Modelling Farm Level Economic Potential for Conversion to Organic Farming

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Abstract

A farm model is developed for simulating the potential income change resulting from conversion to organic farming. The model uses conventional farm data, taken from the Belgian FADN. Given the normative character of the model, and the impossibility of calibration to historical conversion behaviour, two model variants, a rigid and a flexible, are created to broaden the analysis scope. Moreover, extra attention is paid to the verification process and sensitivity analysis. Results reveal that the economic potential for conversion is rather high, if farmers are willing to change their farm management sufficiently. Furthermore, conversion potential depends on the farm type and conventional farm characteristics. The model finally proves to be an interesting tool to analyse policy impact.

Keywords: Organic farming, conversion period, farm model, linear programming
JEL classification: C61, Q12

1. Introduction

Last decades, organic farming received increasing attention in agricultural policy and rural development. For its defenders, organic farming is regarded as a more sustainable production method compared to conventional practices. Moreover, as public concern for food quality and safety, animal welfare and the conservation of natural resources grows, the organic farming philosophy and practice become more important. Policy makers noticed this opportunity and have tried to create a stimulating framework for the development of organic farming. Hence, today a whole set of policy instruments exists both at European and national level, reflecting the willingness for active support, e.g. the European Action Plan for Organic Food and Farming (European Commission, 2004). As a consequence, the organic sector has developed considerably in Europe and experienced a major breakthrough during the 1990's. However, the growth curve differs between countries and in some countries the growth is less prosperous. In particular in Belgium, conversion to organic farming boosted some years after the introduction of the conversion premium in 1994. Yet, since 2001 the number of farms stepping out of organic production exceeds the number of newcomers (MIRA-T, 2004).

Various studies try to reveal the underlying factors determining the choice between conventional and organic farming and to explain the evolution of the growth of the organic sector (Søgaard, 1999; Michelsen, 2001; Pietola & Oude Lansink, 2001; Gardebroek, 2003). In particular, the factors influencing the current stagnating conversion rate can be classified in social and psychological barriers, market structure, farm economics and the need for further technical development and training. This paper concentrates on the role of economic factors, as the lack of insight in the economic potential for conversion of individual farms may be a dominant cause of the low conversion rate. As long as the farmer estimates the conversion process as a profit decreasing event, his willingness to convert will be extremely low. Indeed, surveys among conventional farmers reveal the persisting opinion assuming that the extra constraints associated with organic farming inevitably lead to income losses. On the other hand, insight in the economic performance of organic farming is important for policy makers to allow them to tune their set of incentives to the potentials of individual farms. The aim of this paper is to present a model able to measure the economic potential for conversion, to highlight the variation in results between farms and to explain some underlying structural factors.

Offermann and Nieberg (2000) investigated the economic performance of organic farms in Europe. Various other studies also researched the economic factors (Nieberg & Pals, 1996; Firth, 2002; Lee & Fowler, 2002; Oude Lansink et al., 2002; de Bont et al., 2005). In most studies economic data of organic farms are compared to conventional farm data. For Belgium, where the size of the organic farming sector is very small compared to the conventional sector (MIRA-T, 2004), Offermann and Nieberg (2000) pointed out that data on the economic results of organic farming are rare. This lack of organic farm data necessitates another method to assess the economic potential of organic farming. Therefore, linear programming (LP) based on conventional farm data is used to obtain information on the (potential) performance of organic farms.

Mathematical programming techniques, such as LP, are a common method for farm level research on the economic performance of organic farms. Zander (2003) developed a crop rotation planning tool for organic farms to optimise the design of individual farms with respect to their economic performance to serve as a decision support tool for individual farms. In this model ecological effects of organic farming were also taken into account. Analogous, Smith et al. (2002) and Padel et al. (2002) developed a system specifically for assisting in the conversion process to organic production.

Furthermore, the combined modelling of economic and ecological aspects of organic farming is often used to analyse sustainability of organic agriculture and the impact of different policies on it. Pacini et al. (2004, Pacini, 2003) evaluated for example farm and field level economic-environmental trade-offs under EU's Mac Sharry and Agenda 2000 agricultural policies. A similar approach was amongst others applied by de Koeijer et al. (1999), Falconer & Hodge (2001), Meyer-Aurich et al.(2001). Van Calker et al. (2004) also developed an economic-environmental farm model, but not specifically for organic farms.

Most of these studies implement their model on case study data. In the currently presented study, however, the model is run on a sample of 690 conventional farms, taken from the Belgian FADN. Since due to the lack of organic farm data it is hardly possible to use descriptive models, calibrated to historical conversion behaviour, the model hereafter presented, simulating the conversion to organic farming, is normative. Given this normative character, extra attention is paid to the verification process. Two model variants, a rigid and a flexible, have to broaden the scope of simulated potentials. The outcomes should allow to differentiate farms according to their economic potential.

The paper is organised as follows. First, the economic factors determining the change of income after conversion are briefly listed. Next, the farm model and the model variants are described. In sections 3 and 4 the model results are analysed and a link between farm characteristics and economic potential is searched. In section 5, the robustness of the model to environmental changes is investigated by performing scenario and sensitivity analysis. Finally, conclusions are presented in the last section.

2. Farm model description and use

2.1. Economic factors of conversion

Several economic factors are responsible for a change of income after conversion. Among the most important are the higher input costs for seeds, the investment costs for the change of chemical weed control to mechanical weed control, the extensification of the crop rotation, the lower crop yields, the higher labour requirements, the higher fodder costs, the cost associated with conversion to other breeds and new housing systems. In contrast, fertiliser, herbicide and pesticide costs are lower and organic product prices are higher, although the last are not yet obtained during conversion period.

2.2. A mathematical programming core

Mathematical programming provides a typical framework that is able to account for changes in economic factors like those that have been described in the previous section. Looking to the general description of LP modelling presented in equation (1), the technical factors like crop rotation will affect the left hand side coefficient (a), changing input and output prices are observed in adjustments of the coefficients of the objective function (c), the factor endowments are represented by the right hand side coefficient b.

$$\begin{aligned} &Max Z = cX \\ &aX \leq b \\ &X \geq 0 \end{aligned} \tag{1}$$

However, a mathematical programming representation of a farm has a normative character, so a research strategy has to be developed to attenuate this normativity. A first step is the adoption of an interactive model-building and verification process. By permanently comparing the model output with existing organic farms and confronting it with sector expertise, the normative assumptions are made as realistic as possible. Yet, since the results highly depend on the assumptions, a rigid and a flexible model are defined and an extensive scenario and impact analysis are performed in which the sensitivity of different assumptions is tested. The normative character further implies that model outcomes must be interpreted as potentials and not as actual income changes of converting farms.

2.3. Distinction between a rigid and a flexible model variant

Because of the normative character of LP, two different models, both starting from the same modelling principle, were developed. One model simulates the revenue on converting farms while keeping the livestock and crop production close to the activity mix observed on the conventional farms. This rigid model variant considers the reluctance of farmers to adapt the farm management. The other model simulates the revenue of the converting farms in a similar way, but the farms are allowed to adapt their farming practices to the specific needs of the organic production. The results of this more flexible model variant will give an idea of the theoretical possibilities of organic farming. By comparing the outcomes of these two models with different assumptions on the possibilities of converting farms, the impact of the assumptions is determined. In fact, the model variants can be seen as two scenarios of conversion.

2.4. Model description

The economic potential of conversion is estimated as the difference in labour income between the initial state of the conventional farm ($Z_{conventional}$) and the simulated converted state ($Z_{organic}$). When comparing farm income with and without conversion, the original fixed costs are assumed to remain constant. Liquidation value of equipment specific for conventional agriculture, is supposed to be zero. This means that differences in the labour income predominantly rely on gross margin differences.

Gross margin (GM) is calculated as the financial output (marketable yield * price per tonne) minus the variable costs (seeds, fertilisers, sprays, others). The gross margin value is expressed in euro per hectare for crops and in euro per livestock unit (LSU) for livestock. Fodder costs normally are included in the calculation of the livestock gross margin. For our purposes, however, they are separated from other variable costs to allow an endogenous link with the energy and protein balance. Conventional and organic data on prices and costs are derived from the Belgian FADN, literature (a.o. Lampkin & Padel, 1994; Newton, 1995; PAV, 1997; Offermann & Nieberg, 2000) and expert knowledge.

The organic premium subsidy per hectare is not taken into account, because we are interested in the potential of organic production without policy support. Other premiums, like these originating from the European common market organisations, and that are equal for conventional and organic farming, were incorporated in the model. Besides gross margins, the objective function as presented in equation (2), foresees adjustments for extra investments and extra labour needs associated with the conversion.

$$Z = \sum_{i=1}^{C} GM_i * area_i + \sum_{j=1}^{A} (GMefp_j * number_j - Cost_{fodder} + premium) - Cost_{labour} - Cost_{investments} \qquad (2)$$

with

C the number of different crops that are grown on the farm

A the number of animal groups (dairy cows, suckler cows, replacement stock, meat cows)

$GMefp_j$ the gross margin of each animal group j, exclusive fodder cost and cattle premium

The constraints can be classified into several groups: crop related and livestock related constraints, the nutrient flow, the energy and protein balance and finally, labour and investment constraints. Some of the constraints are specific for the conventional, the conversion or the organic period, some constraints are equal for the different phases.

For the **crops**, a first constraint is the total available area (TAA). Very important in organic farming is the crop rotation scheme. Since no chemical pesticides, herbicides or fertiliser are allowed, a well-equilibrated crop rotation has to help to prevent diseases and to maintain soil fertility and structure. Several constraints are related to this: limited return of the same crops on the same parcel, alternation of nutrient fixing and nutrient demanding crops, alternation of soil structure destroying and rebuilding crops, alternation of deep and shallow rooting crops. As an example, equation (3) represents the limited return constraint with F_i being the minimum number of years between the successive cultivation of crop i on a certain parcel.

The above crop constraints are not related to the currently observed rotation scheme of the conventional farm. So, every farmer is allowed to arrange an economically optimal crop rotation within the technical and government restrictions. The rigid modelling approach restricts some cash crops to the observed area and on the other hand imposes a minimum area of grassland and fodder crops according to the observed area.

Two additional crop constraints, applying both for conventional and organic farms, are policy related. According to the premium conditions of the European common market organisations, a certain percentage of fallow land is imposed. The area of sugar beets is restricted to the observed area on the conventional farm, since farmers normally cultivate only sugar beets within their sugar beet quota.

$$area_i \leq \frac{TAA}{F_i} \tag{3}$$

For **livestock**, there are various policy restrictions. Examples are at European level the milk quota and at Belgian level the limitation of the number of cows in view of the present manure problem. Specific for organic livestock production is the regulation of the livestock density and the level of Caesarean. On the other hand, there is policy support for livestock production in the form of livestock premiums. The model optimises the assignment of these premiums. Since converting farms have the possibility to change their breeding scheme, constraints have to be introduced to keep the changes realistic. Milk quota and the Belgian legislation restrict respectively the number of dairy cows and the total amount of cows, so only the number of replacement stock has to be fixed. In the rigid model, the ratio of replacement stock to the number of dairy or suckler cows is imposed to be equal to the observed ratio on the conventional farm. For the flexible model, however, only a minimum amount of replacement stock is imposed. This means that some farms will be able to reduce the amount of replacement stock when converting to organic farming. This holds in particular for Belgian suckler cow farms, where the typical breed for beef production is the Belgian Blue. Characteristic for this breed is the high turnover rate due to the high level of Caesareans. The necessity to adapt the herd to more extensive breeds implicates a decrease in turnover of the animals. In contrast, other farms will have to increase the number of young stock, e.g. farms that used to buy their replacement stock.

Crop cultivation and livestock breeding are linked to each other by the **nutrient flow** at the level of the soil surface, with incoming nitrogen from manure and nitrogen fixing crops and outgoing nitrogen through crop removal. So, the crop rotation scheme is also optimised in consideration of the soil fertility. The **demand for energy and proteins** for cattle breeding has to be met by fodder crops cultivated on the farm or by purchased fodder. The model optimises the area of grassland and other fodder crops on the farm and the amount of fodder to be purchased.

Organic farming is usually more **labour** demanding than conventional farming. To bring this cost in the objective function, for each crop the labour requirement per hectare per hour is estimated, as well for the conventional as for the organic farming method(PAV, 1997; PAV, 2000; expertise). Based on this, the total amount of required labour for each specific crop rotation scheme can be calculated and deduction of the extra labour requirement is possible. Due to the prohibition of herbicide use in organic farming, it is also necessary to **invest** in specific weeding machines. Depending on the crops scheme, the farms are imposed to buy a tined weeder or a hoeing machine. Both the cost of the extra labour and the weeding machines are taken into account in the objective function of the organic farm.

For the conventional period, which is used as a reference, the constraints impose a farm management equal to the conventional management as observed in the FADN. Revenue is calculated for the observed crop and cattle activities. The model also optimizes the amount of premiums that the farms are entitled to, specifically the compensatory aid for arable crops, the suckler cow premium, the premium for male cattle and the extensification premium.

2.5. Data on farm structure

Both the models for calculating the conventional and the organic labour income are run on individual farms included in the Belgian FADN. The available data reflect the conventional reference situation. The sample constitutes 690 conventional farms and spans the period from 1999 to 2001. Other farm types than arable farms, dairy and suckler cow farms are excluded from the sample. Before calculating the organic labour income, the model first designs a new (optimal) farm management, adapted to the organic conditions described above.

Note that it is possible to run the model both with farm specific and with regional standard gross margins. Model outcomes do not substantially differ. This allows running the model on structured data, such as provided by the annual agricultural census.

2.6. Interactive verification process

Given the normative character of LP, an interactive model building and verification approach is necessary. As long as simulation is done within a rigid framework, the assumptions are very consistent and outcomes will not deviate much from reality. With a more flexible scope, the risk emerges, that model outcomes become too optimistic: the more lucrative enterprises are allowed in the new model plan, the higher the economic potential will be. A too drastic change in production plan compromises the scientific value of the model tool, because non-converting conventional farms also have the possibility to change production plans. Therefore, field expertise was introduced throughout the model building to ensure that the model flexibility is tightly linked to the conversion decision and not to farm development in general. A field expert assisted in verifying the data on organic yields, prices,…. Furthermore, the model results, like the crop rotation scheme and the necessary investments, were also repeatedly examined in order to adapt the model according to field expertise, thus resulting in an interactive and recursive modelling process.

However, the fact that most actual farm management schemes can be economically improved should not be ignored. The flexible model variant assumes that conversion to organic farming is often an occasion to look for possible improvements, so other than typical organic changes do coincide with conversion. For example, on organic dairy farms much attention is paid to the fodder balance due to the expensive organic concentrates, yet, on many conventional farms some improvement is also possible.

2.7. Indicators of economic potential

The aim of the model is to estimate the economic potential of different conventional farms for conversion to organic farming. The difference in labour income before and after the conversion is a possible indicator of this potential. This can be calculated based on the model results, since the model simulates the annual income of every farm in the first five years after conversion. If the labour income increases after conversion, the farm has a positive economic potential. Otherwise, the farm has a low economic potential for conversion.

The potential increase of labour income or earned income (PIEI) can be calculated in two different ways. The first possibility is to compare the conventional income with the income of the converted farm, as stated in equation (4). This simple comparison of two situations in equilibrium shows the difference in revenue of the conventional and the organic farming method. However, this indicator does not take into account the conversion period, which is not only important in evaluating the economic consequences of organic farming, but in particular in studying the reluctance of farmers to go through the transition period between the two equilibriums. Therefore, a second indicator compares the conventional income with the mean income in the first five years after the implementation of the reconversion decision ($PIEI_{transition}$). The decision to consider the first five years is based on the Flemish premium policy where farmers applying for a subsidy commit themselves to adopt the organic farming method for at least five years. A term of three years after the conversion period is also a good standard for an investment to pay.

Since all farms wanting to convert will face the difficult conversion period, the second calculation method offers a more realistic indicator of the economic potential of organic farming. The first indicator is still interesting because it demonstrates the possible profit of the organic farming method. A comparison of the two indicators shows the impact of the conversion period on the potential of the farms.

$$PIEI_{equilibrium} = Z_{organic} - Z_{conventional} \tag{4}$$

$$PIEI_{transition} = (\sum_{y=1}^{5} Z_{organic,y}) / 5 - Z_{conventional} \tag{5}$$

3. Potential income shifts according to model variants and farm types

Analysis of the results in table 1 shows that 46 % of the farms have a positive $PIEI_{transition}$. As stated earlier, the calculated PIEI is an indicator for the economic potential of conventional farms converting to organic farming. A positive PIEI indicates that the farm's income will increase after conversion, a negative PIEI implicates a decrease of income. The potential increase of labour income was calculated in two ways. When comparing only the equilibrium states ($PIEI_{equilibrium}$) even 78 % of the farms could convert to organic farming without a decrease of income. The mean change of labour income is respectively -1167 euro/farm/year and 11 760 euro/farm/year. The negative value of the first mean PIEI means that the labour income is on average lower in the first five years of conversion to organic farming than the conventional income.

The flexible results give a more positive view than the rigid model, which allows only little adaptation of the farm management. However, in the rigid point of view still 24 % of the farms have a positive economic potential.

Table 1: Descriptive statistics of the potential increase of labour income

Farm type	PIEI, potential increase in labour income				
	PIEI, rigid				
	Percentage positive (%)				
Arable farm	20				
Dairy farm	21				
Suckler cow farm	45				
All farms	24				
	PIEI, flexible, transition				
	Percentage positive (%)	Mean (euro/farm)	Std dev (euro/farm)	Min (euro/farm)	Max (euro/farm)
Arable farm	47	891	15587	-48039	57290
Dairy farm	32	-6135	15932	-48860	44247
Suckler cow farm	96	13037	11436	-9177	48588
All farms	46	-1167	16607	-48860	57290
	PIEI, flexible, equilibrium				
	Percentage positive (%)	Mean (euro/farm)	Std dev (euro/farm)	Min (euro/farm)	Max (euro/farm)
Arable farm	84	16597	18607	-21156	89051
Dairy farm	69	7579	16679	-30909	71626
Suckler cow farm	98	16836	14157	-8748	71889
All farms	78	11760	17561	-30910	89051

When comparing the results for the different farm types, there seems to be a difference in economic potential. Almost all **suckler cow farms** have a positive PIEI. Even when the transition period is taken into account 96 % of the farms can convert to organic farming without a loss of income. The mean PIEI, when considering the transition period, is 13 037 euro/farm/year, the mean PIEI in equilibrium is 16 836 euro/farm/year. This high conversion potential of suckler cow farms and the small impact of the transition period on the overall potential can be explained by the low costs for conversion. The suckler cow premiums also count for an important and unchanged part of the income.

The rigid conversion strategy brings forth only 45 % of suckler cow farms with a positive PIEI. The origin of this difference in potential is the replacement stock strategy. The flexible model gives the opportunity to decrease the number of replacement stock whereas the rigid model holds on to the observed ratio of replacement stock to the number of suckler cows.

The economic potential of **dairy farms** is much lower. Only 32 % of the farms have a positive PIEI. When excluding the transition period from the calculation, this percentage increases to 69 % of the farms. The income in the first five years of conversion decreases on average with 6135 euro/farm/year. There are two major explanations for this lower potential. A first cause is the maximum livestock density imposed by the regulation of organic livestock production. Farms with a higher livestock density are obliged to decrease the number of cows resulting in a decrease of milk production. Another cause of the income loss is the decrease of milk yield per cow, particularly in the transition period. Due to the Belgian legislation, this decrease cannot be compensated for by an extended amount of dairy cows.

The **arable farms**' potential finally, lies between the suckler cow and the dairy farms. The share of farms with a positive PIEI is 47 % when considering the transition period and 84 % otherwise. The mean PIEI is respectively 891 and 16 597 euro per farm and per year. The impact of the transition period, shown by the difference of the two PIEI's, can be explained by the lower yield, the higher labour requirements and in particular by the postponed organic price in the transition period. The lower potential in the rigid model is caused by the restricted possibilities to adapt the crop cultivation scheme. Moreover, there is no market for organic sugar beets in Belgium, which complicates the conversion for farms having a sugar beet quota.

4. Underlying farm characteristics

The previous section demonstrated that the mean economic potential for conversion to organic farming is rather high, but strongly dependent on the farm type. However, within each farm type the economic potential is very heterogeneous (fig. 1). So, not only the farm type determines the economic potential, there are other farm characteristics that influence this potential. To find out which farm properties these are, farms are divided into three groups according to the potential (low, medium and high). A comparison of the mean value of the different groups for a certain characteristic and of the corresponding confidence limits (CL) indicates whether the characteristic determines the economic potential.

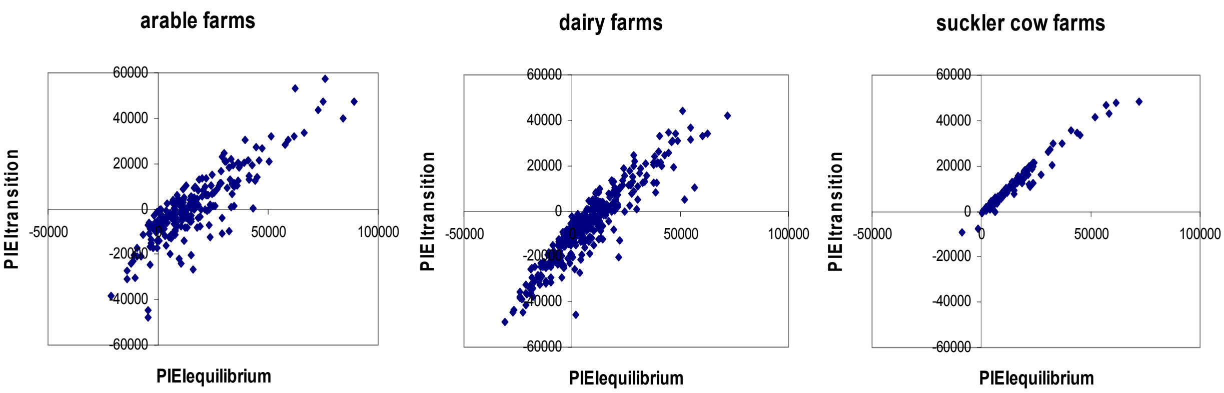

Figure 1: Distribution of the economic potential of individual farms for arable, dairy and suckler cow farms

Farms with a high economic potential seem to have a larger utilized agricultural area (UAA) than farms with a low potential (table 2). This is true for the total amount of farms and for the different farm types. Conclusions on suckler cow farms must be treated with caution, since only two observations are available for the low and medium potential groups. Similar statistics are determined for the livestock density. When considering all farms, the impact of livestock density is not univocal. However, for dairy farms and for arable farms there is an obvious, yet opposite relation between the economic potential and the livestock density. Dairy farms with a high livestock density have a lower economic potential, because farms with a density that exceeds the maximum organic livestock density are obliged to reduce their stock. This relation is even more distinct when only the stocking density of dairy cows is considered. On the contrary, arable farms with a high livestock density have a higher economic potential, which indicates that mixed farms have a higher potential than specialised farms.

Table 2: Impact of utilized agricultural area and livestock density on the economic potential

Impact of utilized agricultural area on economic potential					
Farm type	**Number of farms**	**Potential**	**Mean (ha)**	**Lower 95% CL for Mean**	**Upper 95% CL for Mean**
Arable farms	34	low	50,45	39,85	61,04
	81	medium	62,46	56,37	68,56
	102	high	74,71	68,80	80,62
Dairy farms	114	low	33,09	31,31	34,87
	139	medium	50,24	47,27	53,22
	117	high	73,98	68,79	79,16
Suckler cow farms	2	low	34,08	25,08	43,07
	2	medium	42,56	-20,12	105,23
	94	high	57,42	52,40	62,45
Total of farms	150	low	37,03	34,17	39,89
	222	medium	54,63	51,68	57,59
	313	high	69,24	66,07	72,42
Impact of livestock density on economic potential					
Farm type	**Number of farms**	**Potential**	**Mean (LSU/ha)**	**Lower 95% CL for Mean**	**Upper 95% CL for Mean**
Arable farms	34	low	0,11	0,01	0,20
	81	medium	0,96	0,83	1,08
	102	high	1,32	1,23	1,42
Dairy farms	114	low	2,64	2,53	2,74
	139	medium	2,11	2,04	2,18
	117	high	2,20	2,11	2,29
Suckler cow farms	2	low	3,31	-2,11	8,72
	2	medium	2,80	0,84	4,76
	94	high	2,61	2,50	2,73
Total of farms	150	low	2,07	1,91	2,24
	222	medium	1,70	1,61	1,79
	313	high	2,04	1,97	2,11

The same analysis was done for other farm characteristics like the stocking density of dairy cows on dairy farms, the milk yield per cow, the ratio of replacement stock, the conventional income per ha, the conventional number of suckler cows and the percentage of sugar beets in the conventional crop rotation scheme of arable farms. It showed that farms with a high milk yield per cow and a high conventional income per ha have a lower economic potential. Dairy farms and arable farms with a higher number of suckler cows have a higher economic potential. Combined with the results on UAA and livestock density, one could conclude that intensive, specialised farms have a lower economic potential for conversion to organic farming. Since there are lower average yields and more extensive farms in the Walloon region than in Flanders, this conclusion also explains the higher conversion rate in the first. A higher percentage of sugar beets on arable farms corresponds to a lower economic potential. This result demonstrates the impact of the lacking of a market for organic sugar beets in Belgium.

Pietola & Oude Lansink (2001) showed that in Finland livestock or labour intensive farms and specialised livestock and arable farms indeed are less likely to switch to organic farming. They also found that farms located in low-yield regions are more likely to switch to organic production than farms in more fertile areas, which is consistent with the situation in the Belgian regions. The resemblance of the results suggests a correlation between the economic potential and the conversion behaviour.

5. Scenario and sensitivity analysis

As previously stated, the model results depend on the imposed assumptions. To gain a better insight in the impact of these assumptions, a scenario and impact analysis is done. An additional advantage of the scenario analysis is that it can deal with the uncertainty of future development. "*Scenarios are images of the future, or alternative futures. They are neither predictions nor forecasts. Rather each scenario is one alternative image of how the future might unfold*" (IPCC, 2001).

Two scenarios are worked out with a consistent set of assumptions related to product prices, crop yields, milk yield, seed prices, concentrates prices, labour and investment costs. In the first scenario, all elements are assumed to evolve in a negative way, e.g. lower crop yields and higher seed costs. This scenario is called the pessimistic scenario (PES). The other scenario assumes a positive evolution and is called the optimistic scenario (OPT). It is obvious that the economic potential is the highest in the optimistic scenario and the lowest in the pessimistic. The actual economic potential, also called "business as usual" or BAU, is a third scenario, delimitated by these extremes.

To investigate the impact of changing one of the assumptions e.g. a price decrease, the economic potential in each scenario is calculated for different prices. The assumed prices vary from the actual assumed organic product prices (bau) to the level of conventional prices, where no price premium is obtained for organic crops and milk, and only half of the assumed premium price is obtained for organic meat (pes). The decrease of prices has a negative impact on the economic potential (fig.2). Arable farms suffer most from the decrease of crop prices. The mean economic potential, that was positive for the actual assumed price, drops below zero when the organic price premium decreases. For dairy and suckler cow farms the impact is smaller. The decrease of PIEI is particularly obvious in the optimistic scenario. This is a result of the combination of the decrease in price and the higher crop yield that was assumed in the optimistic scenario.

The overall picture of the economic performance of organic farming in this study is similar to the findings of Offermann and Nieberg (2000). According to their research, organic farms realise on average the same or a higher profit than comparable conventional farms. However, the variance between farms is high, both between and within countries. In Great Britain, for example, organic cattle farms other than dairy farms, perform worse than the conventional reference group, which is opposite to the results for Belgian suckler cow farms. The importance of access to premium prices for organic products for arable farms is also highlighted.

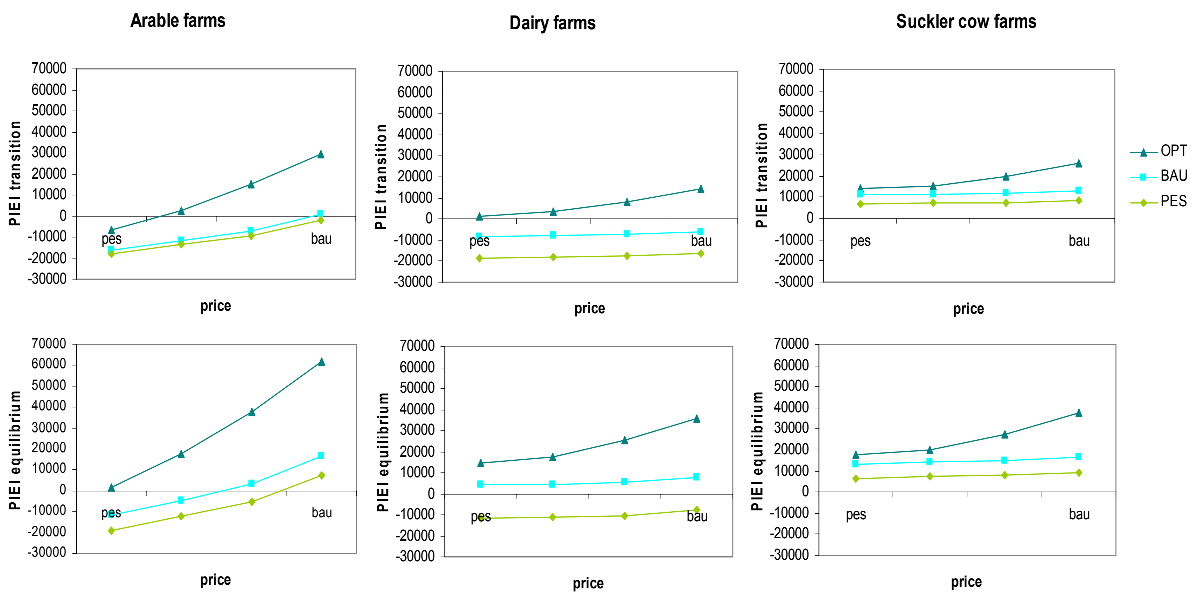

Figure 2: Impact of price decrease on the economic potential in three scenarios (pessimistic, bau, optimistic) and for different farm types (arable, dairy and suckler cow farms)

Another interesting model possibility is to analyse the impact of policy support for organic farming on the economic potential of the farms. Therefore, the per hectare premium subsidy of the Belgian organic farming subsidy programme is added in the PIEI calculation for the BAU scenario in the above analysis. In figure 3 the mean economic potential of all farms is represented for different product prices and for four scenarios, the BAU variant with a premium for organic farming as the fourth scenario. As expected, the economic potential of the farms increases when a premium is allowed. Since the Belgian premium subsidies are mainly concentrated in the first two or three years after conversion, the impact is highest for the PIEI that takes the transition period into account (right figure). The economic potential even exceeds the potential in the optimistic scenario, which shows that the premiums have a higher impact than increasing crop and milk yields and decreasing seed, concentrates, labour and investment costs. However, Søgaard (1999) showed in his study that national support accelerates the growth of organic farming, but does not significantly change the long-term size of the organic sector.

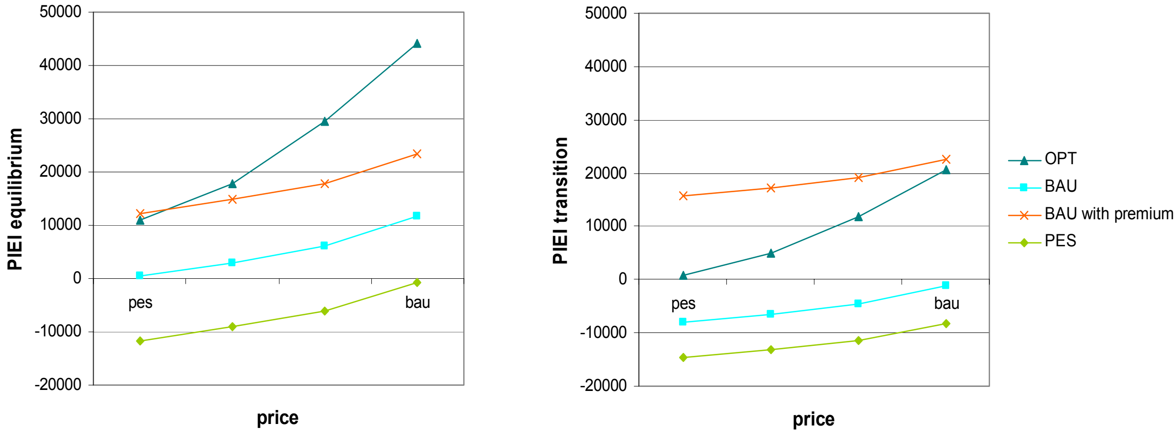

Figure 3: Impact of a price decrease in a BAU, an optimistic and a pessimistic scenario and impact of a premium

6. Conclusions

The model variants, as developed in this study, allow a differentiated analysis of the farm's economic potential to convert to organic farming. The overall potential is rather high, particularly when the flexible model variant is considered. Comparing the results of the rigid and the more flexible model variant illustrates the impact of the farmer's attitude on the farm's potential to convert. Much can be gained when conversion is not considered as a mere complying with organic constraints, but as a production method with extra opportunities. The innovativeness of the farmer and his willingness to adapt his farming practice to the specific needs of organic farming highly affect the economic potential. This is the case in particular for arable farms, where the crop rotation scheme must be thoroughly adapted in order to maintain the soil fertility and to prevent diseases. For dairy farms the difference between a rigid and a flexible conversion is smaller, probably because the organic farming practice, apart from the livestock density, usually is less differing from conventional farm management. However, the acquirement of some new skills is always required.

The difference between the PIEI that considers the transition period and the one that only takes into account the equilibrium phases, reveals the impact of the transition period for the economic potential of conversion. Since the transition period is one of low income and increased risks, going through this period puts farmers off. This is one of the reasons for the low actual conversion rate in proportion to the economic potential. Moreover, for a similar level of potential income gains, some farms will have higher transition costs than others.

There are indeed large discrepancies between the economic potential of different farm types and between the farms within each farm type. The model makes it possible to recognize various farm characteristics that are connected to the economic potential for conversion. The results of this analysis are similar to previous studies of the same interest. In particular, it shows that more extensive farms have a higher potential for conversion.

The model results are not only useful for farmers, but also for policy makers. At first, it is shown that their initial perception on the economic performance of organic farming was too negative. Nevertheless, the transition period stays a tough nut, therefore conversion triggering policy incentives like the per hectare premium subsidy and higher investment support, should preferentially be concentrated in the transition period. Secondly, the information on farm types and farm groups with similar economic potential enables policy makers to outline a policy tailored to the needs of specific farms. Furthermore, more insight is gained in the achievement of the policy objectives. For example, if the objective would be to urge intensive farms to convert to organic farming, then another premium system than the per hectare premium subsidy should be elaborated, e.g. a more straightforward contribution to the investment costs for new housing systems. Thirdly, this study shows that stimulating organic farming is not just a matter of distributing premiums as compensation for presumed income losses. The bottlenecks and risk factors like the lack of a market for sugar beets and more generally, the marketing problems of organic products due to diseconomies of scale, should certainly also be considered. Extra attention for risk decrease can already start at a very early phase by stimulating a more gradual transition to organic farming. For example, implementation of specific aspects of the organic farming method could be supported without the obligation to fully convert. This way, a kind of “pre-conversion” is originated that familiarizes conventional farmers with the organic production opportunities.

Finally the discrepancy between economic potential of farms and actual conversion is illustrated once again by this study. Suckler cow farms for instance have a high economic potential and only a small income decrease during transition period, but the farmers rarely convert since they are too attached to the Belgian Blue breed. As already stated in the introduction, other factors than farm structure and economic factors exist determining the willingness to convert. To better understand the actual conversion rates, studies on the economic factors of organic farming should be integrated with research on psychological, social and technical constraints. Further research is planned to link the economic modelling results with behavioural parameters, derived from a survey among conventional and organic farmers in order to get a better explanation why farmers are or are not willing to convert (personal communication Lieve De Cock).

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