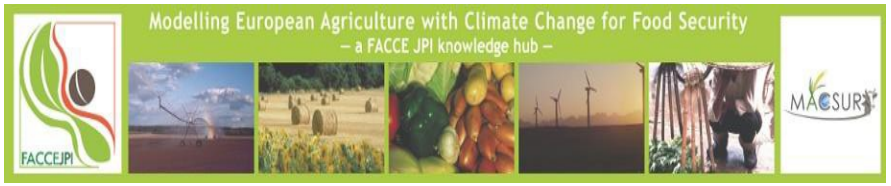

AgMIP

TradeM International Workshop

Economics of integrated assessment approaches for agriculture and the food sector

25-27 November 2014 at Hurdalsjøen Hotel, Norway

How volatile are farm incomes? The case of Italian farms

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1. Issues and research questions
2. Data and methodology
3. Empirical results
4. Conclusions

Issue and research questions

Volatility of farm income over time

Research questions:

1. how volatile are farm incomes?
2. considering only down side risk (i.e. incomes below the average) is different than just volatility ?
3. in which farm groups volatility is higher?
4. has volatility increased over time?

Data and methodology

Data:

- a constant panel
- 2404 single holdings
- belonging to the Italian FADN sample
- decade 2003-2012

Farm Income (FI):

Remuneration to fixed factors of production of the family (work, land and capital) and remuneration to the entrepreneur's risks (loss/profit) in the accounting year.

Motivation:

why does **income** volatility matter?

- Whole farm income is what matter for farmers
- Lack of empirical evidences

Whole Farm Income (FI):

REV = $p\ y\ a$ *(i.e. Price, Yield, Acreage)*

REV = $\sum_i p_i\ y_i\ a_i$ *(i.e. Multiproduct farms)*

FI = $\sum_i (p_i\ y_i\ a_i\ - c_i) -$ NsCosts + …. ? *(i.e. Costs)*

FI = $\sum_i (p_i\ y_i\ a_i\ - c_i) -$ NsCosts + CAP DPs + Others *(i.e. several RM strategies and measures)*

Data

Whole sample and farms grouped according to:

- Type of Farming (7 groups)
- Economic size classes (3 groups)

Types of Farming (TF)	Code	Sample size Number
Specialist field crops	1	572
Specialist horticulture	2	276
Specialist permanent Crops	3	715
Specialist grazing livestock	4	493
Specialist granivore	5	84
Mixed cropping	6	161
Mixed livestock and Mixed crops-livestock	7	103
Economic size (ESU classes)		
Small (ESU classes 1, 2 and 3)		699
Medium (ESU classes 4, 5 and 6)		1595
Large (ESU classes 7 and 8)		110
Total sample		2404

Methodology

The original FI data have been:

- deflated (GDP deflator)
- standardised (dividing by the 10 year average) (series centred around 1)
- detrended

Identification of linear trends by:

- pooling farms into 7 Types of Farming (TF)
- robust regression to account for outliers (two weight functions: Huber weights and bi-weights)

Two volatility indexes (in each farm over 10 years):

- Standard Deviation (**V1**)
- Semi-Standard Deviation (**V2**) (focus only on adverse income conditions, i.e. down-side risk)

Calculated on standardised data → Coefficient of Variation (CV).

- Normality tests: no reject of non-normality of the distributions of volatility indexes (V1 and V2) among farms

Consequences:

- focus on median values
- use of non-parametric tests:
    - Spearman's correlation test and rho
    - Kruskal-Wallis (at least one inequality in the medians)
    - Wilcoxon rank-sum test (pairwise comparison)

Empirical results

Considering only down side risk (i.e. V1 vs. V2) is different?

- No differences
- Correlation between V1 and V2 is always very high and significant

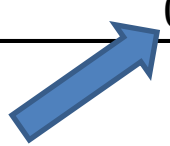
→ Focus on V1 only

		Standard Deviation V1	Semi Standard Deviation V2	Spearman's rho^	
Types of Farming	Code				
Specialist field crops	1	0.659	0.534	0.911	***
Specialist horticulture	2	0.584	0.507	0.790	***
Spec. permanent crops	3	0.665	0.550	0.895	***
Spec. grazing livestock	4	0.572	0.484	0.887	***
Specialist granivore	5	0.844	0.739	0.796	***
Mixed cropping	6	0.688	0.564	0.879	***
Mixed livestock/crops-livestock	7	0.658	0.567	0.904	***
Economic size classes					
Small		0.715	0.595	0.895	***
Medium		0.604	0.509	0.887	***
Large		0.686	0.589	0.828	***
Total sample		0.637	0.530	0.889	***

How volatile are farm incomes?

- High volatility
- Higher than previous studies: why?
  - Methodology
  - Increases over time
- Large dispersion within each group

Types of Farming (TF)	Median	CV
1 Specialist field crops	0.659	6.58
2 Specialist horticulture	0.584	0.69
3 Spec. permanent crops	0.665	1.67
4 Spec. grazing livestock	0.572	2.26
5 Specialist granivore	0.844	2.55
6 Mixed cropping	0.688	1.34
7 Mixed livestock / crops-livestock	0.658	1.53
Total sample	0.637	4.49



In which farm groups volatility is higher (TF)?

- Differences among TFs are often statistically significant

Types of Farming (TF)		1	2	3	4	5	6	7
Specialist field crops	1		***		***	***		
Specialist horticulture	2			***		***	***	*
Spec. permanent crops	3				***	***		
Spec. grazing livestock	4					***	***	**
Specialist granivore	5						***	***
Mixed cropping	6							
Mixed livestock / crops-livestock	7							

Spec. Granivore (0.844) > (Others) >

Spec. Horticulture and Grazing livestock

(0.584 and 0.572)

In which farm groups volatility is higher (size)?

- Differences between groups often statistically significant

	Median	CV^	Wilcoxon test: Medium	Wilcoxon test: Large
Small	0.715	5.63	***	
Medium	0.604	1.35		**
Large	0.686	2.80		
Total sample	0.637	4.49		

Small and Large (0.715 and 0.686) **>**

Medium size farms (0.604)

Has volatility increased over time?

Yes, in almost all groups:

- particularly horticulture
- more in large farms than in small farms

	2003-2007	2008-2012		Change (%)
Types of Farming:				
Specialist field crops	0.515	0.582	***	13.0%
Specialist horticulture	0.302	0.565	***	87.2%
Spec. permanent crops	0.503	0.513		2.0%
Spec. grazing livestock	0.378	0.457	***	21.1%
Specialist granivore	0.515	0.648	**	25.7%
Mixed cropping	0.448	0.588	***	31.2%
Mixed livestock / crops-livestock	0.429	0.593	***	38.1%
Farm size classes:				
Small	0.531	0.585	***	10.1%
Medium	0.424	0.509	***	20.1%
Large	0.438	0.549	**	25.4%
Total sample	0.449	0.531	***	18.1%

- Differences between the two periods very often statistically significant

Conclusions

Conclusions

1. Few methodological insights
2. Some empirical evidences on farm income volatility

On the methodological side:

- no apparent advantage to account only for down side risk
- a (linear) trend on income over time is often found
- significant differences between farm groups have been found

Empirical evidences on farm income volatility

1. How volatile are farm incomes?

   Large volatility (median whole sample 0.637)

2. In which farm groups volatility is higher?

   Granivore > (Others) > Horticulture and Grazing livestock

   (Small > Large) > Medium farms

3. Has volatility increased over time?

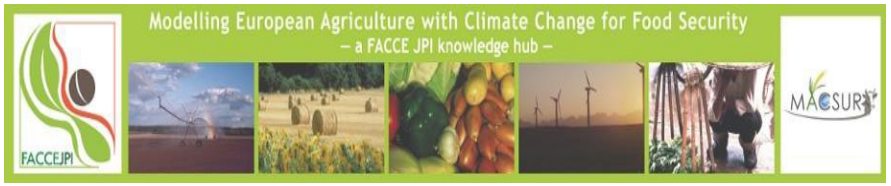
   Definitely yes (median whole sample increased by 18.1%)

Policy considerations:

- introduction of risk management tools within the CAP toolbox seems justified
- scope for better targeting of risk reducing measures

Agenda for future research:

- analysis on additional Countries
- role of different income components (particularly: revenues and CAP direct payments)
- to decompose farm income volatility into price and yield variability



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Appendix 1: Robust regression

- Two weight functions
- Huber weights and bi-weights in STATA
- RR begins by fitting the regression, calculating Cook's D (a commonly used estimate of the influence of deleting a given observation when performing least squares regression analysis) and excluding any observation for which Cook's D>1. Thereafter it works iteratively: it performs a regression, calculates case weights from absolute residuals, and regresses again using those weights. Iterations stop when the maximum change in weights drops below a given tolerance level (Huber, 1964).

Appendix 2: Statistical tests

Sperman's correlation:

Rank ordering of the values of the different groups then calculated as Pearson's correlation computed on the ranks and average ranks. The significance is calculated using the approximation formula of p-value. For any two pairs of ranks (x_i; y_i) and (x_j; y_j) of one variable pair, where n is the number of observations, define them as concordant if the product is positive.

$$p = 2 \times \texttt{ttail}(n-2, |\widehat{\rho}|\sqrt{n-2}/\sqrt{1-\widehat{\rho}^2}) \qquad (x_i - x_j)(y_i - y_j) > 0$$

Wilcoxon's test:

H_0: the two groups come from same distribution

H_1: the two groups differ by a location shift of the distribution

Rank ordering of the values of the different groups like one group. Rank scoring of single group as well as total with mean calculation. Determination of z index that is distributed as a normal to target the distribution and to measure the probability to fall because of the shift, in the tail of distribution. T is the rank group sum.

$$z = \frac{T - E(T)}{\sqrt{\mathrm{Var}(T)}}$$

Kruskal-Wallis test:

H_0: k groups are from the same population and/or from population with same median

H_0: med(TF 1) = med(TF 2) = med(TF 3) = ... = med(TF 7)

H_1: at least one inequality in the medians of groups

Rank ordering of the values of the different groups like one group. Rank scoring of single group as well as total with mean calculation. Determination of g index (KW index) that has a squared-chi distribution with k-1 freedom degrees. Where N is total observations, n_i is single group observations, r_i are the rank mean of the groups.

$$g = \frac{12}{N(N+1)} \sum_{i=1}^{k} n_i \left[\frac{\bar{r}_i - (N+1)}{2} \right]^2$$