Source of income variability at the northern limits of agricultural production in Europe

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Introduction

The EU Commission has recently focused new attention on risk management on European farms (EC 2011). New possibilities have been introduced in line with the WTO 'green box' rules on farm subsidies. One of the most important features of these new risk management possibilities is that member states are individually responsible for developing agricultural insurance schemes. This is an excellent opportunity for member states that do not currently provide such a scheme based on public–private partnership (PPP). However, in parallel with the lack of insurance schemes there is also a considerable lack of knowledge concerning such schemes. One of the main questions is where the income risks come from. Based on earlier studies and experiences, the main sources of income fluctuation between years are volatile commodity prices as well as weather-related and thus volatile yields.

No commercial yield insurances exist in Finland. This is mostly because of the crop damage compensation (CDC) programme implemented by the Finnish government. The CDC programme is an ad hoc type of safety net that is free for all farmers. However, it will not continue after 2015. The main characteristics of the current CDC programme are similar to those of traditional multi-peril crop insurance. A farmer is entitled to crop damage compensation if the whole farm yield is damaged to the extent that it is at least 30% below the corresponding reference yield, which is the regional yield average. Thus, all farms within the same region have the same reference yield. The programme only compensates quantity losses that exceed the 30% threshold, and average producer prices are used to determine the amount of compensation.

The Finnish government is now facing a new challenge. According to the EU commission, the premiums of the yield insurance scheme should be compensated by no more than 65%. Furthermore, insurances should be sold over the counter by private insurance companies. Thus, the current CDC programme does not fulfil the new EU regulations. One of the first challenges is to determine the sources of income variability on Finnish arable farms.

Data and methods

In our analysis, we decomposed the factors affecting net revenue variance in Finnish farms. Data from the Finnish farm accountancy data network (FADN) were used. FADN data included crop yields, prices and costs at the farm gate. Only monetary values of variable costs (fertilizers, seed and

pesticides) were available, and hence information on the per hectare machinery or labour costs were not used. We decomposed the net revenue variance of wheat, barley and oil seeds (rape seed and turnip rape).

The analysis was normalized to one hectare. In their risk management portfolio, farmers protect themselves against adverse weather conditions and price fluctuation by combining different crops in a crop mix at the farm level. Thus, our analysis did not directly reveal the risks that farms face, but it revealed the sources of income variation.

The per hectare net revenue (NR) of crop *i* is defined as the product of prices *p* and yields *q* minus the costs *c* for fertilizer, seed and pesticides:

The variability of NR is measured by its variance over time. We defined the variance of NR for every farm and for every crop over two periods. The first period covered the years 2000–2005 and the second period the years 2006–2011. To increase the number of farms in the analysis, we included all farms having records for more than three years in the studied period.

We used variance decomposition to reveal the impacts of different components on the per hectare net revenue. Formally (Burt and Finley, 1968):

$$GR, c_{pest}$$

where var(.) and cov(.) denote variances and covariances, GR represents gross revenue and μ_p and μ_q are the expected values of price and produced quantity. The decomposition approach used by Burt and Finley (1968) is only an approximation. Thus, using the Wilcoxon signed rank sum test we analysed whether the approximation given by equation 2 is sufficient to represent the variability in net revenue on each farm.

Results

Based on the Wilcoxon signed rank sum test, the approximated variability in net revenue did not differ from the observed net revenue variability at the 5% confidence level. The results were normalized by dividing each component of the variance by the sum of all direct effects. Thus, the direct effects summed up to 100. Increasing the variance of any direct component increased the net revenue variability. Indirect effects could be of either sign. For example, negative covariance between the yield and price was found to lead to a lower level of net revenue variability, indicating a natural hedge.

All results were calculated at the farm level, and the average results are summarized in Table 1. The average results indicate that the main driver behind net revenue volatility changed within the studied period. While at the beginning the main source of NR volatility was yield variation, it changed to the direction of price volatility. In average terms, yield volatility contributed over 50% of

the NR volatility in 2000–2005, but it contributed less than 40% of the NR volatility of wheat and barley in the second half of the study period. Moderate change was recorded in oil seeds. The effect of costs on income variability decreased from the first period. The negative correlation of price and yield decreased for wheat, but increased for barley. For oil seeds, the correlation between price and yield moved from positive during 2000–2005 to negative during 2006–2011. The high negative correlation between price and yield variability implies a strong natural hedge for oil seeds on Finnish markets.

Table 1. Variance decomposition results for wheat, barley and oil seeds (rapeseed and turnip rape) in Finland.

	Wheat		Barley		Oil seeds	
Direct effects (%)	2000–2005	2006–2011	2000–2005	2006–2011	2000–2005	2006–2011
Yield	51.9*	30.1	57.2*	39.4	56.9*	49.0
Price	24.6	61.2*	14.3	44.7	23.2	39.9
Fertilizer	9.7	5.1	11.5	8.1	11.0	8.1
Seed	7.4	2.2	12.2	5.9	3.6	1.5
Pesticides	6.3	1.4	4.8	2.0	5.4	1.5
∑ Costs	23.4	8.6	28.5	15.9	19.9	11.1
Indirect effects (%)						
Price/Yield	-2.9	-1.3	-1.7	-7.3	8.1	-30.0
Revenue/Fertilizer	6.4	-3.1	4.4	-1.7	6.4	2.3
Revenue/Seed	4.3	-0.4	-0.3	1.8	-0.5	1.1
Revenue/Pesticides	0.1	-0.5	7.8	-0.7	-3.0	1.4
Seed/Fertilizer	0.0	0.8	-4.8	-1.8	1.8	-0.1
Pesticide/Fertilizer	1.4	0.9	1.0	1.5	0.7	1.0
Seed/Pesticide	-1.1	0.0	-0.6	0.4	-0.9	0.4

*Yield or price risk is the main and significant (at the 5% level) source of net revenue variability.

Discussion

Previous studies have revealed that before 2005 the main source for income volatility in crop production in Finland was yield variability (Liu and Pietola 2005). Our results are consistent with these observations. However, recent price spikes in commodity markets have increased the price risks faced by farmers. In this study we examined whether price or yield volatility dominates at the northern limits of agricultural production in Europe. Based on our findings, arable farmers in Finland should pay more attention to preventing commodity price waivers than yield volatility. The robustness of our conclusion is weakened by the fact that recent price peaks have mostly been positive compared to long term commodity price trends.

References

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