

Total factor productivity change of Swiss dairy farms located in the mountainous area

Pierrick Jan and Markus Lips¹

Abstract – In view of the ongoing liberalisation process of the Swiss dairy market and as a consequence of the actual low competitiveness of the Swiss dairy production in international comparisons, Swiss dairy farms are under pressure to increase their productivity. In this paper, we measure the Total Factor Productivity (TFP) growth in the period 1999-2007 of a balanced sample of 71 dairy farms located in the mountainous region using the Malmquist Index approach. The average yearly TFP growth rate amounts to 1,4%. This is lower than the 2,1% TFP growth rate of the world agricultural sector reported in the literature, implying thus that the relative competitiveness of the Swiss dairy farms located in the mountainous region has decreased. The analysis of the TFP scores distribution clearly shows however that a 2% TFP growth is not an unreachable goal. At single-farm level, milk production expansion is shown to be a successful strategy to reach high TFP growth rates. With regard to the expected further liberalisation of the Swiss dairy market, an active promotion of structural change seems a promising strategy to increase the productivity of the Swiss dairy sector located in the mountainous region.

INTRODUCTION

The Swiss dairy sector shows in international comparisons a poor competitiveness. The full costs of a typical dairy farm (20 cows) located in the hilly region amounted in 2007 to around 1,7 CHF per kg milk and thus exceeded the full costs of a similar typical German or Austrian farm by around 75% (IFCN, 2008). The Swiss high-cost environment and the lower physical productivity of the Swiss farms are the two major factors which account for this lower competitiveness. Since 1999, the Swiss agricultural sector has faced an ongoing progressive liberalisation of its dairy market. Currently, the Swiss confederation is negotiating a free trade agreement in the agricultural and food sector with the EU. This further liberalisation will put the Swiss dairy farms under pressure to increase their productivity. It will be especially challenging for the dairy farms located in the mountainous region as these farms show a particular low productivity due, amongst others, to the difficult production conditions associated with their natural environment. In this context, a precise knowledge of the Total Factor Productivity (TFP) change of these farms and of its

determinants is required. In this contribution, we measure the TFP change of the Swiss dairy farms located in the mountainous region in the period 1999-2007. In a subsequent step, we examine the effect of farm size on the farm absolute productivity and we investigate the effect of an expansion of the milk production at farm level on the TFP change.

MATERIAL AND METHODS

The study relies on a balanced panel of 71 dairy farms of the mountainous zone 2. These farms have been observed over the period 1999-2007. The data originate from the Swiss Farm Accountancy Data Network (FADN). Productivity is defined as the ratio of amount of outputs produced to inputs used. We calculate both the partial productivity of each production factor and the total factor productivity. The TFP change is assessed using the Malmquist index of productivity growth which draws primarily upon the work of Färe et al. (1994). Considering the fact that a dairy farmer can more easily adjust its inputs use than its output production, we use an input orientated Malmquist TFP Index. The TFP change of a farm between year t and year $t+1$ is equal to the product of the technical change (technical progress), the pure technical efficiency change and the scale efficiency change. The components of TFP change are measured using distance functions. In this study, we follow Färe et al. (1994) and calculate these distance functions using the non parametric Data Envelopment Analysis (DEA) approach. For the productivity and productivity change estimation, we consider the farm gross revenue (in Swiss Francs) as output. The usable agricultural area (in hectares), the intermediate consumptions (in Swiss Francs), the capital (defined as the sum of the depreciations, of the interests on debts, of the calculated interests on equity capital and of the rents, in Swiss Francs) and the labour (in annual work units) are considered as inputs. A particular attention is paid to the consideration of the direct payments. Only the direct payments remunerating a real concrete ecological service provided by the farms, i.e. the ecological and ethological direct payments as well as the slope direct payments, are considered in the output. Performing an analysis of productivity change across time requires creating a quantity index for each farm for both the outputs and inputs that are expressed in monetary terms. This is done using the indirect method, which consists in deflating the monetary values of revenues and costs with corresponding price indices. In the present investigation, the price indices used originate from the official Swiss agricul-

¹ Pierrick Jan is working as a PhD student in the Research Group Farm Economics of the Agroscope Reckenholz-Tänikon Research Station ART, Tänikon, CH-8356 Ettenhausen (pierrick.jan@art.admin.ch). Dr. Markus Lips is the Head of the Research Group Farm Economics of the Agroscope Reckenholz-Tänikon Research Station ART, Tänikon, CH- 8356 Ettenhausen (markus.lips@art.admin.ch).

tural statistics (SBV, 2000-2007). Deflation is performed at a very detailed level (single costs and revenues positions) to ensure getting a quantity index reflecting the reality as faithfully as possible. Furthermore, several "price" indices are created to correct the amount of each direct payment received by a farm for the associated direct payment development since 1999. For each direct payment, any increase in the direct payment rate that is not associated with an increase of the ecological services provided (or of the ecological requirements) is considered as inflation and is corrected for.

RESULTS

The yearly TFP change of the sample of farms investigated amounts on average to +1,4%. This TFP growth arises from a +1,8% annual technical change. The technical efficiency for its part has slightly decreased in the period under investigation (-0,3% yearly). This is due to a 0,4% yearly decrease of the pure technical efficiency whereas the scale efficiency has remained almost constant (0,1% yearly increase). The analysis of the changes in the partial productivities reveals that this TFP growth results from a drastic increase of the work productivity (+2,8% per year), of the land productivity (+2,5% per year) and, to a lesser extent, of the capital productivity (+1,2% per year). The intermediate consumptions productivity has for itself decreased (-0,5% per year). The farms investigated show a high heterogeneity with regard to their TFP change. Whereas the 25% least performing farms show a yearly TFP change lower than -0.6%, the 25% best performing farms record a yearly TFP growth higher than 3.8%. Farm size, measured by the amount of milk produced, turns out to have a significant effect on the absolute productivities. Farms of the third tercile of amount of milk produced show on average in 2007 a 38% higher total factor productivity than the farms of the first tercile of amount of milk produced. This results from a 88% higher labour productivity combined with a 22% higher land productivity. The farms of the first and third tercile of amount of milk produced do not significantly differ from each other neither with regard to their capital productivity nor with regard to their intermediate consumptions productivity. The effect of milk production expansion is investigated by classifying the farms in two groups: the first group is made of the farms with a relative change of their amount of milk produced between 1999 and 2007 equal or higher than the median value of the relative milk production change of the whole sample. The second group is made of the farms whose milk production growth between 1999 and 2007 is lower than the median value of the relative milk production change of the whole sample. The farms of the first group (called hereafter "H-Growth") have increased their amount of milk produced between 1999 and 2007 by at least 13,8% and on average by 36,8%. Those of the second group (called hereafter "L-Growth") have increased their milk production between 1999 and 2007 at the most by 13,8% and on average they have decreased their milk production by 1%. The H-Growth farms show in comparison with the L-Growth farms a significantly higher

TFP growth (+2,3% vs. +0,6% per year). This higher TFP growth is accounted for by a higher increase of the labour productivity (+3,8% vs. +1,7% per year), of the land productivity (+3,4% vs. +1,6% per year) and of the capital productivity (+2,2% vs. +0,2% per year). Whereas for the L-Growth Group, the intermediate consumptions productivity has decreased at a yearly rate of 1,1%, the H-Growth Group has succeeded in maintaining its intermediate consumptions productivity constant. As a result of this higher TFP growth, the H-Growth Group farms, which already show in 1999 a higher absolute total factor productivity (+10%), present in 2007 an absolute total factor productivity corrected for inflation which is by 19% higher than the productivity of the L-Growth farms.

DISCUSSION

Despite very difficult natural production conditions, the TFP of the Swiss dairy farms located in the mountainous region has increased on average by 1,4% in the period 1999-2007. The TFP growth of these farms remains however lower than the +2,1% average TFP growth rate of the top 93 world agricultural producers, which account for roughly 97 percent of the world's agricultural output, reported by Coelli and Rao (2005). This implies that the relative competitiveness of the Swiss dairy sector located in the mountainous region has been decreasing in international comparisons. One could argue that the particular difficult production conditions might be responsible for this lower performance. However the fact that 25% of the farms investigated show a TFP growth higher than 3,8% clearly gives the evidence that a 2% annual TFP growth is a reachable objective for this type of farms. Farm size turns out to have a strong positive effect on the absolute farm productivity. At single farm-level, milk production expansion reveals to be a successful strategy to reach high TFP growth rates. These results imply, that, with regard to the expected further liberalisation of the Swiss dairy market, an active promotion of structural change would be a promising strategy to increase the productivity of the Swiss dairy farms located in the mountainous region.

REFERENCES

- Coelli, T.J. and Rao D.S.P. (2005). Total factor productivity growth in agriculture: a Malmquist analysis of 93 countries, 1980-2000. *Agricultural Economics*, 32, 115-134.
- Färe, R., Grosskopf, S., Norris, M. and Zhang Z. (1994). Productivity growth, technical progress and efficiency changes in industrialised countries. *American Economic Review*, 84: 66-83.
- IFCN (International Farm Comparison Network) (2008). *IFCN Dairy Report 2008*. Kiel: IFCN Dairy Research Centre.
- SBV (Schweizerischer Bauernverband) (2000-2007, diverse Jahrgänge). *Statistische Erhebungen und Schätzungen über Landwirtschaft und Ernährung*. Brugg, Schweizerischer Bauernverband.