

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

Laure Latruffe (INRA Rennes); Stefan Mann

Abstract

Part-time farming in Switzerland is not only less developed in Switzerland than in most other European countries, its share is also falling. We develop the hypothesis that part-time farmers invest in less profitable products that full-time farms, due to the necessary minimum investments which entering a production process require. Descriptive statistics show some indications for this hypothesis, like a much lower revenue and lower agricultural income of part-time farms, despite a comparable value of the farm's assets. A regression analysis in which the share of part-time farms of typical farm products 1996-2005 is explained by the revenue per labour unit confirms that part-time farms tend to focus on products with a low revenue.

1. Introduction

Small-structured agriculture has, for a long time, be 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 rate 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 % p.a. between 2000 and 2005) is considerably higher than for full-time farms (-1.4 % p.a.). This means that the difference in the part-time rate of 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 (Pfaffermayer 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 analysed, constraints on agricultural factor markets other than labour have been neglected in the attempt to understand the nature of part-time farming. This paper is meant to show that severe constraints may not only influence the farmer's behaviour in the labour market, but also on-farm. While factor constraints are usually not seen as being of major importance in reasonably large-structured farming sectors such as in the US (Ahearn et al., 2004), this may well be different in agricultural systems as Switzerland where high subsidies have maintained an average farm size of 19 hectares.

Another difference to the situation in the United States (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 labor 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.

As we are going to show in Section 2 from a theoretical viewpoint, farms with factor constraints may well be forced to stick to unproductive and unprofitable product lines. Factor constraints in terms of limited machinery or stables may prevent particularly part-time farms to produce what the market wants and what would be most profitable. This presumption is going to be tested empirically, for which the method is outlined in Section 3. Results are presented in Section 4. Section 5 draws conclusions in terms of policy recommendations and the role of part-time farms.

2. Theory

The model presented below will demonstrate that, in certain cases, part-time farmers might not produce high productivity products, but will prefer to produce low productivity products on all their land.

The model framework is that farmers have the possibility to produce two products. The assumption is that product 1 has a higher marginal productivity per labour than product 2, but necessitates a minimum labour force. Farmers are either full-time or part-time farmers.

The objective program for full-time farmers is as follows.

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

on X_1, X_2, L_1, L_2

subject to

$$T = L_1 + L_2 + l \quad (2)$$

$$L_1 \geq \bar{L}_1 \quad (3)$$

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;

T, l are respectively total time endowment and leisure time;

\bar{L}_1 is the minimum labour allocated to the production of product 1.

The objective program for part-time farmers is as follows.

$$\text{Max } \Pi = p_1 f_1(X_1, L_1) + p_2 f_2(X_2, L_2) - p_X(X_1 + X_2) + \omega L_o \quad (4)$$

on X_1, X_2, L_1, L_2

subject to

$$T = L_1 + L_2 + l + L_o \quad (5)$$

$$L_1 \geq \bar{L}_1 \quad (3)$$

where

L_o is the time allocated to off-farm employment;

ω is the off-farm wage.

The notion of minimum labour allocated to a specific production activity can only be understood if one knows the technical nature of agricultural production processes. There is always a proportion of factor requirements that are fixed. 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, a lot of human capital has to be invested, so that technologies and the organization of labour is known to the farmer. And in a lot of instances, not only labour investments, but also capital investments become necessary. These fixed factor requirements contribute a lot to the persisting phenomenon of economies of scale (Hallam, 1991; Shah, 1992; Langlois, 1997). And Mann et al. (2003) 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.

\bar{L}_i can be thought of representing these fixed factors within a production process. The different agricultural products will, however, have a varying share of \bar{L}_i . 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 has, 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 share of \bar{L}_i , 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 entering the production of spelt.

The program for full-time farmers can be solved with the Lagrangian function, Λ_{FT} , and the Lagrangian multiplier for constraint (3), λ .

$$\Lambda = p_1 f_1(X_1, L_1) + p_2 f_2(X_2, L_2) - p_X(X_1 + X_2) - \lambda(L_1 - \bar{L}_1) \quad (6)$$

Only first-order conditions with respect to labour are given here (the first-order conditions with respect to the other inputs are the same for full-time and part-time farmers).

$$\frac{\partial \Lambda}{\partial L_1} = p_1 \frac{\partial f}{\partial L_1} - \lambda = 0 \quad (7)$$

$$\frac{\partial \Lambda}{\partial L_2} = p_2 \frac{\partial f}{\partial L_2} = 0 \quad (8)$$

that is to say

$$p_1 \frac{\partial f}{\partial L_1} = \lambda \quad (9)$$

$$p_2 \frac{\partial f}{\partial L_2} = 0 \quad (10)$$

Equation (9) means that full-time farmers are ready to produce product 1 as long as its marginal productivity per labour is at least λ (value strictly positive). By contrast, full-time farmers will always produce product 2, as they only require its marginal productivity to be positive (equation (10)).

As for part-time farmers, the Lagrangian function and the first-order conditions with respect to labour are as follows.

$$\Lambda = p_1 f_1(X_1, L_1) + p_2 f_2(X_2, L_2) + \omega(T - L_1 - L_2 - l) - p_X(X_1 + X_2) - \lambda(L_1 - \bar{L}_1) \quad (11)$$

$$\frac{\partial \Lambda}{\partial L_1} = p_1 \frac{\partial f}{\partial L_1} - \omega - \lambda = 0 \quad (12)$$

$$\frac{\partial \Lambda}{\partial L_2} = p_2 \frac{\partial f}{\partial L_2} - \omega = 0 \quad (13)$$

that is to say

$$p_1 \frac{\partial f}{\partial L_1} = \lambda + \omega \quad (14)$$

$$p_2 \frac{\partial f}{\partial L_2} = \omega \quad (15)$$

Thus, part-time farmers are ready to produce product 1 as long as its marginal productivity per labour is at least $\lambda + \omega$ (equation (14)), and product 2 as long as its marginal productivity is at least ω (equation (15)).

The solutions are illustrated on Figure 1.

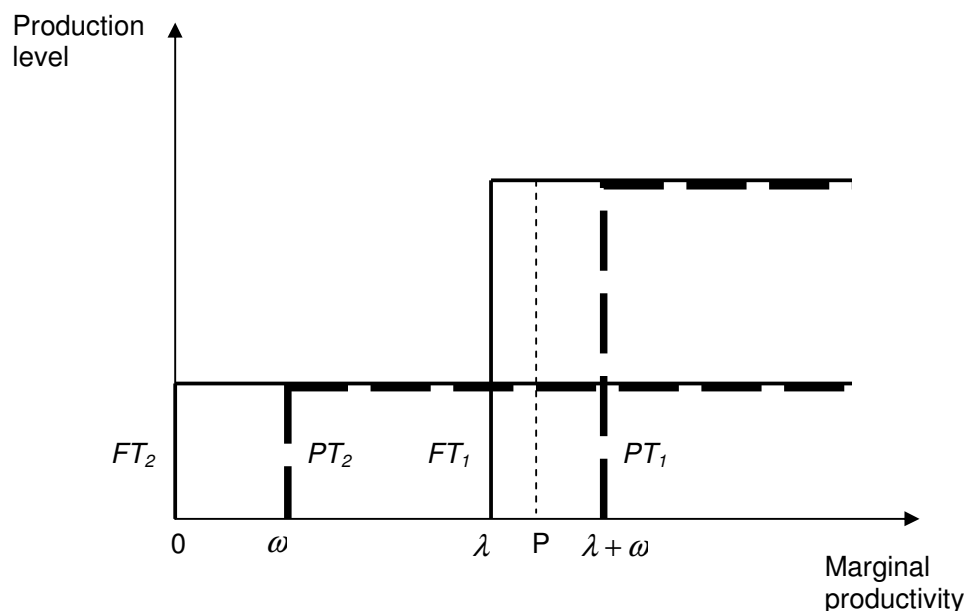


Figure 1: Production behaviour of full- and part-time farms
FT₂: Production curve of product 2 by full-time farmers
PT₂: Production curve of product 2 by part-time farmers
FT₁: Production curve of product 1 by full-time farmers
PT₁: Production curve of product 1 by part-time farmers

Figure 1 shows that at point P, only full-time farmers produce product 1 (with high marginal productivity), while part-time farmers prefer to produce product 2 (with lower marginal productivity) on all land. Thus, at this point, the average productivity of full-time farmers is larger than the one of part-time farmers.

Whether the marginal productivity threshold of product 1 for part-time farmers ($\lambda + \omega$) is close to the threshold for full-time farmers (λ) depends on the level of off-farm wage (ω). In Switzerland, off-farm wage is in general high in most of the areas, and therefore the Swiss situation is likely to be point P. In other words, our hypothesis is that, on average, part-time farmers do not produce products with high marginal productivity, and their average productivity is lower than the one of full-time farmers.

3. Method and data

In order to test the proposition that part-time farmers will rather concentrate on products with a low labour productivity, Swiss FADN data from the years 1996-2005 was examined. For 16 different production activities with a sufficient number of samples, the data revealed the total product-specific turnover. Total labour input on the farm was also known.

One important issue is the definition of part-time farms. The practice most common in Middle Europe is to distinguish between farms where the household income comes mainly (= above 50 %) from on-farm income (hitherto: regular farms) and farms where income comes mainly from off-farm activities. Since some of the regular 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 distinction between regular and part-time farms.

The “Labour Economics” Research Group from the Swiss Federal Research Station ART has detailed labour requirements for almost all farm products under typical Swiss conditions available. 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

$$L = \text{RLR} / \text{FLR}.$$

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

$$R = L * \text{SLR}$$

Monetary labour productivity on a single-farm-level (Pf) was then calculated by monetary produced amounts, divided by R.

Average labour productivity per product line is calculated by

$$P = \frac{\sum (P_f * W_f * A_f)}{(F * \sum W_f * \sum A_f)},$$

where W_f is the weight of the single farm in accordance to representativity, A_f is the amount produced of the single farm and F 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 will influence the level of part-time farms involved in delivering this product. Another explaining variable is the categorisation 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 regular and part-time farms are illustrated in Table 1. In assets, acreage and particularly in number of animals, regular farms outsize part-time farms. The most striking difference, however, is the income situation. While the agricultural income for regular 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 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 a similar value of their farms, 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 regular and part-time farms (Data source: FADN Switzerland, 2004)

	Regular Farms	Part-time Farms
<i>Labour units</i>	1.7	1.2
<i>Hectares</i>	21	15
<i>Livestock units</i>	28	17
<i>Assets (Fr.)</i>	783.000	634.000
<i>Direct payments (Fr.)</i>	50.000	40.000
<i>Total revenues (Fr.)</i>	240.000	143.000
<i>Total costs (Fr.)</i>	170.000	124.000
<i>Agric. Income (Fr.)</i>	70.000	19.000
<i>Nonagric. Income (Fr.)</i>	14.000	54.000

Table 2 shows that the share of part-time farms is indeed influenced by the financial productivity of the farm product. The more revenue is generated per labour unit 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.

Table 2: Explaining the share of part-time-farm-production 1996-2005 in Switzerland (n=157)

<i>Variable</i>	<i>coefficient</i>	<i>t-value</i>	<i>p</i>
Financial Productivity per labour unit	-0.0000000448	-2.05	0.026
Animal activity	0.0118	1.20	0.234
Constant	0.1065	16.4	0.000

$R^2=0.03$

This result confirms our hypothesis that part-time farmers tend to engage on products with a low labour productivity. It contradicts, on the other hand, Schmitt's proposition that the marginal productivity of part-time farms will be higher than of full-time farms. Having said this, 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 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 (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 (Data source: FADN Switzerland, 2004)

<i>Product</i>	<i>Share (%)</i>	<i>Annual turnover/ labour unit (Fr.)</i>
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 productivity could be maximized through splitting ones personal labour resources between on-farm and off-farm.

In business economics, we have become used to the distinction between fixed and variable costs. Perhaps, we should use this model to understand the resource allocation of labour. Each activity has fixed time requirements. These arise through learning the activity and through entering the activity. Only the variable labour time is spent proportionally to the extent of the activity.

Our results, both theoretically and empirically, 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. 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.

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