15653 | -2 | 0 | -2 | 0 | -2 | 0 | -1 | 0 | -1 | 1 |
| | | abs | abs | abs | abs | abs | abs | abs | abs | abs | abs | abs |
| Grassland fallow | Tsd. ha | 101 | 116 | 36 | 8 | 0 | 7 | 0 | 40 | 15 | 60 | 21 |
| Fallow of arable land | Tsd. ha | 0 | 220 | 5 | 94 | 0 | 17 | 0 | 28 | 0 | 80 | 5 |
| **Production** | | abs | % | % | % | % | % | % | % | % | % | % |
| Milk | 1000 t | 29104 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Beef meat | 1000 t | 1092 | -15 | -15 | -18 | -18 | -19 | -18 | -11 | -11 | -15 | -14 |
| Pig meat | 1000 t | 4681 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| **Income** | | | | | | | | | | | | |
| Direct payments | Mio. EUR | 4795 | 5 | 3 | 4 | -1 | 4 | 7 | 11 | 7 | 2 | 3 |
| NVAf [4] | Mio. EUR | 7868 | -1 | -3 | -1 | -4 | -1 | 0 | 2 | -1 | -5 | -4 |
| Net-income | Mio. EUR | 5086 | 20 | -12 | 24 | -15 | 32 | -8 | 22 | -10 | 10 | -12 |
| Costs of land rented | Mio. EUR | 1634 | -67 | 25 | -64 | 24 | -76 | 17 | -80 | 36 | -60 | 22 |
| Rental price of arable land | EUR/ha | 185 | -73 | 3 | -77 | -3 | -77 | -5 | -82 | 5 | -62 | 12 |
| Rental price of grassland | EUR/ha | 56 | -11 | 232 | 0 | 164 | -63 | 294 | -62 | 349 | 331 | 2130 |

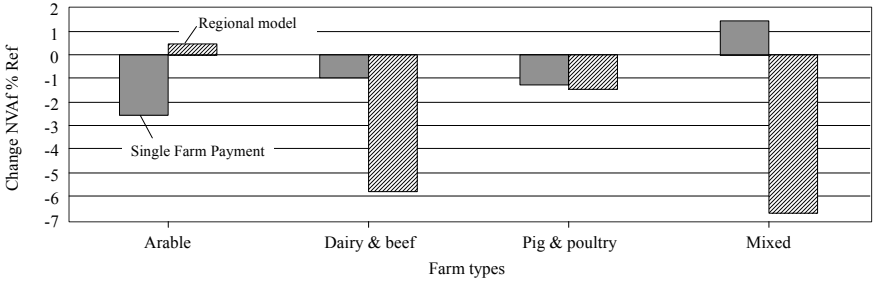
1) Projection of Agenda 2000 towards 2012. 2) Single Farm Payment. 3) German Implemention of decoupling (regional model). 4) Net valued at factor costs.
Source: FARMIS 2004.

### 3.3 Income effects

Despite the similar effects on production and allocation, the analysis shows that the schemes will differ with regard to their impact on incomes. In the final stage of the Regional Model the whole premium volume will be transferred into equal but regionally differentiated levels of entitlements for agricultural used land (excluding permanent crops). Entitlements will also be given to activities formerly excluded from premia schemes (i.e. vegetables) causing some distribution effects.

Using net-value added at factor costs (NVAf) as income indicator, income at sector level will decrease by 1.3 and 2.8 % for the SFP and the Regional Model, respectively. These results are caused by the milk market reform and the assumption that funds lost to the farmers due to modulation are not accessed again via Pillar II measures. As mentioned before the Regional Model will induce a rather strong redistribution of direct payments. The redistribution can only be identified looking at a disaggregated level, i.e. by farm types. Income effects by **farm types** are shown in Figure 2.

**Figure 2: Income effects (NVAf) by farm types**




Source: FARMIS 2004.

In the SFP scenario dairy and beef farms get 12.7 % higher direct payments due to increasing milk premia. In the Regional Model the redistribution of premiums from beef and dairy production towards land causes the increase of premia to be much lower (5.8 %). The model predicts income losses for beef and dairy farms to be 0.9 % in the SFP scenario and 5.7 % in the case of the Regional Model. Rather significantly different income effects can also be expected for mixed farms: 1.4 % (SFP) and - 6.7 % (Regional Model). Pig and poultry farms are not affected differently. In the SFP scenario incomes of arable farms decline while they increase by 0.4 % in the case of the Regional Model. This difference is caused by the redistribution of premia to land in the Regional Model. Especially farms with sugar beet production are benefiting because they did not receive area payments for land grown with sugar beets in the past.

The regional harmonisation of area payments in the German scheme also induces differing income effects at regional level (see Table 1). Particularly farm income in the North and South and also in the East is in comparison to the SFP negatively affected by the Regional Model. The Centre is positively affected by the premium redistribution and has slightly positive income effects compared to income losses of 0.8 % caused by the SFP.

### 3.4 Income effects allowing for rental prices

The above used income indicator does not include changes of rental prices for land and quota. The inclusion of regional markets for milk quota, arable and grassland enabled the modelling framework to quantify changes of equilibrium prices caused by changes of economic conditions. In the following the net-income is used as an additional income indicator. It is derived from NVAf by subtracting costs for hired labour and paid rents for milk quota and land. For the latter, the whole part of rented arable land and grassland is valued by the calculated equilibrium rental prices. Concerning transfers of entitlements in both decoupling scenarios it was assumed that they are always related to eligible land.

Changes of rental prices for **milk quota** due to decoupling of the milk premiums were are in the range of 3 to 4 ct /kg or about half of the rental prices in terms of the Agenda 2000 scenario. They do not deviate much between the two decoupled premia schemes and are mainly determined by reduced milk price.

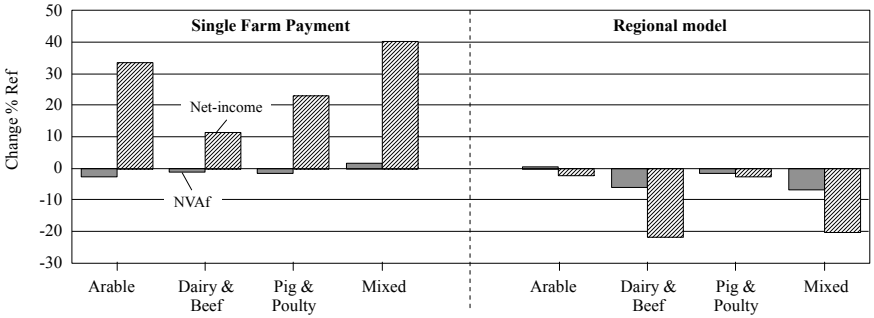
The impact of the decoupling schemes on the rental price for land differs by a huge degree. Decoupling via the *SFP* would induce a significant reduction of **rental prices for land** (Table 1). Those for arable and grassland decrease by 73 % and 11 %, respectively. This is mainly influenced by two facts: the different level of entitlements of farm groups within regions and the existence of land free of entitlements but eligible for entitlements (about 5 % of total area). Under these conditions not land but entitlements are the restricting factors to receive direct payments because farmers can lease-out land without losing entitlements. Therefore, the rental price for land is oriented towards the ground-rent of land excluding direct payments. Rental costs for land decrease by two thirds and net-income increases by 19.8 % at sector level.

In the case of the *Regional Model* the number of entitlements is equal to the amount of land (including permanent crops) and therefore land free of entitlements is absent. This causes rental prices for land to increase by 3 % for arable land but by more than 100 % for grassland. As a consequence rental costs increase by one quarter and net-income falls by 12 % at the sector level. This indicates transmission effects of direct payments in favour of land owners. As about 90 % of rented land belongs to owners engaged in non-agricultural sectors (DEUTSCHER BAUERNVERBAND, 2004), the Regional Model induces further income flows from agriculture towards other sectors.

Effects on net-income differ significantly by the farm types shown in Figure 3:

- **Arable farms** profit from the large reduction of rental prices for arable land in the SFP scenario. Their net-income will increase by one third. As the Regional Model induces a slight increase of rental prices for arable land only, changes of net-income will be only -1.9 % and therefore be in the same magnitude as the effects on NVAf. Income effects of **pig and poultry farms** do not differ much from the impact on arable farms.
- In the case of the SFP **dairy and beef farms** benefit from an increase of net-income by 11 %. In contrast the Regional Model causes net-income to diminish by 21.6 % due to the increase of rental prices especially for grassland. **Mixed farms** are affected in a similar way.

**Figure 3: Income effects including changes of rental prices**




Source: FARMIS 2004.

## 4 Summary and conclusions

FARMIS is used to assess the impact of 2003 CAP reform on the German agricultural sector. Two decoupling schemes are analysed: the Single Farm Payment (SFP) and the national implementation (Regional Model: RM). In comparison to Agenda 2000 strong effects on land use and supply are predicted for both scenarios. In particular arable crop and beef production are affected. Irrespective of the type of the decoupling scheme the results show similar impacts on factor allocation and corresponding supply. However, both decoupling schemes differ with respect to their impact on farm income. While at the sector level income effects of the two schemes are almost identical, in the case of the RM the income of beef and dairy farms is considerably reduced. These impact differences are caused by a re-distribution of direct payments induced by the RM.

With respect to the price development of agricultural assets two main effects are predicted: first, the rental value of milk quota will decline. This is mainly induced by price policy measures and decoupling and not by the type of decoupling. Second, in the case of the RM an increase of the rental value of land is forecasted while under conditions of the SFP falling land prices are predicted; in the case of the RM rents for arable land stay constant whereas rents for grassland increase. Increasing costs for land will be a burden on farms, which are willing to grow. Predominantly investment in dairy farms might be inhibited, as the positive effect of the quota price reduction is more than compensated by the milk price reduction and rising land rents.

However, the drawn conclusions at the reform's effect on structural change are preliminary, as it has to be acknowledged that the current model does not allow a comprehensive representation of structural change, yet. Within further modelling work this topic will be partially addressed by the implementation of (exogenously estimated) exit rates and the adjustment of aggregation factors. Currently, the model is further developed and applied towards other EU Member States based on the EU FADN[4]. A first application to France has already been realised (KUEPKER et al. forthcoming 2006). Following this, it is intended to apply the model towards other Member States of the EU-25.

4 This task was realised within two EU funded research projects in the 6th framework programme, EDIM (European Dairy Industry Model) and GENEDEC (A quantitative and qualitative assessment of the socio-economic and environmental impacts of decoupling of direct payments on agricultural production, markets and land use in the EU).

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