

An application of positive mathematical programming to analyse the effects of the Common Agriculture Policy in Transylvania.

Abstract

Presently, Romanian agriculture is part of a complex process of changes that are meant to create the legislative, organizational and institutional framework required in order to join the European Union, process politically accomplished in the 1st of January 2007. With the help of a "positive" recursive single period model, three North - Western Romanian agricultural farms (Transylvanian) specialized in field crops were modelled. Based on this model six scenarios are evaluated: Romania won't apply the CAP starting with 2007; the prices of Romanian agricultural products will decrease to the European level due to the trade liberalization; Romania will gradually apply the Common Agricultural Policy as a unique payment surface scheme starting with 2007; besides the European unique payments per hectare the farmers will receive national compensatory payments at different levels (10 % in the fourth scenario; 20 % in the fifth scenario or 30 % in the sixth scenario).

The results show that the trade liberalization will decrease the net income of the farmers without CAP payments. These will sustain their revenue, but for those who practice bigger prices than the EU ones, even in the optimist financial scenario, the revenue won't maintain to the same level as before joining. Furthermore, the production will suffer great changes: the farms will be specialized in those productions in which they have comparative advantages. For the others (wheat especially for the Transylvanian region) they have to change their technologies. In the matter of the financial constraints, the model shows that the credit access has a greater impact over the farms revenue than the interest rate level. So after joining, such measures should be taken to ensure their modernization.

Key words: The Common Agricultural Policy; positive mathematical programming; vegetable farms; Romania.

1. Introduction

The use and the development of mathematical models which can simulate the functioning ways of farms have an extremely rich tradition and practice.

At the European level these practices have been particularly used and developed at a conceptual level since the 1992 reform of the Common Agricultural Policy. When evaluating the impact of the proposed changes for the agricultural policy in terms of forecasted yields, there are three mathematical methods, being: the analysis of the different types of agricultural exploitations (the SIMULPAC method) (Carles and al., 1998); the linear programming method (which is the traditional method used in optimising the production structure) (Hazel and Norton, 1986); the positive mathematical programming – a highly attractive method due to the reduced information level required for building nonlinear models which can very well simulate the behaviour of the agricultural decision taker (by calibrating the production structure to a reference year) (Howitt, 1995). The use of these methods in simulating the farms' reactions to the changes in the macro-economical environment proved to be complementary. Using a specific type of mathematical model depends on the quality of the information that the researcher has on the analysed production structure, and the economical level to what the research has been done.

These kinds of researches have become increasingly intense after continuing the Common Agricultural Policy with the 2000 Agenda reform. Through these kinds of preoccupations the answers of the European farmers have been anticipated (French, Spanish, Italians, Germans, etc) by the European Commission's agricultural reform. The conclusions of these studies have been the basis of evaluating the impact of the up mentioned reforms on the European overproduction crisis (Boussard and al., 1997), (Barkaoui and Butault, 1998), (Judez and al., 1998),(Flury and al. 2000), (Heckelei and Britz, 2000) and (Chatellier, 2006).

These kinds of issues are extremely relevant to both European and Romanian agricultures whereas the last one is now preparing to join the Common Agricultural Policy. Analysing the way in which the Romanian farmers will react to the new policy conditions represents a challenge to both the European Commission and the Romanian institutional decision takers. These last ones have the responsibility to establish the agricultural strategies meant to ensure its rapid integration as part of the Common Market. The financial resources that the Romanian Government owns for such reforms are obviously extremely limited. From this perspective, identifying those decisions to be taken is a central concern to this study.

Therefore, the probable ways in which the Romanian farmers will react are modelled in a mono-periodical recursive framework with the help of the positive mathematical programming, section 2. The different ways in which the CAP can be applied in Romania were used as starting points in building six scenarios which are evaluated in section 3. Following the forecasted farmers' reaction, important conclusions for the Romanian Agriculture Policy are presented in the last part of this paper.

2. Material and methods

2.1 The model

The basic hypothesis of the model is that the farmer should maximise the net income of his farm taking into consideration the risk common to his activity, physical constraints (the land surface at use; the labour force at use; etc) and the financial constraints (treasury liquidities; the use of different kinds of credits; etc).

The developed model is a positive mono periodical recursive one and the optimisation of the production structure has been made over six years, starting with 2004. Broadening the forecasted period over 2010 is difficult, because the conditions of the Romanian' agricultural policy can't be established for certain. The choice of a specific forecasted period has to take into consideration the fact that the most important decisions are to be taken immediately after joining. The decisions to be taken in the future can be modified greatly with the new information that is going to be available (Boussard, 1987).

The model is a recursive one because the results obtained after optimising the structure of production in year "t" are used as starting data for the optimisation made for year "t+1" (especially the treasury level; the level of placements and the borrowing levels). The way in which the available resources were used in the reference year in the modelled farms, is considered to be optimum, the production pattern is optimum reported to the maximum level of the risk that the farmer wants to assume (Howitt, 1995) and that's why the model is positive.

The first issue which has to be overcome when building a model is that of establishing its activities and constraints. Field crops have been established as activities in the simulations (cereals, oil plants, vegetables, etc) because:

- in Romania these have the greatest degree of incidence;
- the CAP will produce important macro-economical changes in their production;

2.2 Taking risk into consideration

Risk represents a very important variable in the farm's behaviour simulation and can be modelled in various ways:

- building the objective function with the use of criteria such as "safety-first" (Hazel and Norton , 1986). In this kind of model the farmer is sensible only to the negative evolutions of his income. In the objective function, a coefficient of risk aversion is introduced (it represents the substitution rate between the expected income and its variability). This coefficient is characteristic to each farmer and its level depends on his own risk aversion. In practice, this coefficient was used as calibrating tool (Boussemart and al., 1996), so it is chosen to minimise the gap between the observed choices of the farm (especially the production pattern) and the results obtained in the optimisation. That coefficient is an exogenous parameter which makes the model not very sensitive to agricultural politics changes;
- the model can be calibrated using an PMP classical approach in which the parameters are most likely to have been used by the farmer are represented in a quadratic function (cost function or yield function) (Howitt, 1995). In order to apply this method there have to be known not only the technical and economical coefficients of the outputs, but also economical results like: the gross margin per hectare; the variable average cost per hectare; the selling price of an yield unit, etc (Gohin and Chantreuil, 1999);

Whereafter, the model becomes more flexible and in the same time more sensitive to agricultural policy incentives. When taking into account the nonlinearity of the objective function, this can be done in two ways:

- by introducing an ascending cost function in the model for every type of production, while considering a constant yield per hectare when expanding the cultivated surface with a certain culture;
- by introducing an descending yield function when expanding the cultivated surface with a certain culture;

The issue of optimising for a farmer using "m" inputs and producing "n" outputs becomes:

$$\max \sum_{i=1}^n (P_i * (\beta_i - \delta_i x_i) * x_i - \sum_{j=1}^m \varpi_j a_{ji} x_i)$$

subject to the following set of constraint s :(1)

$$Ax \leq b \text{ and } x \geq 0$$

, where:

- β_i and δ_i represent the free term and the slope (the parametres) of the yield function for output "i";
- P_i - the price per unit for output "i";
- A – is a n x m dimension matrix with a_{ij} elements which represent the necessary quantity of input "j" in order to produce a unit of output "i";
- x_i - is the surface cultivated with production "i";
- ϖ_j is the cost of a unit of input j;

To determine the parameters of this objective function, there are necessary three stages (Howitt, 2005):

- establishing the shadow prices for those agricultural activities that in the base year should have a greater surface in the production pattern, but which due to the risk aversion of the farmers, were cultivated on a smaller acreage.

To do it, the following linear model in which the objective function maximises the farmer profit in the base year of production (2004 in our case) can be established:

$$\max \sum_{i=1}^n (p_i \bar{q}_i - CMV_i) * x_i$$

, subject of the following set of constraints:

$$\begin{aligned} x_i &\leq x_i^* + \varepsilon, \forall \quad i = \overline{1, n} \quad (\lambda_2) \\ \sum_i x_i &\leq \sum_i x_i^* \quad (\lambda_1) \end{aligned} \quad (2)$$

et

Where:

$$x_i \geq 0$$

- i different production types in the base year (n is their complete number);
- p_i the selling price for an “i” production unit;
- \bar{q}_i the average production obtained in “i” branch in the reference year;
- CMV_i the variable average cost needed to cultivate an hectare of “i” production ;
- x_i^* - the surface (hectares) which has been allocated for “i” production type ;
- ε is an vector which counts the calibration constraints’ perturbation (Howitt, 1995).

The perturbations are chosen in an exogenous manner as small positive numbers, and their use in the model is motivated by the need to prevent the degeneracy problem. The shadow prices of the fixed resources (land in this case λ_1) rest in the same time unaffected by the use of the calibration constraints sets.

The model was applied on the economical and the financial data of the three agricultural exploitations specialised in field production from Central Transylvania:

Table 1: Data used in the model

| Description | Farm 1 | | | | Farm 2 | | | | Farm 3 | | | |
|----------------------|--------|-------------|---------|---------|--------|-------------|---------|---------|--------|-------------|---------|---------|
| | p_i | \bar{q}_i | CMV_i | x_i^* | p_i | \bar{q}_i | CMV_i | x_i^* | p_i | \bar{q}_i | CMV_i | x_i^* |
| <u>Cereals:</u> | | | | | | | | | | | | |
| Wheat | 539.28 | 2.33 | 1065 | 12 | 420 | 2 | 973.94 | 90 | 712 | 3.3 | 854.57 | 236 |
| Durum wheat | -- | -- | -- | -- | 550 | 0.666 | 226.67 | 3 | -- | -- | -- | -- |
| Rye | -- | -- | -- | -- | 510 | 1.25 | 553.34 | 12 | -- | -- | -- | -- |
| Barley | -- | -- | -- | -- | 390 | 0.8 | 298 | 5 | 525 | 4 | 856 | 10 |
| Spring barley | 635 | 2.19 | 741 | 10 | 390 | 2 | 702.81 | 16 | 816.7 | 3 | 703.33 | 60 |
| Oat | 522 | 2 | 540 | 5 | 540 | 0.4 | 216 | 5 | -- | -- | -- | -- |
| Corn | 610 | 3 | 572.5 | 20 | 375 | 1.6 | 547 | 25 | 480 | 5 | 910 | 100 |
| Other cereals | 200 | 2.5 | 100 | 20 | 500 | 0.833 | 387.5 | 12 | -- | -- | -- | -- |
| <u>Proteaginous:</u> | | | | | | | | | | | | |
| Peas | -- | -- | -- | -- | 620 | 1.4 | 814 | 5 | -- | -- | -- | -- |
| Lentil | -- | -- | -- | -- | 620 | 0.833 | 487.5 | 6 | -- | -- | -- | -- |
| <u>Oleaginous</u> | | | | | | | | | | | | |
| Soya | -- | -- | -- | -- | 2954.8 | 1.2 | 718.96 | 5 | -- | -- | -- | -- |
| Sun flower | -- | -- | -- | -- | -- | -- | -- | -- | 2000 | 1.5 | 385 | 10 |
| Other productions: | | | | | | | | | | | | |
| Potatoes: | -- | -- | -- | -- | -- | -- | -- | -- | 300 | 3 | 580 | 10 |
| Green crops: | -- | -- | -- | -- | -- | -- | -- | -- | 300 | 8 | 370 | 40 |

Source: DADR Bistrita and DADR Cluj Napoca – questionnaires completed by the farmers;

Where:

- p_i is the price per tone of the “i” output in RON/tonne;
- \bar{q}_i is the average “i” yield in tonne/ha ;

- CMV_i in the medium variable cost in RON/tonne ;
- x_i^* is the production pattern used by the farmer in 2004– the base year in hectares;

After optimising the model (2), results show that for the first farm, the less attractive output is wheat (table 2), for the second such production is oat and potatoes for the third farm. So these three crops were cultivated due to the risk aversion of the farmer.

Table 2: The opportunity cost paid in 2004 by the farmers to secure their income in RON

| Exploitation | Wheat | Durum wheat | Rye | Barley | Spring barley. | Oat | Corn | Other cereals | Peas | Lentil | Soya | Sun flower | Green crops: |
|--------------|---------|-------------|-------|--------|----------------|-------|--------|---------------|------|--------|--------|------------|--------------|
| The first | ---- | ---- | ---- | ---- | 456.22 | 404 | 1157.5 | 300 | ---- | ---- | ---- | ---- | ---- |
| The second | 62.38 | 139.63 | 54.16 | 14 | 150.12 | ---- | 53 | 29 | 54 | 28.96 | 2826.8 | ---- | ---- |
| The third | 1175.03 | ---- | ---- | 924 | 1426.77 | | 1170 | ---- | ---- | ---- | ---- | 2295 | 1710 |

For instance, the first farmer gave up to 1157,5 RON when in 2004 he decided to produce wheat instead of corn. These production plans, even if they were less effective, they would have met the risk level that the farmers were ready to assume.

With these opportunity costs (λ_{2i}) (table 2) and the equations $\delta_i = \frac{\lambda_{2i}}{p_i x_i^*}$ and $\beta_i = \bar{q}_i + \delta_i * x_i$ (Howitt, 1995), the parameters of the yield function can be calculated.

Table 3: The yield function parameters

| Exploitation | Parameters | Wheat | Durum wheat | Rye | Barley | Spring barley. | Oat | Corn | Other cereals | Peas | Lentil | Soya | Sun flower | Green crops: |
|--------------|------------|--------|-------------|-------|--------|----------------|------|--------|---------------|-------|--------|-------|------------|--------------|
| The first | δ_i | -- | -- | -- | -- | 0.07 | 0.15 | 0.09 | 0.07 | -- | -- | -- | -- | -- |
| | β_i | -- | -- | -- | -- | 2.91 | 2.77 | 4.90 | 4.00 | -- | -- | -- | -- | -- |
| The second | δ_i | 0.0016 | 0.085 | 0.014 | 0.007 | 0.024 | -- | 0.0056 | 0.005 | 0.017 | 0.077 | 0.835 | -- | -- |
| | β_i | 2.61 | 0.0921 | 1.418 | 0.83 | 2.57 | -- | 1.74 | 0.833 | 1.485 | 0.879 | 5.3 | -- | -- |
| The third | δ_i | 0.01 | -- | -- | 0.18 | 0.03 | -- | 0.02 | -- | -- | -- | -- | 0.11 | 0.14 |
| | β_i | 4.95 | -- | -- | 5.76 | 4.75 | -- | 7.44 | -- | -- | -- | -- | 2.65 | 13.7 |

The objective function of the model maximises the net income for each farm which represents the financial resources at the end of each year. These can be used for investments in the following year or to pay the dividends. The net income is defined as the difference between the commercial outputs value and the total production costs. The non linear objective production is becoming:

$$\max(\sum_p \sum_i (P_i(\beta_i - \delta_i x_i)x_i - CMV_i)x_i + (P_r * \bar{q} - CMV_r) * x_r - INTPAY + INTRECU - CHARGI - AMORTI - INVAMORTI - H \text{ sup lim} * PH - FVI * PMT - FEr \text{ sup lim} * Pr \text{ fer}) \quad (3).$$

Where:

- « p » represents the different production techniques ;
- « i » represents the different types of crops produced by each farm;
- P_i is the price per unit obtained in crop “i” (ron/tonne) ;
- δ_i et β_i are the parameters of yield function ;
- x_i is the surface allocated to the “i” crop in the crop rotation (ha) ;
- P_r is the price of the selling unit in the less efficient crop ;
- \bar{q} is the average yield obtained in the least favourable production ;
- CMV_i is the average variable cost for yielding one hectare of the “i” crop (ron/ha) ;

- INTPAY is the interest paid by the farm for obtained credits (on short or long run) (ron);
- INTRECU the possible interests obtained for the placements with the treasury liquidities (ron);
- CHARGI is the general administration costs (ron) ;
- AMORTI are the amortisation costs (ron) ;
- INVAMORTI is the value of the new investments made in the base year (ron) ;
- H_{suplim} supplementary working hours in the agricultural exploitations (based on the season market) ;
- PH the price per hour of an supplementary working hour (calculated on the base of the average income in Romania) ;
- FVI the owned surface (ha) ;
- PMT the opportunity cost per hectare of arable land (in RON/Ha), calculated by the dual of the model;
- FER_{suplim} the leasable arable land (in ha) ;
- Pr_{fer} is the rental per hectare (in ron/ha); for the base year the rental corresponds to the real expenses paid by the farmer; for the following years it follows the land opportunity cost;

2.3. The model constraints

The economical and mathematical programming models represent the functioning mode of a farm (Hazel and Norton, 1986). Thus, the constraints system needs to simulate the real conditions on which a farmer takes his decisions. In this model, multiple types of constraints have to be taken into account:

- i. constraints simulating factorial resources:
 - **the available arable land:** the cultivated surface within a year cannot exceed the area in property plus leasable and bought land;
 - **the available labour force:** the necessary labour time to organise the optimal rotation of the crops cannot exceed the permanent working force (family or hired labour in full time) to which can be added the seasonal labour;
 - **agronomical requirements:** in order to be functional, the production pattern has to undergo certain agronomical constraints. In this paper, farms are specialised in cereal production, therefore the built model imposed a three years crops rotation: corn – other cereals;
- ii. treasury constraints due to:
 - **the operational treasury balance,** the liquidities in and the liquidities out must be balanced. In order to assure an optimal management of the treasury, the farmer has to follow up the gap between obtaining the production counter balance and paying his legal duties (salary, taxes, payments) enhanced with possible annual payments (annuities for the obtained loans). The last month treasury balance to which there are added the liquidities in the analysed period reduced with the value of monthly costs determine the final monthly treasury balance. The available data, namely the three modelled farms (FADN questionnaire written by the farmer) didn't allow to build a monthly equation of the treasury constraint. Still, there has been built a yearly operational treasury constraint in order to balance it. The operational needed capital represents all the production cost encountered from the moment of starting the production within the moment of gather in. Moreover, the operational capital resources are represented by the starting-period liquidities and the short-run credits.

- **the treasury balance at the end of year** : the cash (liquidities) at the end of the base year (for the optimised year) is equal to the sum between the last year end liquidities , the gross margins and the credits minus the current year annuities;

iii. financial constraints: if the financing possibilities were unlimited, the producer would be interested in capital placements in his farm for a short period of time (by immobilising it in the present production) or by making long-run capital placements (investments), taking into consideration the agricultural constant return to scale hypothesis (Boussard, 1987). Actually, the financial resources which can be borrowed are incredibly limited because agriculture is a very risky activity. However, the bankers would rather prefer bigger farms which can provide better collaterals in receiving credits. Based on these observations, farms development is limited to the capital level which they can attract. Consequently, there have been built the following types of financial constraints:

- **financing the present production needs**: this constraint stands for overcoming the gap between paying the duties which are part of the productive process (payments for agricultural inputs, payments of the salaries; payments of the legal duties) and the money received (the production value) smaller at a certain time. This temporary unbalanced situation has to be financed from external resources. These are represented by the short term bank loans because the modelled farms have a juridical form. The level of short term bank credits doesn't have to exceed a certain level established by the bank. In its definition, it has been taken into consideration the legal issues – Law 311/2001 – the agricultural credit law – which say that when contracting such credits, the state through the Rural Credit Warranty Fund, warranties 80 % of the contracted credit volume. Based on this information, it is most likely that the banks will give credits solely if the liquidities of the agricultural farm represent 20 % of the required credit;

- **financing the achieved investments**: the decision for an investment requires a financial engagement assumed on several years (Boussard, 1987). In this situation an economical and mathematical monoperoiodical programming model can't assure very good answers. The Johnson theory (1951) regarding immobilisations of capital says that they have fixed value over a short period. That's why their supplementary depreciation must be part of the objective function, and the model accepts an investment only if the annual income value rise is higher than the depreciation rate and the financial spendings in case of financing the investments by long-run credits;

In order to simulate these constraints, several equations have been used. The first establishes the extra financial resources after covering the production spendings, resources that the farmer can decide to use for new investments in short-run capital placements (deposits) or long-run placements (farm investments). In financing the investments, the model takes into account that their value cannot exceed the volume of resources at dispense in the farm to which one can add the possible credits for the contracted investments. The maximum level of the contracted credits has been established in the model in an arbitrary mode.

- other financial information: mainly mean the financial spendings of the farms. These costs are due to the short and long-run credits of the farm. The financial spendings for the contracted credits are optimised by the model regarding their moment of contracting and their level. For credits with over a yearly period of contracting there was used the reimbursement system with constant annuities. The rate of interest of these credits is the same as the one on the Romanian capital market. For the short-run credits, the rate of interest was 20 % (an observed average in 2004), and for long-run credits 15 % (www.bnr.ro). Moreover, for capital placements, it was considered a rate of interest of 12 % (www.bnr.ro).

3. Results and discussions

3.1 The scenarios

The agriculture plays a very important role in the Romanian economy. Therefore, almost 31,5 % of the Romanian active population worked in 2003 in agriculture and had a contribution of 11,6 % in the GDP. In this meaning, Transylvania produced 24,7 % of the Romanian GDP and its agriculture had around 26,8 % contribution in the Romanian agriculture value added (INSSE, 2004). The arable land counts in this area 1.466.591 hectares (16,71 % of the total Romanian resource) : 59,02 % is used for cereals; 6,63 % for potatoes and 4,94% for oil plants. Moreover, two types of farms can be distinguished: farms without juridical status that have an average 1,28 Ha and farms with juridical status that have 105 hectare in average (INSSE, 2003). So the acreage is very much divided for the individual farms (very low average compared to the EU ones).

The scenarios are mainly about evaluating the effects of different possible ways of introducing the CAP payments system in the Romanian agriculture. These possibilities are scheduled in the Adhesion Treaty (Chapter 7 – Agriculture) that was signed between Romania and the European Union; the right choice can assure a rapid modernisation of the Romanian agriculture.

The first scenario presumes that the CAP won't be implemented in Romania starting with 2007 and that the Romanian farms will function having the same agricultural politics conditions (without receiving European decoupled direct payments) –**scenario (I)**.

Romania's joining the European Union shall be followed up by free trade liberalisation of the agricultural products. This is the reason why the Romanian prices shall be getting in line with the European ones (table 4). **In the second scenario (II)**, Romania shall join the Common Market, and the selling prices for the Romanian agricultural products are similar to the European ones. So, it is assumed that the prices at which the modelled farms can sell their crops will be reduced, as in the table below:

Table 4: The evolution of the selling prices after joining the EU

| Production | The first farm | The second farm | The third farm | Average European prices* |
|---------------|----------------|-----------------|----------------|--------------------------|
| | In RON/tonne | In RON/tonne | In RON/tonne | In RON/tonne |
| Wheat | 539,28 | 420 | 712 | 379,49 |
| Durum wheat | - | 550 | - | 569,87 |
| Barley | - | 390 | 525 | 384,61 |
| Spring barley | 635 | 390 | 816,7 | 438,72 |
| Oat | 522 | 540 | - | 361,94 |
| Corn | 610 | 375 | 480 | 390,9 |
| Sun flower | 2000 | - | - | 734 |
| Potatoes | - | - | 300 | 300 |

Source: www.agpb.fr/fr/chiffre/prix.asp

As a recent study says, Romanian European Institute-Impact studies III- study number 6 (2005), Romania chose to implement the direct European financial support given to farmers as a unique payment surface scheme (UPSS) (for more insight about the CAP in Romania see Appendix A). The main reasons for this decision were of technical and budgetary nature. This decision affects over half of the Romanian farms, because as the General Agricultural Survey

data show that 49,5 % of the 4,5 million Romanian farms use less than 1 hectare of land, which makes them non eligible for UPSS.

In this payment scheme, the value of hectare direct payments is calculated by dividing the national direct payments limits to the total eligible surface for these kinds of support. The starting point in evaluating the surface unique payments is the same with the data from the Romanian National Institute of Statistics for surfaces bigger than 1 hectare (the first eligible condition), and this is around 12651447,6 hectares (Romanian European Institute-Impact studies III- study number 6 , 2005).

The hypothesis taken into consideration in determining the hectare unique payments are the following:

- the period of applying the UPSS is supposed to be five years (time in which Romania will perfect the ICAS);
- the national limit for direct payments for the 2007-2009 period is 881 millions euros (Romanian European Institute, study number 6, 2005) and it represents the financial flow for two years (2008 and 2009). The explanation resides in the fact that after the first year after joining ,direct payments shall be given from the state budget; they are to be discounted by 2008 from the EU budget while the payments from 2008 are to be given back by 2009;
- the value limit for direct payments for 2007 is 422,88 million euros (48 % in 2007) and for 2008 – 458,12 million euros(52 % with 5 % raise more than the year before);
- for the 2009-2010 period, we estimate an annual raise of 5 % of the national financial limit for direct payments, after which this will raise with 10 %.

With the **third evaluated scenario (III.1)** Romanian farms will receive unique payments per hectare after Romanian's joining the EU as part of the unique surface payment scheme, and the selling prices shall be similar to the European ones. According to the up mentioned hypothesis, the amount of these payments is the following:

Table 5: The unique surface payments (USP) level received in EURO/ha – scenario III.1

| Elements | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|----------|------|------|------|------|------|------|
| USP/HA* | 33,4 | 40,1 | 46,8 | 53,5 | 66,8 | 80,2 |

USP/HA – the financial package foreseen to be given to Romania for direct payments divided to the eligible surface.

Knowing the different possible ways of supplementing the European financial package with national compensatory direct payments (NCDP) (Appendix A), the following three scenarios were built. Mainly these evaluate the impact of the Romanian government's decision to give them for all eligible surfaces (for those sectors which are covered by the EU-15 support schemes) but with different intensities. Therefore, **scenario III.2** evaluates the impact of supplementing the surface unique payments with an additional 10 % as national compensatory direct payments; meanwhile, **scenario III.3** presumes that NDCP will raise at 20% as compared to the European subsidies level per hectare; nevertheless in **scenario III.4**, the NDCP shall reach the highest possible level of 30%. In the mean time the prices will align to those of the unique EU market. From this point of view, the forecasted financial support received by the modelled farms after 2007 have the following level:

Table 6: The level of financial support received per hectare when USP are supplemented with NDCP in euro/ha;

| Elements | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|----------------|-------|-------|-------|-------|-------|-------|
| USP/HA* | 33,4 | 40,1 | 46,8 | 53,5 | 66,8 | 80,2 |
| NDCP 10 % | 13,37 | 13,37 | 13,37 | 13,37 | 13,37 | 13,37 |
| NDCP 20 % | 26,74 | 26,74 | 26,74 | 26,74 | 26,74 | 26,74 |
| NDCP 30 % | 40,11 | 40,11 | 40,11 | 40,11 | 40,11 | 40,11 |
| Scenario III.2 | 46,8 | 53,5 | 60,2 | 66,8 | 80,2 | 93,6 |
| Scenario III.3 | 60,2 | 66,8 | 73,5 | 80,2 | 93,6 | 106,9 |
| Scenario III.4 | 73,5 | 80,2 | 86,9 | 93,6 | 107,0 | 120,3 |

Source: own results based on the financial package given to Romania.

3.2 Validation and results

3.2.1 Model calibration and sensitivity

The model simultaneously optimises: the production pattern, the investments level, the contracted credits, and also the capital placements. To be representative, the model has to calibrate to a base year (Hazel and Norton ,1986). It calibrates correctly when the optimum solution obtained corresponds to the decision taken by the farmer in that year. The simplest way to test the validity of the model is that of comparing the obtained rotation of crops with that actually applied in each farm in 2004:

Table 7: The analysis of the model validity as compared to the real crops rotation and the calibrated one

| Farm | | Wheat | Durum wheat | Rye | Barley | Spring barley | Oat | Corn | Other cereals | Peas. | Lentil | Soya | Sun flowers | Potatoes | Green crops: |
|------|------------|--------|-------------|------|--------|---------------|-----|--------|---------------|-------|--------|------|-------------|----------|--------------|
| 1 | Real | 12 | - | - | - | 10 | 5 | 20 | 20 | - | - | - | - | - | - |
| | Calibrated | 3,2 | | | | 10,9 | 5,2 | 22.11 | 25,4 | | | | | | |
| 2 | Real | 90 | 3 | 12 | 5 | 16 | 5 | 25 | 12 | 5 | 6 | 5 | - | - | - |
| | Calibrated | 91.5 | 2.99 | 11.9 | 4.7 | 15.99 | 5.7 | 25.11 | 5.7 | 5.06 | 5.97 | 2.54 | - | - | - |
| 3 | Real | 236 | - | - | 10 | 60 | - | 100 | - | - | - | - | 10 | 10 | 40 |
| | Calibrated | 237.41 | - | - | 10.08 | 60.11 | - | 100.23 | - | - | - | - | 11.58 | 10.02 | 40.07 |

Source: the obtained results in the second stage of the PMP model

The results from the upper table show the model calibration. There are only two main limits: in the case of the first farm, it concerns the wheat and respectively, in the second farm the other cereals. These are the less efficient yields used in both farms, and in the objective function there was estimated a constant return per hectare for them. To overcome it, there should be established the price elasticities for these outputs (Howitt, 2005), (Heckelei, 2005). As a result, a yield function can be parameterised in the model. The information available on the Transylvanian farms, isn't sufficient to determinate these elasticity coefficients (no panel data). Even with these limits the model calibrates well. Moreover, for the third exploitation, the model has almost a total calibration.

The analysis of the model sensitivity to the risk aversion coefficients has been done with the purpose of judging the stability of the model. For fulfilling this issue, the yield function slope from the objective function has been changed in the sense of raising or falling as the next figure shows. We can see that the net income obtained at the farm level is sensitive to the variation of risk coefficients. When the aversion towards risk is high, the net income per hectare falls. On the other hand, the total cultivated surface doesn't show important changes:

Figure 1: The model sensitivity: farm 1;

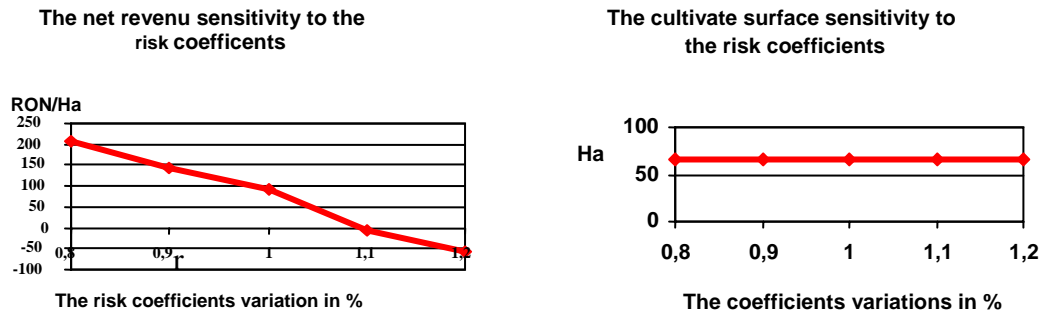


Table 8: The sensitivity of production pattern to risk coefficients – farm 1

| Risk coefficients variation | 0,8 | 0,9 | 1 | 1,1 | 1,2 |
|-----------------------------|-------|-------|-------|-------|-------|
| Wheat | 2,94 | 10,87 | 4,7 | 2,94 | 6,13 |
| Barley | 11,79 | 10,25 | 10,8 | 11,79 | 8,81 |
| Oats | 5,79 | 4,92 | 5,16 | 5,79 | 4,8 |
| Corn | 22,79 | 22,11 | 22,11 | 22,77 | 22,1 |
| Other cereals | 23,69 | 18,83 | 24 | 23,69 | 25,13 |

Actually, the crops rotation isn't very sensible to risk coefficients. The only outputs which are intensively linked to the risk coefficients are the ones with the highest and the smallest gross margins per hectare. Based on these considerations, we can conclude with the fact that the model well represents, the functioning ways of the three farms.

3.2.2 The results

A. The CAP impact on the farmer's gross margin

The level of the financial support given to Romanian farmers after joining represents an important element which shall influence especially the way in which they fundament the production decisions. In the below table the impact of the financial sustaining on the average gross margin per hectare can be analysed for each farm in different scenarios.

Table 9: The evolution of the average gross margin per hectare after the CAP implementation
In ron/ha

| Scenarios | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|-----------|------|------|------|------|------|------|
| Farm 1 | | | | | | |
| I. | 723 | 663 | 791 | 817 | 817 | 817 |
| II. | 723 | 663 | 457 | 457 | 457 | 457 |
| III.1 | 723 | 663 | 503 | 510 | 515 | 519 |
| III.2 | 723 | 663 | 526 | 529 | 542 | 563 |
| III.3 | 723 | 663 | 542 | 564 | 586 | 608 |
| III.4 | 723 | 663 | 588 | 610 | 631 | 662 |
| Farm 2 | | | | | | |
| I. | 82 | 82 | 82 | 82 | 82 | 82 |
| II. | 82 | 82 | 69 | 69 | 69 | 69 |
| III.1 | 82 | 82 | 176 | 197 | 219 | 239 |
| III.2 | 82 | 82 | 222 | 243 | 264 | 284 |
| III.3 | 82 | 82 | 256 | 264 | 283 | 301 |
| III.4 | 82 | 82 | 290 | 309 | 327 | 346 |
| Farm 3 | | | | | | |
| I. | 1686 | 1678 | 1642 | 1642 | 1642 | 1642 |
| II. | 1686 | 1678 | 1087 | 1087 | 1087 | 1087 |
| III.1 | 1686 | 1678 | 1220 | 1237 | 1256 | 1274 |
| III.2 | 1686 | 1678 | 1234 | 1270 | 1265 | 1288 |
| III.3 | 1686 | 1678 | 1249 | 1265 | 1284 | 1303 |
| III.4 | 1686 | 1678 | 1264 | 1268 | 1293 | 1289 |

The evolution of the average forecasted gross margin per hectare in all the six scenarios is depending on the modelled farm. In the case of farm 1 and farm 3, if the trade agricultural food will be liberalised, the gross margin per hectare shall decrease, to a great extent (35 % and 31 % for farm 3 and farm 1 respectively). Nevertheless, in the case of farm 2, the decrease of the gross margin per hectare due to free food trade is only around 16%. When the farms will receive decoupled unique payments per hectare (the third scenario), the average gross margin per hectare will raise, supporting in this way the farmers' incomes. Even in this situation, the farms react differently, after receiving the unique surface payments. Farm 1 and 3 won't reach the average gross margin per hectare which existed before the reform.

In the III.4 scenario, farm 1 will recover 39 % of the average gross margin per hectare loss as a result of the price liberalisation, while farm 3 only 31 % of this loss. Still, one can see that farm 2 has a different behaviour. Even in the scenario in which the unique surface payments are not supplemented with national compensatory payments, the gross margin/ hectare doubles as compared to the gross margin/ hectare which had been before the reform.

The different farms' behaviour to the Common Agricultural Policy has as a starting point in their micro-economical situation. Farms that sell their production at higher prices than the EU-15 ones (which is the case for the first and the third farm) expect to have important gross margin/ hectare falls together with Romania's joining the European Union. On the other hand, farms which apply more performant technologies and which sell their production at prices similar to the EU 15 ones shall maintain the incomes they had before the reform, if there are unique surface payments (which are the case for the second farm).

B. The Common Agricultural Policy's impact on the acreage and on the crop rotation

As the next tables shows, the crop rotation will be completely changed after Romania's joining the European Union and the trade liberalisation. In the crop rotation, there are two types of outputs:

- production branches, which become totally inefficient, due to the fall of the selling prices;

In the case of farm 1 the wheat crops won't be yielded after Romania's joining the European Union; in farm 2, the used agricultural surface for wheat crops shall decrease with about 84 % (from 91,6 hectares before free prices down to 14,4 hectares after their liberalisation); for farm 3, the wheat surface shall decrease with almost 49 % (from 226 hectares before Romania's joining the European Union down to 115,6 after joining the EU).

- crops as barley, oats, cord and others won't encounter spectacular fluctuation in the crop rotation .

The wheat production in the region where the farms are located (Bistrita Nasaud and Cluj) is not very relevant, because this cereal potential is low. As a conclusion for the results obtained, we can estimate a specialisation of the Transylvanian farms to those outputs branches which suit best to the local comparative advantages.

Farm's 1 forecasted acreage show that without any subsidies (scenario II) the farmer will restrict the production to the most attractive outputs (oats, corn and other cereals). Moreover, the wheat wouldn't be produced with the same technologies after joining. Furthermore the farm will receive direct payments without cultivating any outputs on 5 % of its initial surface:

Table 10: Crops rotation in different scenarios in hectares – farm 1

| Production type | Scenario.I | Scenario.II | Scenario.III.1 | Scenario.III.2 | Scenario.III.3 | Scenario.III.4 |
|-------------------|------------|-------------|----------------|----------------|----------------|----------------|
| Forecast for 2007 | | | | | | |
| Wheat | 12 | 0 | 0 | 0 | 0 | 0 |
| Barley | 10,4 | 7,3 | 8,8 | 9,4 | 9,9 | 10,1 |
| Oats | 4,8 | 3,7 | 4,5 | 4,8 | 5,1 | 5,3 |
| Corn | 19,6 | 17,3 | 19,4 | 20,4 | 21,4 | 21,8 |
| Other cereals | 20,2 | 23,0 | 26,7 | 27,4 | 28,5 | 28,9 |
| Total | 67 | 51,3 | 59,4 | 62 | 64,9 | 66,1 |

Table 11: Crop rotations in different scenarios in hectares – farm 1

| Production type | Scenario.I | Scenario.II | Scenario.III.1 | Scenario.III.2 | Scenario.III.3 | Scenario.III.4 |
|-------------------|------------|-------------|----------------|----------------|----------------|----------------|
| Forecast for 2010 | | | | | | |
| Wheat | 12 | 0 | 0 | 0 | 0 | 0 |
| Barley | 10,4 | 7,3 | 10 | 10 | 10 | 10 |
| Oats | 4,8 | 3,7 | 5,2 | 5,2 | 5,2 | 5,2 |
| Corn | 19,6 | 17,3 | 19,6 | 19,6 | 19,7 | 19,7 |
| Other cereals | 20,2 | 23 | 28,8 | 28,8 | 28,8 | 28,8 |
| Total | 67 | 51,3 | 63,6 | 63,6 | 63,7 | 63,7 |

Farm 2 has nearly the same behaviour. Still, some crops such as the barley shall raise the crop areas from 4,7 hectares before the reform up to 16,5 hectares in the case of the scenario with the most important financial sustaining. As well, corn will gain almost 25 hectares in the farm's 2 acreage but oats wouldn't be used in the production pattern. The total forecasted acreage used in production seems to rise with almost 24 % by renting additional plots:

Table 12: Crop rotations in different scenarios in hectares – farm 2

| Production type | Scenario I | Scenario II | Scenario III.1 | Scenario III.2 | Scenario III.3 | Scenario III.4 |
|-------------------|---------------|---------------|----------------|----------------|----------------|----------------|
| Forecast for 2007 | | | | | | |
| Wheat | 91,6 | 14,4 | 50,6 | 50,6 | 61,3 | 72,5 |
| Durum wheat | 2,98 | 3,06 | 3,5 | 3,5 | 3,7 | 3,8 |
| Rye | 11,9 | 11,9 | 14,9 | 14,9 | 15,9 | 16,7 |
| Barley | 4,7 | 3,9 | 12,1 | 12,1 | 14,5 | 16,7 |
| Spring barley | 15,99 | 20,2 | 22,2 | 22,2 | 22,9 | 23,4 |
| Oats | 12,3 | 0 | 0 | 0 | 0 | 3,29 |
| Corn | 25 | 33,3 | 43,2 | 43,2 | 46,1 | 48,7 |
| Other cereals | 5,8 | 5,8 | 14,6 | 14,6 | 17,2 | 19,6 |
| Peas | 5,1 | 5,1 | 7,1 | 7,1 | 7,8 | 7,8 |
| Lentils | 5,97 | 5,96 | 10,6 | 10,6 | 11,9 | 11,9 |
| Soya | 2,5 | 2,5 | 2,6 | 2,6 | 2,6 | 2,6 |
| Total | 183,84 | 106,12 | 181,4 | 181,4 | 203,9 | 226,99 |
| Forecast for 2010 | | | | | | |
| Wheat | 91,6 | 14,4 | 47,2 | 47,2 | 72,3 | 72 |
| Durum wheat | 2,98 | 3,07 | 3,5 | 3,5 | 3,8 | 3,8 |
| Rye | 11,9 | 11,9 | 14,7 | 14,7 | 16,6 | 16,6 |
| Barley | 4,7 | 3,9 | 11,4 | 11,4 | 16,5 | 16,5 |
| Spring barley | 15,9 | 20,2 | 22,1 | 22,1 | 23,3 | 23,3 |
| Oats | 12,2 | 0 | 0 | 0 | 0 | 5,52 |
| Corn | 25,1 | 33,4 | 42,3 | 42,3 | 48,4 | 48,5 |
| Other cereals | 5,8 | 5,8 | 13,8 | 13,7 | 19,3 | 19,4 |
| Peas | 5 | 5,1 | 6,96 | 6,9 | 7,5 | 7,6 |
| Lentils | 5,9 | 5,9 | 10,1 | 10,1 | 11,2 | 11,4 |
| Soya | 2,5 | 2,5 | 2,6 | 2,6 | 2,6 | 2,6 |
| Total | 183,58 | 106,17 | 174,66 | 174,5 | 221,5 | 227,22 |

After 2007, wheat will lose 37 % of the arable land in farm's 3 production pattern even in the optimist financial package (scenario III.4). For 19 % of the total initial acreage the farm will receive in 2010 direct decoupled subsidies without producing any outputs:

Table 13: Crop rotations in different scenarios in hectares – farm 3

| Production type | Scenario I | Scenario II | Scenario III.1 | Scenario III.2 | Scenario III.3 | Scenario III.4 |
|-------------------|--------------|--------------|----------------|----------------|----------------|----------------|
| Forecast for 2007 | | | | | | |
| Wheat | 226 | 115,6 | 112 | 122 | 130,9 | 142 |
| Barley | 9,5 | 7,0 | 6,9 | 7,2 | 7,6 | 8,0 |
| Spring barley | 57,9 | 37,5 | 37,1 | 38,9 | 40,8 | 42,6 |
| Corn | 95,7 | 84,4 | 82,6 | 84,9 | 87,4 | 89,8 |
| Sun flower | 9,8 | 6,8 | 6,9 | 7,2 | 7,5 | 7,8 |
| Green crops | 38,8 | 38,8 | 39,2 | 39,7 | 40,3 | 40,8 |
| Total | 437,7 | 290,1 | 284,7 | 299,9 | 314,5 | 331 |
| Forecast for 2010 | | | | | | |
| Wheat | 226 | 115,6 | 114,5 | 123 | 132,1 | 153,7 |
| Barley | 9,5 | 7,0 | 6,97 | 7,3 | 7,7 | 8,5 |
| Spring barley | 57,9 | 37,5 | 38,2 | 39,8 | 41,8 | 46 |
| Corn | 95,7 | 84,4 | 83,5 | 85,9 | 88,3 | 94,4 |
| Sun flower | 9,8 | 6,8 | 7 | 7,4 | 7,7 | 8,2 |
| Green crops | 38,8 | 38,8 | 39,7 | 40,2 | 40,7 | 41,7 |
| Total | 437,7 | 290,1 | 289,87 | 303,6 | 318,3 | 352,5 |

In fact, the results aren't surprising. In the European Union, the CAP leads to farm specialisation – each farmer finds his comparative advantages. Therefore, Transylvanian farms shall reduce crops' acreage which in the new market conditions are inefficient and shall expand crops which turn out to be more efficient. Another important conclusion must be emphasised as well: farms will need to modernize their production technologies in order to overcome the EU competition. Even if the Romanian government shall decide to give national subsidies after 2007 these wouldn't support the farm's long run development. So, finding the financial parameters which could influence Transylvanian farms modernisation must be taken into account.

3.2.3. The financial parameters' influence

Three simulating series were conducted. The first one tested the influence of the initial financial resources on the crops rotation and on the farm's income. The second one studied the impact of the interest rate, while the third one dealt with evaluating of the short-run credits access:

Table 14: The variation of different financial parameters

| Parameter | Variation in % | | | | | |
|-------------------------------------|----------------|-------|-------|-------|-------|-------|
| | -75% | -50 % | -25% | +25% | + 50% | + 75% |
| Initial financial resources in RON | -75% | -50 % | -25% | +25% | + 50% | + 75% |
| Interest rate | 0 % | | | | | 45 % |
| Borrowing possibilities in RON/year | -75% | -50 % | -25% | +25% | + 50% | + 75% |

According to the initial situation of the farmer (choice of a particular crop, land buying or rental, financial placements or self financing, national compensatory subsidies or not), the role of the financial resources can be different and significant. The financial parameters have been analysed over the net income of every farm and the practiced crop rotation.

A. The impact of the initial treasury financial resources on the net income and on the crop rotation

A raise of 1 % of the initial treasury financial resources causes an increase of the net income per hectare. For farm 1, a raise with 1 % of the initial financial resources leads to a raise of the net hectare income with 0,105% ; for the second one, the raise is 0,15%. In the case of farm 3, the raise of the net income per hectare is more important because the necessary credit is as well more important; altogether a raise with 1% of the initial treasury leads to a raise with 12% of the net income per hectare.

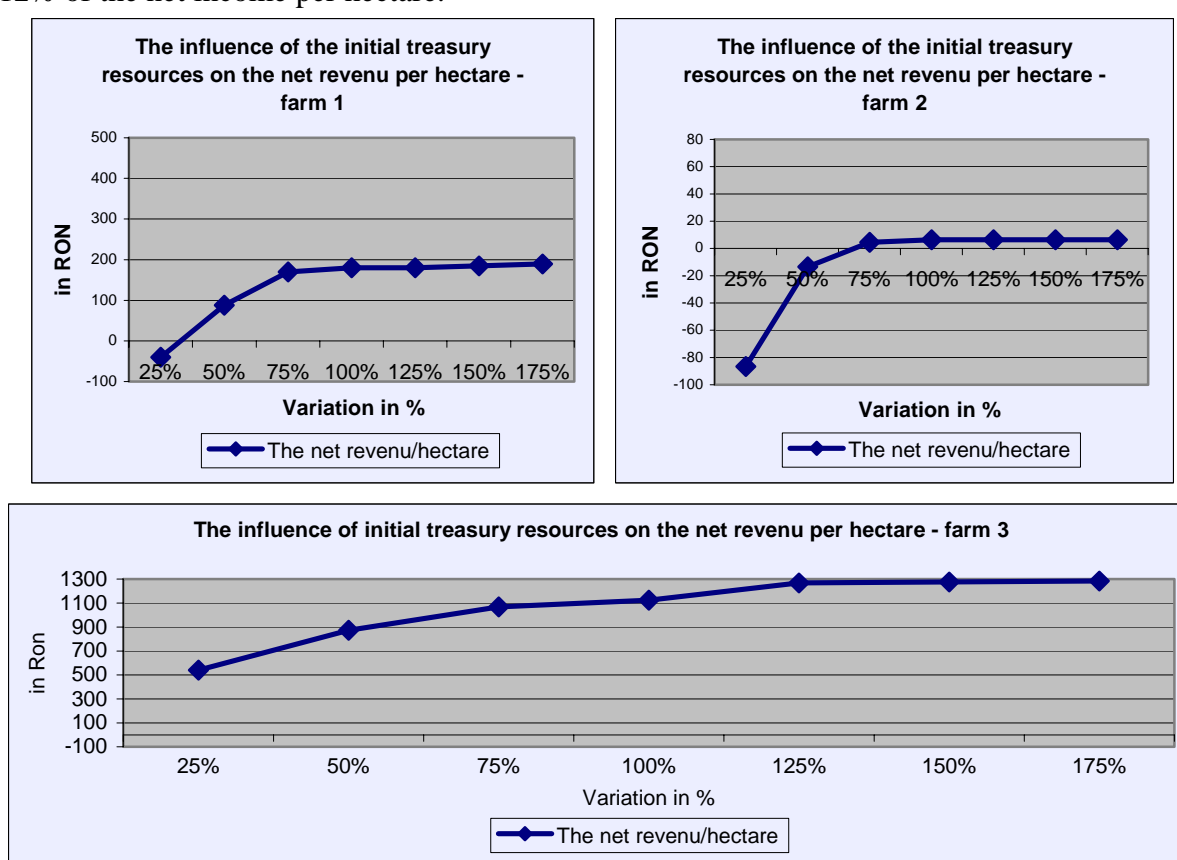


Figure 2: The influence of initial treasury resources over the farms' net revenue/hectare"

The level of initial disponibilities significantly influences crops pattern. When a farmer doesn't get the necessary financial resources, he reduces the cultivated surface. In this situation, the chosen crops are the most attractive ones in terms of margin. Over a certain treasury amount, farmers stops investing. The risk aversion and the rental cost don't permit to raise the acreage. These results sustain the idea that the model stand as a correct presentation of the financial farms' flows.

Table 15: The influence of the initial liquidities over crop rotation in hectares

| Production type | 25 % | 50 % | 75 % | 100 % | 125 % | 150 % | 175 % |
|-----------------|--------------|--------------|---------------|---------------|---------------|---------------|---------------|
| Farm 1 | | | | | | | |
| Wheat | 0 | 0 | 0,86 | 3,2 | 0,86 | 0,86 | 0,86 |
| Barley | 0 | 4,11 | 11,16 | 10,9 | 11,1 | 11,1 | 11,1 |
| Oats | 0 | 3,34 | 5,49 | 5,29 | 5,49 | 5,49 | 5,49 |
| Corn | 13,7 | 22,11 | 22,11 | 22,11 | 22,1 | 22,1 | 22,1 |
| Other cereals | 27,8 | 37,42 | 23,37 | 25,45 | 27,37 | 27,37 | 27,37 |
| Total | 41,5 | 66,98 | 62,99 | 66,95 | 66,92 | 66,92 | 66,92 |
| Farm 2 | | | | | | | |
| Wheat | 12,2 | 39,75 | 66,1 | 91,6 | 91,6 | 91,6 | 91,6 |
| Durum wheat | 2,7 | 2,81 | 2,9 | 2,99 | 2,99 | 2,99 | 2,99 |
| Rye | 7,6 | 9,14 | 10,5 | 11,9 | 11,9 | 11,9 | 11,9 |
| Barley | 0 | 0,79 | 2,78 | 4,7 | 4,7 | 4,7 | 4,7 |
| Spring barley | 11,8 | 13,2 | 14,66 | 15,9 | 15,9 | 15,9 | 15,9 |
| Oats | 0 | 0 | 0 | 4,8 | 4,8 | 4,8 | 4,8 |
| Corn | 10,8 | 15,78 | 20,5 | 25,1 | 25,1 | 25,1 | 25,1 |
| Other cereals | 0 | 0,24 | 3,06 | 5,77 | 5,77 | 5,77 | 5,77 |
| Peas | 0,8 | 2,2 | 3,69 | 5 | 5 | 5 | 5 |
| Lentils | 0,3 | 2,3 | 4,1 | 5,9 | 5,9 | 5,9 | 5,9 |
| Soya | 2,4 | 2,5 | 2,52 | 2,5 | 2,5 | 2,5 | 2,5 |
| Total | 48,6 | 88,71 | 130,81 | 176,16 | 176,16 | 176,16 | 176,16 |
| Farm 3 | | | | | | | |
| Wheat | 58 | 131 | 181 | 240 | 242 | 234 | 243 |
| Barley | 0,3 | 4,3 | 7,05 | 10 | 20 | 9,9 | 10,4 |
| Spring barley | 27,8 | 41 | 50 | 60 | 60 | 59,7 | 60,5 |
| Corn | 18,7 | 52 | 74 | 101 | 102 | 98,3 | 102 |
| Sun flower | 7,9 | 8,8 | 9,44 | 10 | 9,9 | 10 | 10,3 |
| Green crops | 24,2 | 33,9 | 37,07 | 39,9 | 39,8 | 40,4 | 40,7 |
| Total | 136,9 | 271 | 358,56 | 460,9 | 473,7 | 452,3 | 466,9 |

B. The influence of the interest rate variation

Taking into account the numerous investments and borrowing possibilities, we wonder about the influence of credit parameters on the economical results, on the choice of the outputs and also on the investment decisions.

We can draw the conclusion that credit costs influence the evolution of the average net income per hectare. To maintain the income to a certain level farmers change their crop rotation. The outputs with the highest gross margin are preferred when the rate is higher (figure 3 and table 17).

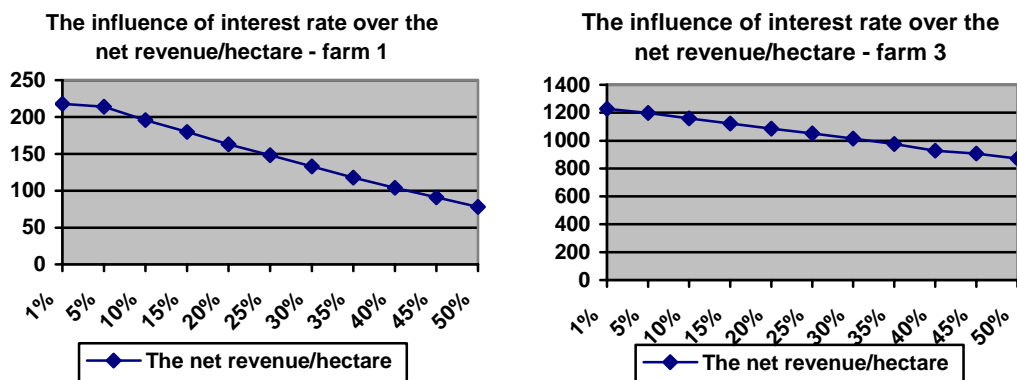


Figure 3: The influence of the interest rate on the net revenue/hectare

On the other hand, the influence of the credit cost varies for each farm that needs short-run credits in the base year (farm 1 and farm 3). We can estimate that in order to support the agriculture sector, Romanian government may decide to subsidize the interest rate for short-run credits with 5%. The effects of such a policy are positive: the net income per hectare shall rise with almost 8,9 % in the case of the smaller farm and with almost 3,2% in the case of the third farm. After Romania's joining the European Union, such politics may positively influence the economical situation of the smaller farms and so it allows their modernisation and their adaptiveness to the European production rules.

Table 16: The influence of the interest rate on the crop rotation in hectares

| Production type | 1 % | 5 % | 10 % | 15 % | 20 % | 25 % | 30 % | 35 % | 40 % | 45 % |
|-----------------|--------------|--------------|--------------|-------------|-------------|--------------|--------------|-------------|--------------|--------------|
| Farm 1 | | | | | | | | | | |
| Wheat | 1,47 | 4,2 | 3,7 | 3,2 | 2,7 | 2,2 | 1,7 | 1,3 | 0,8 | 0,4 |
| Barley | 11,1 | 10,8 | 10,9 | 10,9 | 10,9 | 11 | 11 | 11,1 | 11,1 | 11,1 |
| Oats | 5,4 | 5,2 | 5,2 | 5,2 | 5,3 | 5,3 | 5,4 | 5,4 | 5,4 | 5,5 |
| Corn | 22,1 | 22,11 | 22,11 | 22,1 | 22,1 | 22,1 | 22,1 | 22,1 | 22,1 | 22,1 |
| Other cereals | 26,8 | 24,6 | 25,01 | 25,4 | 25,8 | 26,2 | 26,6 | 26,9 | 27 | 27,7 |
| Total | 66,87 | 66,91 | 66,92 | 66,8 | 66,8 | 66,8 | 66,8 | 66,8 | 66,4 | 66,8 |
| Farm 3 | | | | | | | | | | |
| Wheat | 239 | 239 | 239 | 237 | 237 | 231 | 231 | 231 | 231 | 231 |
| Barley | 10 | 10 | 10 | 10 | 10 | 9,8 | 9,7 | 9,7 | 9,7 | 9,7 |
| Spring barley | 60 | 60 | 60 | 60 | 60 | 59 | 59 | 59 | 59 | 59 |
| Corn | 101 | 101 | 101 | 100 | 100 | 98 | 97 | 96,6 | 96,6 | 96,6 |
| Sun flower | 10 | 10 | 10 | 10 | 10 | 10 | 10,1 | 10,1 | 10,8 | 10 |
| Green crops | 39,9 | 39,9 | 39,9 | 40 | 40 | 40 | 40,6 | 40,6 | 40,4 | 40,4 |
| Total | 459,9 | 459,9 | 459,9 | 457 | 457 | 447,8 | 447,4 | 447 | 447,5 | 446,7 |

Also, the above data show that the crop rotation is more sensitive to the interest rates changes in the smaller agricultural farms which have lower hectare average gross margins.

C. The influence of credit access

A farm is financially constrained if the farmer can't attract all the financial resources that he needs in order to do his activity in an effective manner (Petrick M., 2004). The banks impose financial constraints to the farms. A constraint represents the size limitation of the given credit. At each farm level, there were established two kinds of financial constraints: a constraint for short-term credits (production credits) and constraint for long-term credits – investments credits. In this paper, only the short term credits access is analysed on the crop rotation and the average hectare net income for farms that contracted such credits (farm 1 and farm 3 respectively).

The influence analysis of the short term credit access possibility, has been completed in the following way:

- firstly, we assumed the fact that farmers cannot contract any credit (which corresponds to level 0 for the below figures)
- the 100% level represents the limit imposed by banks to farmers (calculated according to the Romanian credit laws)

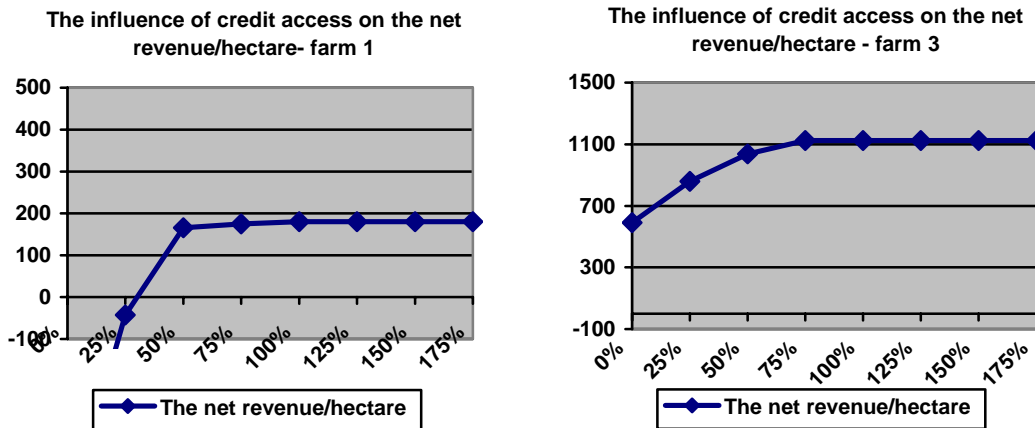


Figure 4: The influence of credit access on the net revenue/hectare

The results indicate that credit access influences significantly the net income of farms. If farmers would access to only half of the initial crops contracted credit their net hectare income shall be reduced with almost 7,7% in the case of both farms. The inability of production credits access would lead to negative net hectare incomes per hectare in the case of farm 1 and incomes with almost 1/3 less in the case of farm 3. Also, we can draw the conclusion that crop rotations suffer if farms do not have credit access. For farm 1 only two crops out of five are still produced and for farm 3 only five out of six.

Table 17: The influence of credit access on the crop rotation in hectares

| Production type | 0 % | 25 % | 50 % | 75 % | 100 % | 125 % | 150 % | 175 % |
|-----------------|--------------|--------------|---------------|--------------|--------------|-------------|-------------|-------------|
| First farm | | | | | | | | |
| Wheat | 0 | 0 | 0,81 | 3,2 | 3,2 | 3,2 | 3,2 | 3,2 |
| Barley | 0 | 0 | 9,5 | 11,16 | 10,9 | 10,9 | 10,9 | 10,9 |
| Oats | 0 | 0 | 5 | 5,4 | 5,2 | 5,2 | 5,2 | 5,2 |
| Corn | 3,8 | 22 | 22,1 | 22,1 | 22,1 | 22,1 | 22,1 | 22,1 |
| Other cereals | 63 | 45 | 30,2 | 27,4 | 25,4 | 25,4 | 25,4 | 25,4 |
| Total | 66,8 | 67 | 67,61 | 69,26 | 66,8 | 66,8 | 66,8 | 66,8 |
| Third farm | | | | | | | | |
| Wheat | 45,8 | 94,9 | 144 | 193 | 240 | 234 | 234 | 234 |
| Barley | 0 | 2,3 | 5,07 | 7,7 | 10 | 10 | 10 | 10 |
| Spring barley | 25,2 | 34,3 | 43,1 | 52 | 60 | 60 | 60 | 60 |
| Corn | 13,6 | 35,8 | 58,2 | 80,5 | 101 | 99 | 99 | 99 |
| Sun flower | 7,6 | 8,3 | 8,8 | 9,4 | 9,9 | 10 | 10 | 10 |
| Green crops | 27,6 | 31,1 | 33,9 | 37 | 39,8 | 40 | 40 | 40 |
| Total | 119,8 | 206,7 | 293,07 | 379,6 | 460,7 | 453 | 453 | 453 |

Conclusions:

Due to these results the following conclusions can be underlined:

- Romania's joining the European Union will lead to a decrease of the farmers' income. The decrease depends on their initial situation. For farmers that used very intensive technologies the decrease will be severe (almost 30% lose of the net income per hectare).
- Decoupled hectare unique payments lead to sustaining the farmers' income. The capacity of recovering income losses differs from farm to farm. For farms which cannot be influenced much by the new market conditions we can estimate a raise of the net income.
- The crops rotations are to be changed. Farms tend to specialise towards more attractive crops in terms of gross margins. The crops for which the new market conditions are less favourable (wheat for example) the producers must change their practices and investments will play a very active role.
- The financial parameters show that credit access has a greater influence over the farms' income and the crop rotations than the interest rate. This conclusion was also sustained by the way in which the absorption of the SAPARD pre – joining European funds was done. Until in 2006 there was only 50% engaged of the financial support given to Romania, but since introducing the "Fermierul" programme in January 2006, there was engaged all the non returnable financial support given to Romania until June 2006 (source www.sapard.ro). These types of supporting credit access shall have positive effects on the farm modernisation, so the Romanian financial support should rather be used in supporting the farmers investments that for direct payments which have proved not to have important effects.

This study must be fulfilled with an analysis over a bigger Transylvanian sample. Building that kind of data base is now a priority.

Appendix A. The C.A.P in Romania after the 1 of January 2007

The CAP suffered extensive reforms after the Berlin agreement. This reform and the negotiated financial frame have been established as a prologue for the EU extension in 2004 with 10 more states from Central and Eastern Europe (NMS). The reforms meant especially the following:

- allaying the European prices to those of the world market. The scheduled fall was about 15 % for the 2000-2006 period in the cereals case, but this fall was partially compensated by the direct compensatory payments.
- in order to obtain financial support, the farmers must follow certain environmental specifications – eco conditional financial support – in order to obtain the compensatory payments;
- the possibility of modulating the financial support, which means the possibility of using a part of this sums for the rural development measures – the rural development has become the second CAP pillar Zahiu Letitia (2005);

Due to the Joining Treaty the Romanian farmers have access to the support given to the regularized markets through the Common Market Organisation (CMO) as well as to direct payments. Therefore, the value of the financial support given by the communitary budget for the Romanian farms is 25 % of the direct payments value in the EU in the first year of joining; 30 % in the second; 35 % in the third; 40 % in the fourth followed by a 10 % annual rise, up to 100 % of the EU-15 support Word Bank, working paper no 39(2005).

Due to present laws and the negotiations results, the direct payments, both the vegetable and the animal sectors of activity, could be allocated separately from the production level, depending on political decisions, as a **simplified payment scheme** (the standard direct payments scheme –SPS) as well as applying **the unique payment surface scheme** (UPSS). This payments scheme (UPSS) can be applied 3 years after joining, period when the NMS can establish the Integrated Control an Administration System (ICAS) needed in order to administrate the unique payment scheme (UPS). After the three years period, the European Commission will evaluate the CAP implementation phase and will decide if this payment scheme will continue (up to two new prolongations – one year each) or if it will be switched to the unique payment scheme European Institute of Romania, study no 11(2004).

The unique payment surface scheme (UPSS) stands for paying a constant sum/hectare which is to be paid once a year independently from the production level. The eligibility conditions are mainly the following:

- maintaining the field in good environmental and agricultural conditions;
- the minimum farm surface to be 1 ha and cannot contain less than 0,3 ha plots;

In this scheme the value of hectare payment is calculated by dividing the direct payment (level) to the eligible agricultural surface. The eligible agricultural surface is the used agricultural surface established according to the EUROSTAT definition (no matter whether it is part of the productions surface at that time or not) from the year before the Romanian joining to the EU, adjusted according to criteria approved by the Commission, minus the surfaces with non eligible plots- less than 0,3 ha , and minus the exploitations surfaces between 0,3 and 1 ha and minus the fields which are not maintained in healthy environmental and agricultural conditions.

The financial support obtained by Romania, as a result of the negotiation, between 2007 and 2009 is over 4 billions euros, which is money divided between rural development, market support and direct payments.

Thus the financial support for Romanian direct payments, for three years period, is 888 million euros, sum which includes the financial support for products or sectors with

established cote, reference surfaces or national limits. This type of financial support doesn't require budgetary national co financing, but implies national implementations costs.

The 732 million euros for market measures, which consist of market intervention and export refinancing, doesn't require national co financing. This financial support shall be allocated starting with 2007.

Financial support for rural development from the EU budget represents a 2308 millions euros engagement for 2007 – 2009. The percent for co financing required by the national budget is up to 25 % (Zahiu Letitia, 2005).

Besides the surface unique payments the EU gave Romania free decision responsibility in respect of the possibility of direct payments supplementation after joining (transition period) with the so called "top ups" payments. The complementary national payments can't exceed 55 % of the direct payments value at the EU level in the first year after joining; 60 % in the second year; 65 % in the third and starting with the fourth the maximum 30 % limit over the payment level for that year. Romania has another "exception from the rule" and that is in the first three years after joining, the national direct compensatory payments (NDCP) to give, can be partially financed from the rural developments funds. This contribution doesn't have to exceed 20 % of that year's financial rural allocation. Taking into consideration the communitary rules these sums, have to be co financed from the national budget too.

Moreover, the options for applying the NDCP in this case can be:

- for a group of sectors (for instance two schemes , one for the products which are part of the unique payment schemes - example the vegetable production, and the other – a payment scheme for the animal production);
- for a particular sector or a sector of a less importance (for instance a scheme of payment for a product or two which are part of the vegetable farms and the other payment scheme - the same for all vegetable farms);
- a scheme of payment for the set aside fields or to exclude these fields from payments.

But the NDCP can't be given for sectors which are not part of the support schemes from EU -15 (like: potatoes, sugar beet, fruits and vegetable and other permanent crops).

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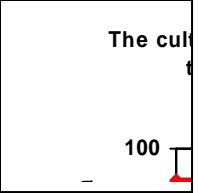
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