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Abstract

As a consequence of the reorientation of the Swiss as well as the European agricultural policy, prices for agricultural products drop and farmers have to reduce their production costs or will lose income. Therefore a lot of farmers have a high incentive to change their production structures. One of the most effective strategies to reduce production costs is going into cooperation and collaboration with other farmers. Therewith farmers can profit from scale effects without changing the property rights. Several case studies as well as results from modeling reveal that farmers have more income with less workload.

In reality only 3% of Swiss farmers have gone into a collective farming system. Weaker forms of cooperation like sharing machinery are more common between farmers. Their main reasons not going into cooperation are often the loss of autonomy of decision in combination with financial risks. And here trust can act as a counterbalance. Farmers with positive experiences from weaker forms of cooperation are able to assess their partners regarding trust. And their trust enhance when their partners are capable and loyal for a stronger cooperation form.

Keywords: Agent-based simulation, structural change, cooperation strategies, collaboration

JEL classification: C61, Q12, Q15

Introduction

One of the main objectives of the reorientation of the Swiss as well as the European agricultural policy is the liberalization of agricultural markets. As a consequence, prices for agricultural products drop and farmers have to reduce their production costs or will lose income. In addition, social acceptance of structural change increased in importance in the agricultural policy and became part of the Swiss agricultural law (LwG, 1998). Several studies in Switzerland have shown that different policy goals and measures increase the conflicts between economically essential structural adjustments and their social and ecological impacts (e.g. Hofer, 2002).

The objective of this research is to improve the understanding of the structural adjustment processes in a locality and on farm level especially the influencing factors of cooperation and collaboration. Therefore we searched for the best modeling method based on case studies and at the moment we create an agent-based simulation tool, with which it is possible to identify important factors of influence and to estimate in advance their effects on structural change. The resulting structures will be compared with the relevant goals of the agricultural and regional policy in order to draw conclusions about the effectiveness of the adjustment process. To specify
the options open to action, the modifiable influencing factors will be varied to generate a better effectiveness of social, ecological and economic goals. Furthermore several case studies (Balmann et al., 2002, Rouchier et al., 2001) have shown that structural adjustment processes on farm level depend not only on economic forces, but also on social and psychological factors. Farmers do not decide only rationally and maximize their income, in reality they act upon guidelines like fairness, solidarity, confidence and altruism. Therefore, it is necessary to implement these social and psychological principles as endogenous variables in the model and not as restrictions only.

Farm management strategies to change structure

As Hofer (2002) has shown, farm land markets has become smaller in Switzerland since decoupled direct payments on farmland were introduced in the first half of the nineties. For this reason farmers had to choose the remaining strategies to reduce their production costs or to generate more added value. One possible strategy is an enhancement of livestock, but this is restricted because of ecological legislation. For example in watershed areas of some lakes in the Swiss middle lands the water pollution is so high that farmers were forced to reduce the quantity of pigs and poultry.

Searching for off-farm labor is also a possible strategy when on-farm income is to low to cover the costs of the farm and family. But in fact the percentage of sideline farmers decreases from 30.1% in the year 2000 to 27.8% in the year 2005 (BLW, 2006).

Increasing services and vertical integration as well as production specialization are possible strategies for several well-educated farmers with sufficient access to capital to increase the value added on their farms. These strategies result often in cooperation and collaboration along the value chain.

Further cooperation and collaboration strategies between farmers enable them to use scale effects and reduce production costs. So for example 3% of Swiss farmers have gone into a collective farming system (Pulfer et al., 2006). Unfortunately there is actually no representative survey about the occurrence of other forms of cooperation and collaboration in Swiss agriculture. But several case studies have shown positive effects regarding production cost and workload (e.g. Pavillard, 2005, Schlatter, 2003, Wyss, 2002).

In addition we have to understand structural change in a larger context, not only as the expansion of farm land or the disappearance of farms. In our simulation we implement eight assumed strategies the modeled farmers choose to change their structure. Figure 1 presents an overview. The modeled farmers combine the first seven strategies to get a situation with the best benefit. Afterwards they compare this benefit from the mixed strategies with the benefit from the last strategy, the cessation of farming. If cessation has the higher benefit, they stop farming, else they keep on farming with the new strategy mix.
The cooperation problem in game theory, modeling and reality

For implementing cooperation and collaboration strategies in a structural adjustment simulation the modeled farmers must can interact. They decide simultaneously without knowing the decision of the other farmers. Hendrikse (2003) characterizes this situation as the cooperation problem where various Nash equilibria are possible by a lack of information. Hendrikse (2003) describes several ways to solve this problem: first, to get additional information; second, to change the payoffs; third, to reduce the number of players to one; and the fourth, to decrease the possibilities of choice. The only reasonable way to reduce the several equilibria to one is to minimize the lack of information within the modeled farmers. Therefore the modeled farmers must communicate with each other to share their information about their best individual strategies.

In fact, we can also observe this lack of information situation in reality. Farmers have hidden costs for communication and administration. So they have higher costs for management on the one hand and on the other, their production costs can be lowered with cooperation and collaboration by scale effects. For example they can pool their fields to get greater land area for reducing their work time or machine costs per hectare (e.g. Pavillard, 2005, Schlatter, 2003). Or they can share a stable together and minimize the investment costs per livestock unit or free up time (e.g. Wyss, 2002). The empirical findings from these case studies (see following chapters) will be compared with resulting structures from the simulation to detect hidden costs for administration and risks.

Case study 1: Virtual farm land consolidation

Pavillard (2005) analyzed the effects of a virtual farm land consolidation. Farming with a lot of small sized parcels results in high production costs and is not competitive because: first, the total labor input per hectare is very high due to the ratio of nonproductive work per parcel (e.g. drive time between parcel and farmstead or turning time at the parcel border); second, more production supplies (e.g. fertilizer, pesticides) are needed caused by overlapping effects; and third machinery with high power of impact (e.g. sugar-beet harvester or wide spraying machinery) cannot used or only in an inefficient way.
If farmers consolidate their parcels like shown with the different colors in figure 2, they can reduce the production costs and work time per hectare. But in fact a consolidation requires negotiations over years and causes immense costs. If the farmers pool their parcels without changing the ownership, they can avoid this time-consuming and costly process. They have to arrange several points like crop rotation or production technique and machinery. The most delicate problem the involved farmers have to solve is how they split the costs (e.g. for pesticides or hired machinery) and the harvests. Very often they use precision farming machinery equipped with GPS technique therewith the farmers can identify the costs and the harvest per each parcel, although the small parcels exists only virtual and no more in reality.

Pavillard (2005) analyses in his diploma thesis a virtual farm land consolidation in Riedhausen, Germany. In this municipality with a total size of 800 hectares, 150 land owners have more than 1’400 parcels. The land is used by 10 full time and 13 part time farmers. In the year 2000 six farmers pooled their parcel to bigger land units. To split the revenue exactly they rented a combine harvester equipped with GPS technology for measuring the crop yield per parcel. In the last years, more farmers joined this project and Figure 2 shows the situation of the pooled parcels in the year 2005.

The economic effects of this farm land pooling was a success, the involved farmers reduced their work time per hectare and year from more than 12 hours before to less than 6 hours after pooling. And they could decrease the machinery replacement value per hectare and year from 3’500 € before to 1’000 € after pooling. The farmers appraise the pooling as a very powerful project, because they earn more money with less labor time. Furthermore they can profit from higher crop prices and lower cost for input factors like pesticides and fertilizer because of the bigger trading volume. In spite of the interdependence, the involved farmers have fewer conflicts among themselves at present because of the improved situation.
Case study 2: Collective farming in Switzerland

Last year the Agroscope Reckenholz-Tänikon Research Station ART conducted a survey by all Swiss farmers being a member of a collective farm (Pulfer et al., 2006). The aim was to collect data about why farmers join a collective farming system. The return rate was 53% or 462 questionnaires totally.

By 53% of the collective farmers are the partners also relatives. The reasons going into a collective farming were for 76% of the farmers a better efficiency of the machinery and for 59% a better efficiency of the investments. For 58% was the possibility to have more leisure time an important reason. Experiences with collaboration are also an important factor before starting a collective farm, 59% of the farmers were member of machinery collectives and 50% have collaborated with a contractor.

Furthermore the farmers were questioned about their satisfaction of economic and social aspects of collective farming. Nearly 88% of the farmers are satisfied with the new economic situation and 76% are satisfied with the income per working hour. 70% of the farmers are satisfied with the return on equity and 75% with the interpersonal situation.

For 60% of the farmers is the increased labour productivity an advantage of going into a collective farm. Further advantages are for 50% the reduction of overwork, for 47% the saving of paid labor. 46% of the farmers have more leisure time and 33% have more time for off-farm labor. Pulfer et al. (2006) have also asked the farmers about communication rules and interpersonal conflicts. The majority of the farmers answered that they communicate daily with their partners and that the communication quality is very satisfying. Concerning the conflicts, only the conflict of interdependence is critical, the potential of all other measured types of conflicts are low. At the end, Pulfer et al. (2006) concluded that collective farming is for the involved farmers a story of success regarding the high happiness, the good communication and the low interpersonal conflicts. But Pulfer et al. find no answer to the question why only 3% of the Swiss farmers joined a collective farming system. Their new hypotheses are that the spatial availability of potential partners or the personal preferences of the farmers have an impact in going into collective farming.

The risks of cooperation and collaboration and the role of trust

One main problem of cooperation and collaboration is the interdependence among the farmers. Before going into a collective farming system farmers fear the risk to fail and to lose a part of the bounded investments. Therefore they start with a weaker cooperation strategy with less risk like sharing machinery. After having made positive experiences farmers rely more and more on their cooperation partners and go into higher risk cooperation strategies. Jungermann et al. (2005) described this stereotypic decision making process as familiarity effect. In psychological experiments the tested people have significant higher preferences for options they are familiar with from the rounds before and they have made positive experiences.

Familiarity and positive experiences are the principal part of trust. After having made positive experiences with weaker forms of cooperation, farmers are able to assess their partners. Their trusts in their partners enhance when the farmers consider them as capable and when the farmers believe in partner’s loyalty in future, like shown in figure 3.
Scholtes (1998) define trust as the combination of high capability and high loyalty. Farmers assess their partner’s competence and qualification due to the experiences in the past. Therefore weaker cooperation and collaboration forms are an important factor before going into collective farming system. But the future point of view is also very important for trust, and farmers try to rate their partner’s goodwill and support in the future. This could be an explanation why so many farmers in a collective farming system are relatives. As a consequence of trust, the potential of conflicts and the costs for administration and communication decline. This leads to a less fear of failing and losing invested money and time.

**Modeling method, model validation and the limit of prediction**

To estimate the economic effects of cooperation and collaboration we create an agent-based simulation tool. This approach integrates various advantages for modeling structural adjustment processes. First, the limited resources like farmland are allocated in a mutually beneficial way by negotiating. Second, the integration of path dependence allows us to model structural adjustment as a strongly dynamic process. So the farmers in the model cannot revoke their decisions already made without sunk costs and thus they have to share information about their preferences for cooperation and collaboration. And third, the multi-level design and the object programming language facilitate the adaptation of the model (for new policy or cost scenarios or for other regions) as well as the implementation of GIS data (e.g. for calculating more realistic production costs).

Jager and Janssen (2002) warned against using agent-based simulation models for policy development and support without improving the validity of the behavioral dynamics that is based on empirical findings. To validate our model, we use several approaches. First, we start the model with a historical situation from 2000 and compare the modeled results for the year 2005 with the actual situation. Using this approach the modeled environmental and market rules can be validated. Second, we will conduct a survey with the farmers from the modeled area to explain the differences between the model results and current situation. Third, we will use the model results as an input in a role playing game with other farmers. With these behavioral experiments, the modeled behavioral patterns of the agents can be compared with the observed behavior of the farmers.

Another approach for validation we will use is comparing this model with other agent-based simulation models in related field of research. As it uses object oriented programming, the model could be easily adapted for new market or policy rules as well as other local attributes. Thus, it is applicable for several country situations as well.
Conclusions

The results of the case studies have displayed that cooperation and collaboration can enhance the economic situation of the involved farmers without larger social and interpersonal problems. Familiarity and positive experiences are the principal elements of trust and we conclude that trust is a very important factor for going into cooperation and collaboration because it reduces the risks and the costs for administration and communication.

The comparison of the modeling results with empirical findings from the case studies shows that the implementation of cooperation and collaboration strategies into the structural adjustment models allows us to get a more realistic behavior of the modeled farmers. In addition the agent-based modeling approach facilitates the implementation of the path-dependence concept and GIS-data into the simulation.

References


