Working Papers SMART - LERECO

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Working Paper SMART – LERECO N°08-03

July 2008

UMR INRA-Agrocampus Ouest **SMART** (Structures et Marchés Agricoles, Ressources et Territoires)

UR INRA **LERECO** (Laboratoires d'Etudes et de Recherches Economiques)

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The authors thank Pierre Dupraz for his valuable comments.

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Abstract

Based on a conceptual framework, we develop the hypothesis that part-time farmers invest in less profitable products than full-time farms, due to the necessary minimum labour requirements which entering and running profitable production processes require. Descriptive statistics for Swiss farms show some indications for this hypothesis, like a much lower total revenue and lower agricultural income of part-time farms, despite a comparable value of the farm's assets. A regression analysis for the period 1996-2005 confirms that Swiss part-time farms tend to focus on products with low labour profitability. This may explain why part-time farming in Switzerland is less developed than in most other European countries, and raises the question whether part-time farming offers a solution for structural change process in small-structured agricultural systems affected by imperfections on factor markets.

Keywords: farms, part-time, profitability, Switzerland

JEL classification: Q12

Le temps de travail disponible limite l'engagement des agriculteurs pluriactifs suisses dans des productions rentables

Résumé

Grâce à un modèle conceptuel, nous développons l'hypothèse que les exploitants agricoles pluriactifs investissent dans des productions moins rentables que ne le font les exploitants à plein temps, en raison des exigences minimales de travail que nécessitent les technologies de productions les plus profitables. Des statistiques descriptives pour les exploitations suisses semblent confirmer cette hypothèse, comme par exemple un revenu agricole plus faible pour les exploitations pluriactives malgré une valeur comparable de capital utilisé. Une régression économétrique pour la période 1996-2005 confirme que les exploitations pluriactives suisses sont plutôt engagées dans des productions à faible profitabilité par unité de travail. Ceci pourrait expliquer pourquoi l'agriculture pluriactive est moins développée en Suisse que dans la plupart des autres pays européens. La question se pose alors si l'agriculture pluriactive est vraiment une alternative au changement structurel dans les systèmes agricoles de petite taille lorsque ceux-ci font face à des imperfections sur les marchés des facteurs.

Mots-clefs : exploitations agricoles, pluriactivité, profitabilité, Suisse

Classification JEL : Q12

Labour constraints on choosing profitable products for part-time farmers in Swiss agriculture

1. Introduction

Small-structured agriculture has, for a long time, been seen as unambiguously inefficient (Brandes, 1978; Koester, 1979; Johnson, 1982). This view has been challenged since some seminal work by Schmitt (1988; 1989). Schmitt emphasized the difference between farm and household income. He showed how combining off- and on-farm income could be a utility-maximizing strategy, because working only partly on one's farm could attain a high marginal productivity until decreasing to the marginal productivity of off-farm labour. He concluded that "resource allocation in agriculture is an efficient one" (Schmitt, 1989; 1273 f.). Even earlier, Lee (1965) had developed a first model to show the rationality of part-time farming. This theoretical framework is challenged by the Swiss situation. Analyses by FAT (2002) have shown a very low agricultural income per full-time worker on part-time farms. In addition, the share of part-time farms in Switzerland is at 28 per cent and by far lower than in most neighbour countries where it is often above 50 per cent. More remarkably, the rate of structural change among part-time farms (-3.6 per cent p.a. between 2000 and 2005) is considerably higher than for full-time farms (-1.4 per cent p.a.). This means that the difference in the part-time share in Switzerland's agriculture to its neighbour countries is likely to grow. This raises the question about possible constraints that limit the attractiveness of part-time farming under Swiss conditions.

Particularly Austrian economists (Pfaffermayr et al., 1991; Weiss, 1997) have shown the responsiveness of off-farm labour to the labour market and thereby apparently confirmed Schmitt's theory. Similarly, Huffman (1980) showed how improving farmers' education would increase off-farm labour supply. However, Juvancic and Erjavec (2005) indicated that there are constraints with respect to the participation of farmers in the off-farm labour market. While distortions and constraints on the labour market have been relatively thoroughly analyzed, on-farm labour constraints have been neglected in the attempt to understand the nature of part-time farming. While factor constraints are usually not seen as being of major importance in reasonably large-structured farming sectors such as in the United States (US) (Ahearn et al., 2004), this may well be different in agricultural systems as Switzerland where high subsidies have contributed to maintain an average farm size of 19 hectares. Another

difference to the situation in the US (Hanson, 1996) is that part-time farms in Switzerland are, on average, considerably smaller than full time farms. This is not always by free decision, but farm expansion in Switzerland is constrained. Obstacles to farm growth are particularly prevalent at the land market which is characterized by high prices and low availability (Giuliani, 2002). Other barriers may be the availability of capital for major investments, also because of the mediocre income situation of most family farms. As few farms rely on hired labour, the labour supply of family farms is usually fixed. Thus, there may well be a mismatch between the availability of "excess supply of labour in agriculture" (Schultz, 1945; 91) and the availability of other factors, a mismatch which can only be balanced by offering labour outside of the farm.

This paper investigates how labour constraints limit part-time farmers' choice of production activities. Farmers with such constraints may well be forced to stick to unprofitable product lines. Although there exist factor constraints in terms of limited machinery or stables, we focus on the constraints on labour force availability, that may prevent part-time farms to produce what the market wants and what would be most profitable. This presumption is firstly explained with a conceptual framework in Section 2, and then tested empirically for Swiss farms, for which the method is outlined in Section 3. Section 4 presents the results and Section 5 concludes.

2. Conceptual framework

The conceptual framework presented below shows that it is likely that part-time farmers in Switzerland do not produce highly profitable (in terms of monetary productivity per labour) products, but are constrained to produce mainly low profitable products on their land. This is due to the fact that products with a high labour profitability usually require a minimum labour force, and that part-time farms cannot meet this minimum requirement.

The notion of minimum labour allocated to a specific production activity deals with the technical nature of agricultural production processes. There is always a proportion of factor requirements that are fixed, which may occur, firstly, when entering a new production activity, and secondly, during the production process of specific activities. Firstly, as shown by Mann et al. (2003), entering a production activity requires investment decisions in at least two respects. In order to start a new production activity, not only capital investments become necessary, but a lot of human capital has to be invested, so that technologies and the

organization of labour are known to the farmer. In a lot of instances, labour investments, but also. These fixed factor requirements contribute a lot to the persisting phenomenon of economies of scale (Hallam, 1991; Shah, 1992; Langlois, 1997). Mann et al. (2003) additionally showed by internationally comparing exit rates from production lines that conservative farmers like in Switzerland tend to consider entering a new production process more as an investment compared with more flexible farmers as, for example, in the Netherlands. Secondly, different agricultural products have different minimum labour requirements. Consider pig breeding as a case in point. This activity requires a relatively high minimum of labour time in order to become acquainted with the many complicated cycles and processes of piglet production (Knap et al., 2001). Once the business is running, a certain minimum number of hours have, at several stages of the breeding process, to be spent in order to keep animals healthy and to result in the desired number of piglets, independent of holding size. An example with a relatively low level of labour requirements, on the other hand, would be the production of spelt. Producers who are familiar with grain production in general do generally have little additional investments to do to enter the production of spelt.

Our conceptual framework is mainly graphical, but is based on a theoretical objective program of farmers who may work or not off farm, and who have the possibility to produce two products with different labour profitability and requirements. We assume that product 1 has a higher labour profitability than product 2, but necessitates a minimum labour force.

The objective program for farmers is as follows [1]:

$$\text{Max} \quad \Pi = p_1 f_1(X_1, L_1) + p_2 f_2(X_2, L_2) - p_X(X_1 + X_2) + \omega L_O \tag{1}$$

on X_1, X_2, L_1, L_2, L_O

subject to

$$f_1(X_1, L_1) = 0 \quad \text{for } L_1 < \bar{L}_1 \tag{2}$$

$$p_1 \frac{\partial f_1(X_1, L_1)}{\partial L_1} > p_2 \frac{\partial f_2(X_2, L_2)}{\partial L_2} \tag{3}$$

$$T = L_1 + L_2 + L_O \tag{4}$$

$$L_1 \geq 0 \tag{5}$$

[1] For simplicity, a farmer is assumed to behave like a firm and not like a household (i.e. consumption and leisure are not considered).

$$L_2 \geq 0 \quad (6)$$

$$L_O \geq 0 \quad (7)$$

where

Π is the total farm (on-farm and off-farm) profit;

f_1, f_2 are the production functions of respectively product 1 and product 2;

L_1, L_2 are labour times devoted to the production of respectively product 1 and product 2;

X_1, X_2 are other factors devoted to the production of respectively product 1 and product 2;

p_1, p_2, p_X are the prices of product 1, product 2 and the other inputs, respectively.

$\overline{L_1}$ is the minimum labour allocated to the production of product 1.

T is the total time endowment;

L_O is the time allocated to off-farm employment;

ω is the off-farm wage.

Constraint (2) represents the minimum labour requirement for the production of product 1, while constraint (3) shows that the marginal labour (financial) productivity of product 1 is greater than the one of product 2, therefore representing the larger labour profitability of product 1. As for constraint (4), it is the time constraint.

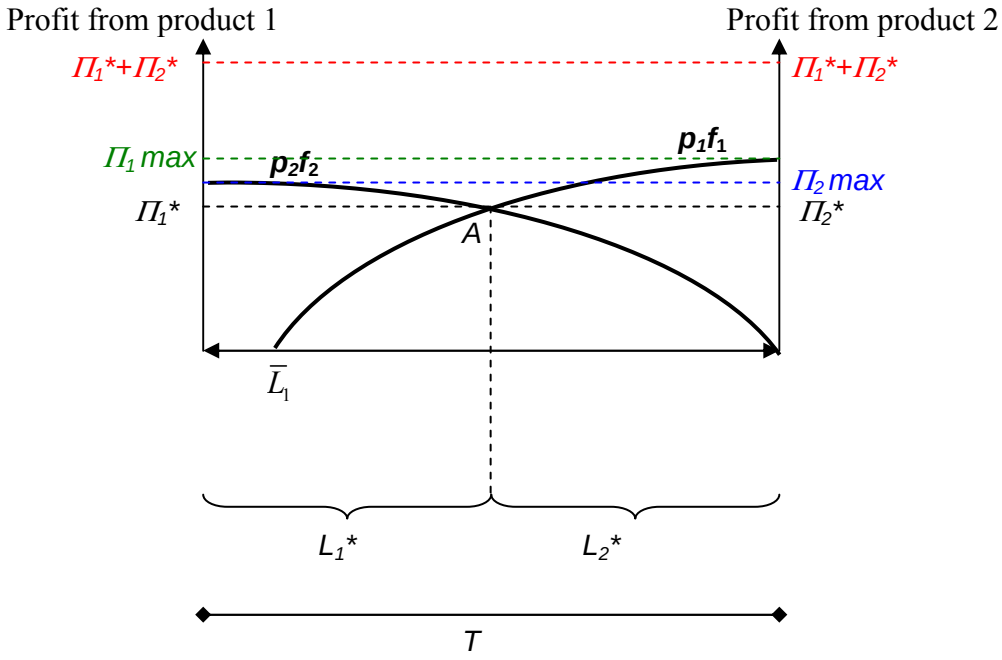
The case of a farmer producing both products is depicted on Figure 1. The horizontal axis of this figure shows the labour allocation to both products, the total length of the axis being the total time available to the farmer (*T*). The left, respectively right, vertical axis represents the profit generated from the production of product 1, respectively of product 2. Both production technologies ($p_1 f_1$ and $p_2 f_2$) are depicted, with the production technology of product 2 starting at $L_2 = 0$ and the production technology of product 1 starting at $L_1 = \overline{L_1}$. The larger labour profitability of product 1 than of product 2 (i.e. constraint (3)) is represented by a greater slope of the production technology of product 1 than of product 2. The farmer's objective is to maximize its total profit; the latter is maximized at point *A*, that is to say where the marginal labour productivities of both products are equal. From the farmer's objective program above, the optimal point *A* is represented by the following Kuhn and Tucker condition:

$$p_1 \frac{\partial f_1\left(L_1^*\right)}{\partial L_1} = p_2 \frac{\partial f_2\left(L_2^*\right)}{\partial L_2} = \omega - \mu_0 \tag{8}$$

μ_0 being the Lagrange multiplier of constraint (7).

At point A, the total profit generated is $\Pi_1^* + \Pi_2^*$, which is greater than the maximum profit that could be generated if the farmer was producing product 1 only (Π_1 max) or product 2 only (Π_2 max). Thus, the farmer produces both products.

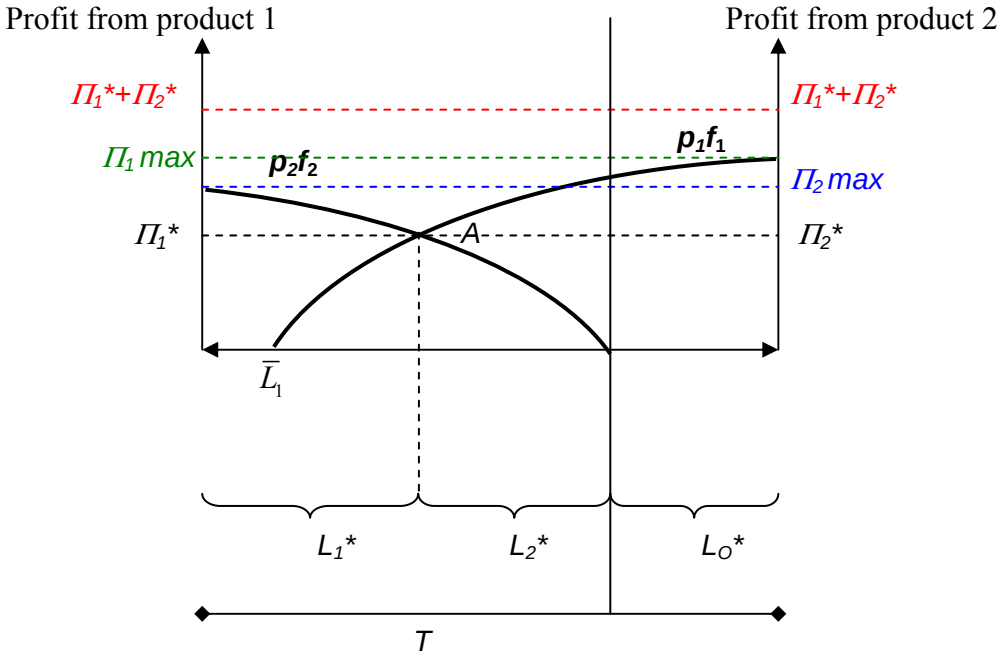
Figure 1: Graphical representation of labour allocation of a full-time farmer



This is the case of a full-time farmer (all time is allocated to production: $T = L_1^* + L_2^*$). But the farmer may also work off farm, as represented by Figure 2. In the case depicted by this figure, the farmer's off-farm labour allocation is L_O^*, and both products are still produced ($T = L_1^* + L_2^* + L_O^*$). In this case, the Kuhn and Tucker condition is:

$$p_1 \frac{\partial f_1\left(L_1^*\right)}{\partial L_1} = p_2 \frac{\partial f_2\left(L_2^*\right)}{\partial L_2} = \omega \tag{9}$$

Figure 2: Graphical representation of labour allocation of a part-time farmer allocating little time off farm



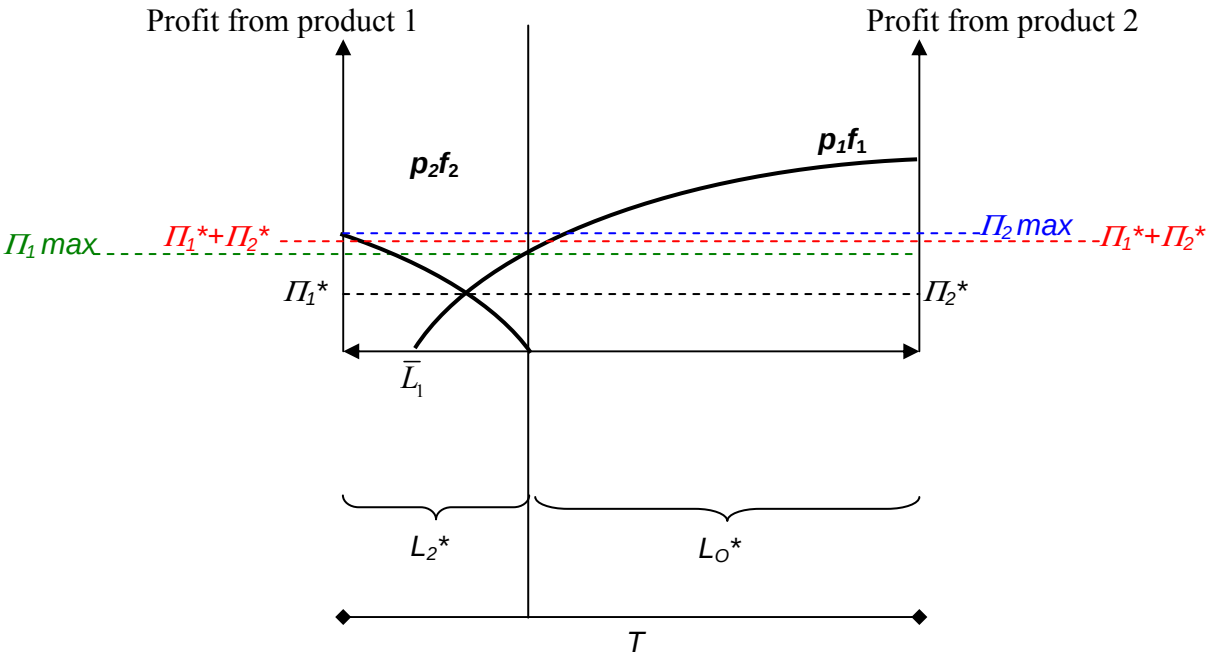
However, when a farmer allocates a large part of its time off farm, only product 2 may be produced, as depicted by Figure 3. In this case, the farmer is constrained in its time left for production. As shown on the figures, the profit from producing product 2 only (Π_2 max) is greater than any other combination (production of product 1 only, or production of both products). Thus, in this case, the farmer is better off not producing at all product 1, even though this product is more profitable than product 2. The Kuhn and Tucker conditions for product 1, respectively product 2 are:

$$(p_1 - \lambda)\frac{\partial f_1(L_1^*)}{\partial L_1} = \omega \tag{10}$$

$$p_2 \frac{\partial f_2(L_2^*)}{\partial L_2} = \omega \tag{11}$$

λ being the Lagrange multiplier of constraint (2).

Figure 3: Graphical representation of labour allocation of a part-time farmer allocating much time off farm



3. Method and data

The above conceptual framework shows that farmers who allocate a large part of labour off farm may not be able to produce profitable products. Thus, in order to test this proposition, that part-time farmers will rather concentrate on products with a low labour profitability, Swiss farm level data from the Farm Accountancy Data Network (FADN) from the years 1996-2005 were examined for 16 different production activities with a sufficient number of observations. One important issue is the definition of part-time farms. The practice that is most common in Middle Europe is to distinguish between farms where the household income comes mainly (i.e. above 50 per cent) from on-farm income and farms where income comes mainly from off-farm activities; in this paper we will call the first type of farms full-time farms and the second type of farms part-time farms. Since some of the so-called full-time farms are also part-time farms, it would be more accurate to define the latter as sideline farms. For simplicity reasons, however, we will stick to the labelling full-time and part-time farms.

The "Labour Economics" Research Group from the Swiss Federal Research Station ART has available detailed labour requirements for almost all farm products under typical Swiss conditions. With these figures, Standard Labour Requirements for each farm were calculated based on the farm's production portfolio, both for single products (*SLR*) and for the total farm (*FLR*). The latter figure was compared by the total labour requirement of the farm as documented in its books (*RLR*) so that

$$L = \frac{RLR}{FLR} \tag{12}$$

Real labour requirements for single product lines (*R*) were subsequently estimated by

$$R = L \times SLR \tag{13}$$

Monetary labour productivity on a single-farm-level (P_f) was then calculated by monetary produced amounts, divided by *R*. Finally, average monetary labour productivity per product line was calculated by

$$P = \frac{\sum \left(P_f W_f A_f \right)}{N \sum W_f \sum A_f} \tag{14}$$

where

W_f is the weight of the single farm in accordance to FADN representativity,

A_f is the amount produced by the single farm,

N is the number of farms involved.

This modification of FADN data allows now to test empirically how the share of part time farms in each production activity can be explained. The explanation of the share of part-time farms in each production activity is now carried out by *P*, as described above. This means that we test whether the level of labour productivity of a farm product (explanatory variable of the regression) will influence the production level of part-time farms involved in delivering this product (dependent variable of the regression). Another explaining variable is the categorization into animal and crop activities, since there could be any systematic bias for part-time farmers to either of them. In order to allow for a changing share of part-time farms over time, a fixed-effect regression was applied.

4. Results

The main differences between full- and part-time farms are illustrated in Table 1. In assets, acreage and particularly in number of animals, full-time farms outsize part-time farms. The most striking difference, however, is the income situation. While the agricultural income for full-time farms in Switzerland is slightly higher than the direct payments they receive, the opposite is true for part-time farms. Their agricultural income is at only 19,000 Swiss Franks per year. This is not only far too low to make a living under Swiss conditions, it is also not even the half of the governmental transfers they receive. This means that every production process by part-time farms seems to be bound to make economic losses. This is a first indicator for the truth of our hypothesis.

Looking at costs and revenues of full- and part-time farms, another indicator supports the hypothesis that only full-time farms manage to produce profitable products. With similar asset value and labour use, part-time farms only manage to have a bit more than half of the revenues which full-time farmers have. This means that not the high cost level is the chronic problem of Swiss part-time farms, because their cost level is even below the one of full-time farms. The problem is the low revenue which part-time farms earn with what they produce.

Table 1: Characteristics of full- and part-time farms in 2004 in Switzerland

	Average for full-time farms	*Average for part-time farms*
Labour units	1.7	1.2
Area farmed (hectares)	21	15
Livestock units	28	17
Assets (Swiss Franks)	783,000	634,000
Direct payments (Swiss Franks)	50,000	40,000
Total revenue (Swiss Franks)	240,000	143,000
Total costs (Swiss Franks)	170,000	124,000
Agricultural income (Swiss Franks)	70,000	19,000
Non-agricultural income (Swiss Franks)	14,000	54,000

The regression results presented in Table 2 show that the share of part-time farms is indeed influenced by the monetary productivity of the farm product. The more revenue per labour unit is generated by a product, the less part-time farms will engage in its production. However, the fact that an agricultural activity is connected cannot be shown to influence the engagement of part-time farms.

Although the relatively low R^2 shows that many other factors which have not been identified yet are also responsible for the role that part-time farms play for sectoral production, the results confirms our hypothesis that part-time farmers tend to engage on products with a low monetary labour productivity.

Table 2: Explaining the share of part-time farms in the country's agricultural production in 1996-2005 in Switzerland

Variable	*Coefficient*	*t-value*	*Probability*
Monetary productivity per labour unit (*P*)	-0.0000000448	-2.05	0.026
Animal activity (dummy)	0.0118	1.20	0.234
Constant	0.1065	16.4	0.000

$R^2 = 0.03$

Number of observations: 157

The results are illustrated by Table 3 which shows the part of products being provided by part-time farms in Switzerland. The data confirms our example of pig breeding which is highly profitable, but requires a certain minimum of (time, financial and intellectual) resources, so that most part-time farmers refrain from it. There are other examples like potatoes, where similarly high entry barriers keep most part-time farmers off, but where the turnover per worker turns out to be rather low. Such cases may contribute to the low measure of determination in Table 2. As supposed in Section 2, spelt is the opposite example which is often produced by part-time farms, but which has a low revenue.

Table 3: Examples for the share of production by part-time farms and annual turnover per labour unit in 2004 in Switzerland, 2004

Product	*Share of the country's agricultural production by part-time farms (%)*	*Annual turnover / labour unit for all farms (Swiss Franks)*
Wheat	5.9	229,000
Potatoes	6.1	94,000
Pig breeding	8.1	357,000
Milk	8.8	102,000
Pig fattening	9.7	264,000
Maize	9.7	147,000
Barley	9.8	103,000
Sugar beets	10.8	127,000
Rapeseed	11.6	119,000
Oat	12.8	98,000
Sunflower	14.1	96,000
Spelt	20.2	115,000
Suckler cows	22.1	182,000

5. Conclusion

Few of us have two different jobs. Many people balk at the thought of running through two different educations and of keeping the issues of importance from two different working places in their mind. If we are economists in the morning, we are unlikely to work at a travel agent or a bakery in the afternoon. Conventional wisdom has it that this is different for agriculture. From the literature cited above, it appears as if monetary labour productivity could be maximized through splitting ones' personal labour resources between on-farm and off-farm activities. However, the existing literature has not investigated part-time farmers'

choices of production activities on their farm. Such choices are likely to be more constrained than those made by full-time farmers.

Our hypothesis was that part-time farmers, due to their labour constraint on farm, do not engage is highly profitable products. The explanation is that such production activities have fixed costs, in other words, they require fixed time requirements, in terms of learning, entering and running the activity. Our conceptual framework and our results for Swiss farms confirm the difficulties to enter attractive activities within agriculture if off-farm employment constitutes an important part of the household income. The smaller farms are, the clearer will these difficulties become. Imperfectly functioning land and labour markets exacerbate the situation, as part-time farmers cannot overcome constraints on farm expansion and labour hiring.

Therefore, Swiss farms, being very small in international comparisons anyway, are a good example for the disadvantages that arise for part-time farmers. It is therefore questionable whether part-time farming offers a solution for structural change process in small-structured agricultural systems affected by imperfections on factor markets.

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