

Examples of statistical analyses with regard to policy assessment and farm performance

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Structure

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- 2. Econometric estimation of standard income for taxation of small farms**
- 3. Use of a Generalized Linear Model wrt analysis of income and farm performance**
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1 Introduction

- **FADN opens manifold options for classical statistical analysis, sophisticated modelling and simulations wrt to evaluation of policy measures, efficiency and performance of farms**
- **Two examples:**
 - Econometric estimation income
 - Use of a Generalized Linear Model wrt analysis of income and farm performance
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2 Estimates of standard income for taxation of small farms

According to § 13 Income Tax Act...

- the profit of small farms can be determined based on standard rates (UAA <20 ha (excluding i.e. horticulture) , LU < 20, ...)
- based on the 'economic farm value', where rates are differentiated by farm size (Wesche, 2009)

Ministry of finances asks for a new methodology and calculation base for standard income

- Agric. Ministry (BMEL) tested different measures based on TBN (proposal)
 - Author's proposal to identify main influencing factors and to (econometric) estimate income based on TBN data
- Simulations of different schemes

Data and method

Farm sample selected from TBN data 2006/7 to 2012/13 according to the following criteria:

- $UAA < 20$ ha, $LU < 50$, areas (ha) of hops < 0.6 , asparagus < 0.8 , fruits < 1.85 , strawberries < 0.6 , horticulture open field 0.5, ..., vines < 0.66
- Standard income (**proposal**) = $UAA * 300 + LU > 20 * 50 / 100 + UAA_{hops} * 3815 + UAA_{hortic_xx} * yy$ (standard values)

Econometric model

Pre-test of variables and data preparation

- Economic farm value used for § 13A (old) not significant
- Exogenous variables with high inter-correlation aggregated
- Outlier observations excluded

Stepwise (forward) regression model (no intercept):

- Profit = UAA_hops UAA_asparagus UAA_fruits
UAA_strawberries UAA_nurseries
UAA_flowers/ornamentalPlants UAA_vine LU_dairycow
UAA_arable

Regression results – Model statistics

Summary of Forward Selection

Step	Variables	n Var	Partial R-Square	Model R-Square	F-Value	Pr > F
1	LU_Dairy	1	0.4846	0.4846	3255.34	<.0001
2	UAA_Arable	2	0.0605	0.5451	460.50	<.0001
3	UAA_Flowers	3	0.0056	0.5507	42.79	<.0001
4	UAA_Vine	4	0.0008	0.5515	6.12	0.0134
5	UAA_Asparagus	5	0.0005	0.5520	3.77	0.0522
6	UAA_Strawberries	6	0.0003	0.5523	2.67	0.1024

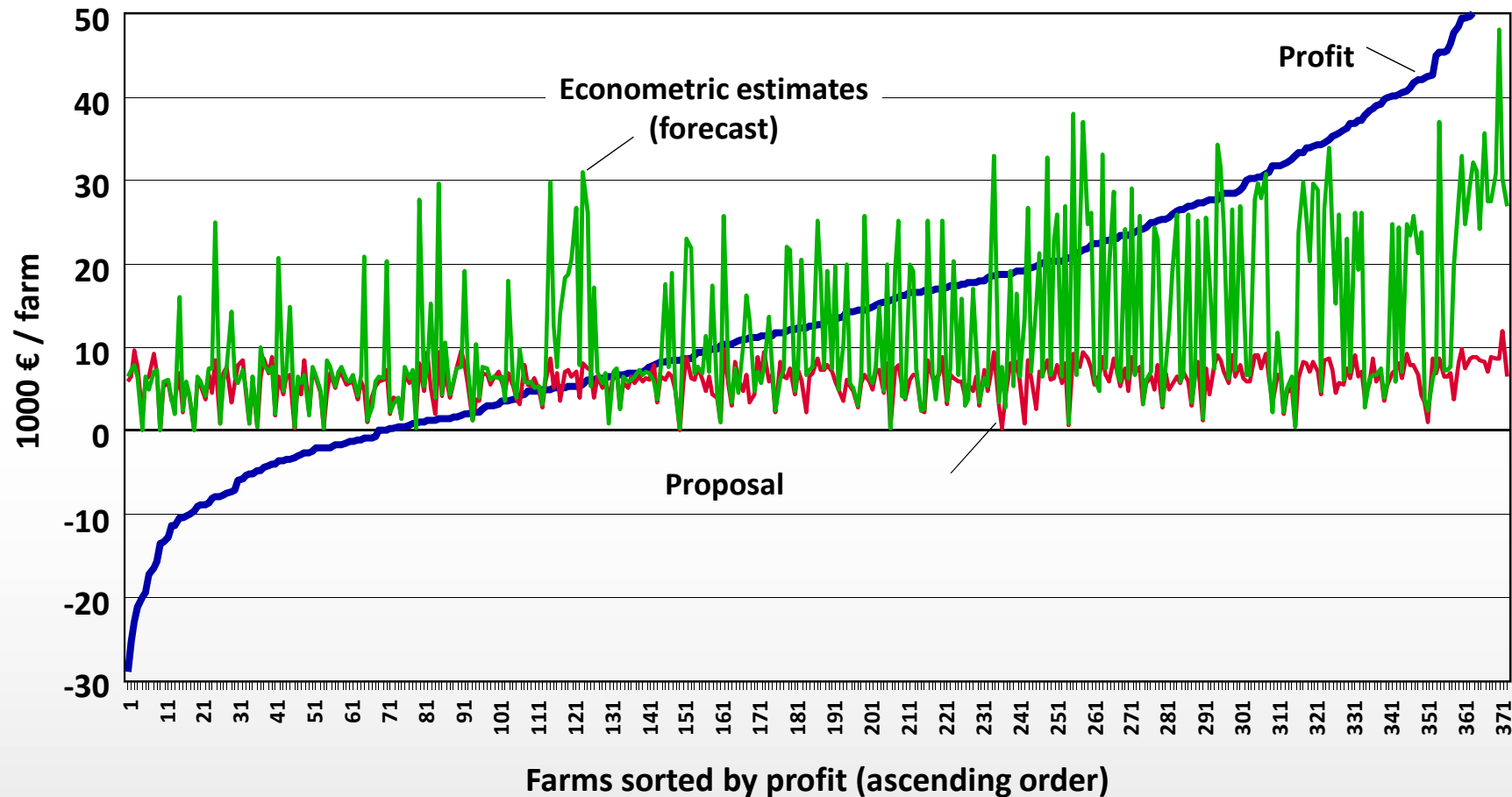
Parameter estimates

Parameter				
Variable	Parameter € / unit	STD	t-Value	Pr > t
UAA_Asparagus	19847	10216	1.94	0.052
UAA_Strawberries	38880	23795	1.63	0.102
UAA_Flowers	211573	35973	5.88	<.000
UAA_Vine	11803	4759	2.48	0.013
LU_Dairy	870	25	35.0	<.000
UAA_Arable	391	19	20.95	<.000

Parameters expressing income contribution per unit

- Dairy cows * 879 €, stat sign., greatest explanatory contribution
- Arable area * 391 €/ha, stat sign, 6 % contribution to R-Square
- Vines * 11,803 €/ha (seems to be realistic)
- Asparagus * 18,847 €/ha
- Strawberries * 38,880 €/ha (lower significance)
- Ornamental plants * 211,573 €/ha

Comparing profit, proposed standard and econometric forecast (2012/13)



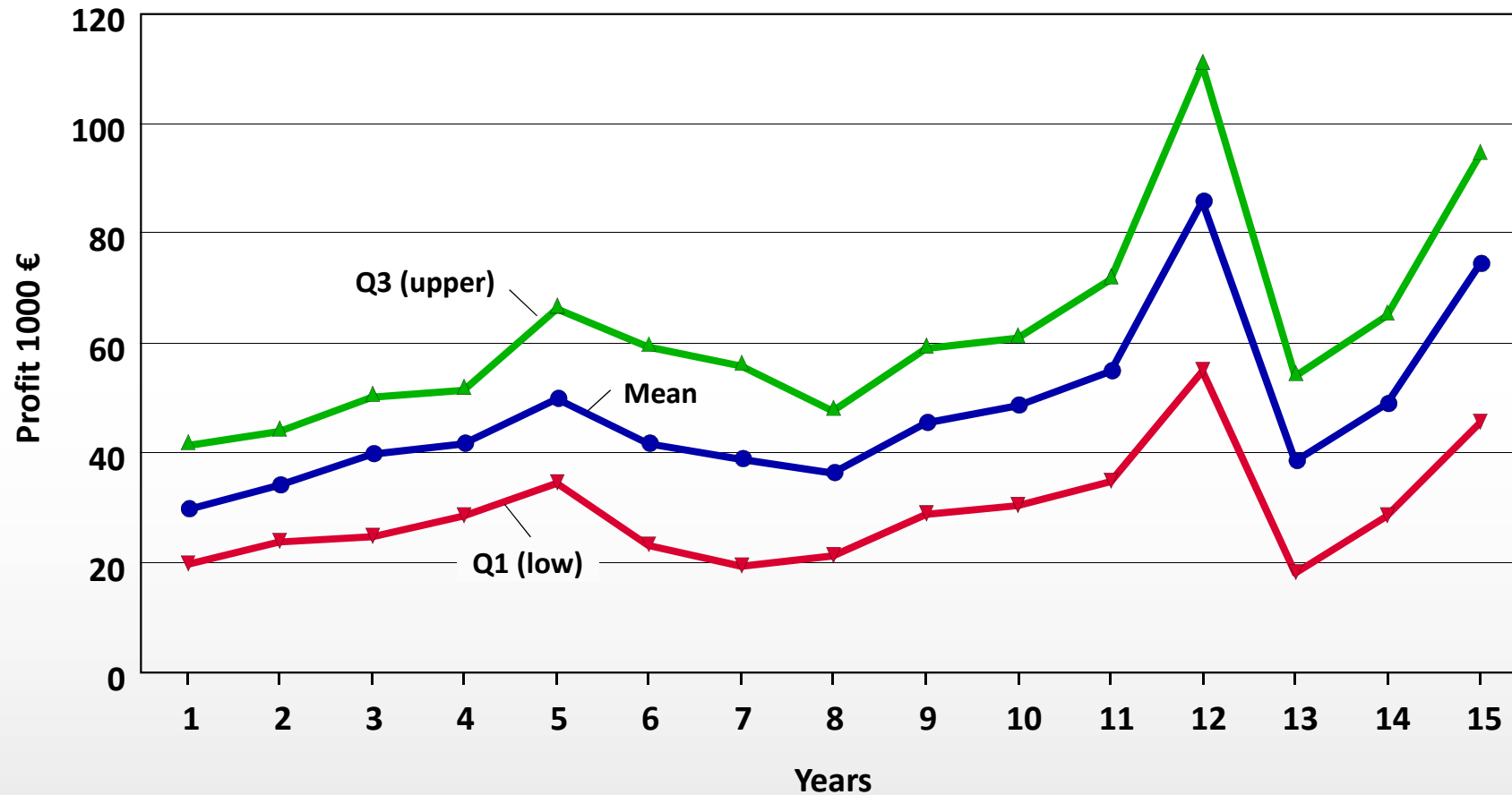
3 Use of a Generalized Linear Model (GLM) wrt analysis of income and farm performance

- **GLM-Models, combining regression and variance analysis, allowing analysis of treatment effects based on the variance component**
- **Statistical procedures automatically defines dummy variables to measure fixed effects**
- **Different statistical tools (Univariate, Linear or Generalized Linear Models), the latter can be extended to random effects using OLS or ML estimators**

Objectives and working procedure

- Estimating profit functions over time, using farm dummies as indicators of long term farm (income) performance (use of SAS GLM)
- Data: Balanced sample of dairy farms over 15 years (1996/97 to 2010/11), Schleswig-Holstein, based on TBN data, removing outliers, 59 farms over 15 years
- Model: $\text{profit} = O_{\text{crops}} O_{\text{milk}} O_{\text{otherLivstock}} O_{\text{subsidies\&others}} I_{\text{Crops}} I_{\text{LivestSpec}} I_{\text{otherMaterials}} I_{\text{wages\&deprec}}$ **year farm_ID**
 - Covariates
 - fixed effects
 - +/- constant (different specifications)
- Comparison with analyses based on income quartiles (number of farms being in income quartiles in each year)

Development and variation of income (profit €) 1996/97 (T=1) to 2010/11 (T=15)



Parameter estimates – covariates, time (1)

Covariates

	Coeff	Pr > ChiSq
Intercept	6896	0.1965
O_Crops	0.7966	<.0001
O-milk	0.7709	<.0001
O_oLiv	0.5683	<.0001
O_SubsiOth	0.6267	<.0001
I_Crops	-0.4654	0.0008
I_specLivest	-0.57	<.0001
I_othMateri	-0.8686	<.0001
I_WageDepr	-0.7214	<.0001

F-Statistic 50.04

R-Square↓ 0.80

Fixed effect Time (T)

	Coeff	Pr > ChiSq
T 1	-1276	0.7058
T 2	-3691	0.2652
T 3	1922	0.5554
T 4	1746	0.5883
T 5	109	0.9717
T 6	-7252	0.0133
T 7	-3935	0.185
T 8	-8045	0.0059
T 9	-1336	0.6362
T 10	2518	0.3746
T 11	3408	0.2127
T 12	10307	<.0001
T 13	-3828	0.1517
T 14	-317	0.9029
T 15	0	.

Parameter estimates – farm_ID (2)

(best / worst performers wrt quartiles)

		Coeff	Pr > ChiSq
ID 10	-16833	0.0123	
ID 71	-11877	0.017	
ID 85	9468	0.0665	
ID 87	-8742	0.1177	
ID 93	-6991	0.2618	
ID 121	7354	0.1392	
ID 144	16057	0.0013	
ID 157	22290	0.0001	
ID 165	-11309	0.0194	
ID 185	-5731	0.2471	
ID 187	-1510	0.7854	
ID 212	-676	0.8944	
ID 213	994	0.8452	
ID 233	5598	0.2676	
ID 261	4964	0.3191	
ID 263	10083	0.079	
ID 265	-13646	0.0079	
ID 266	-1378	0.7949	
ID 273	9677	0.0563	
ID 283	-9494	0.0827	

	Coeff	Pr > ChiSq
ID 284	14217	0.0051
ID 305	-46296	<.0001
ID 306	4173	0.4092
ID 308	8415	0.0961
ID 321	-8842	0.0794
ID 324	7482	0.1409
ID 327	4670	0.3595
ID 331	-5283	0.317
ID 341	-122	0.9804
ID 342	-1623	0.7369
ID 343	-12366	0.0139
ID 350	4922	0.3277
ID 354	-7345	0.1664
ID 369	92	0.9857
ID 379	-4756	0.3427
ID 380	-11014	0.0323
ID 382	-15374	0.0016
ID 383	8028	0.1202
ID 403	-1412	0.8156
ID 405	-13723	0.0064

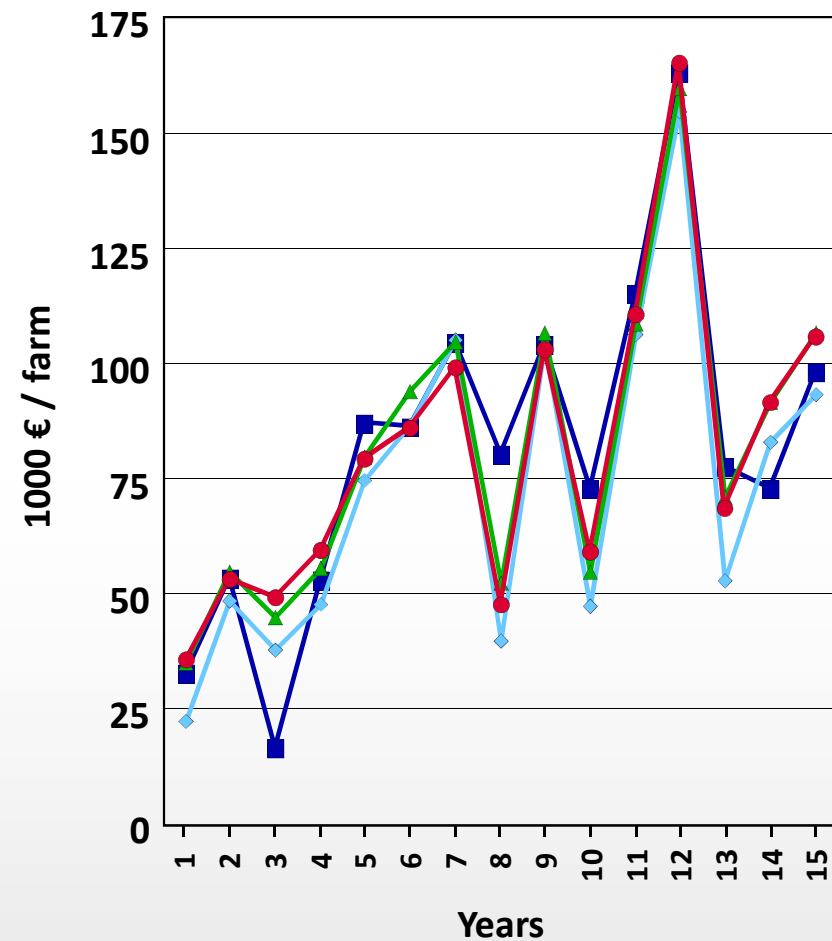
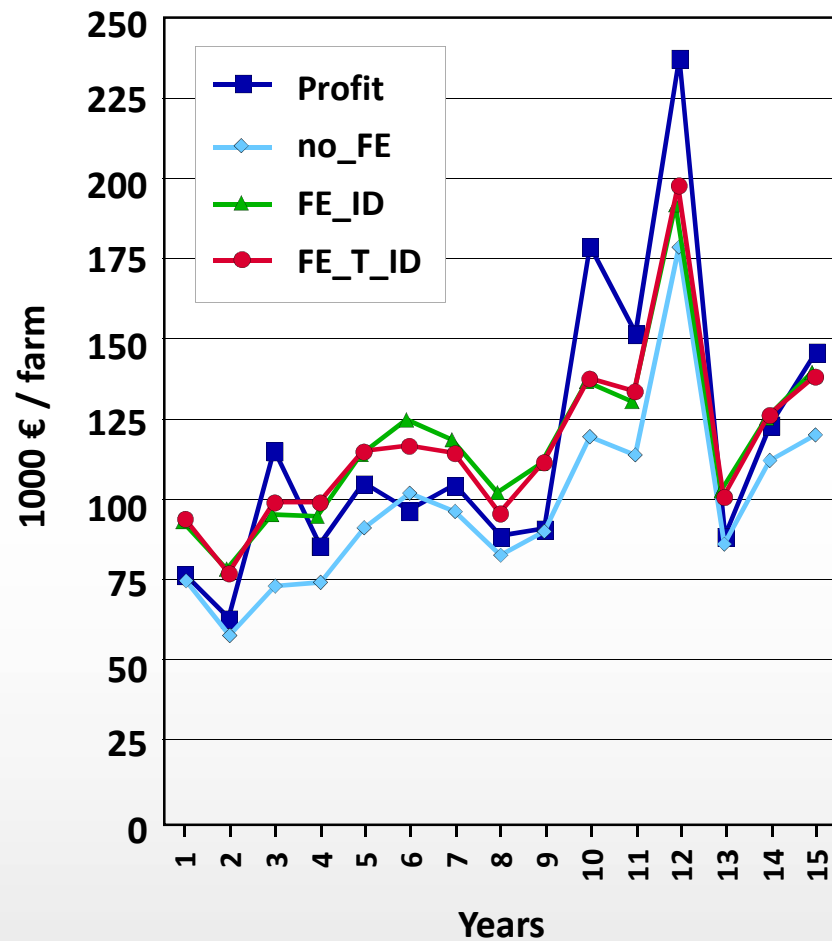
	Coeff	Pr > ChiSq
ID 409	-1239	0.8138
ID 417	-2884	0.5984
ID 418	-3359	0.5111
ID 430	-1469	0.7627
ID 436	7221	0.2586
ID 442	-1803	0.7166
ID 447	-3157	0.5569
ID 452	-3616	0.4686
ID 484	-1424	0.7751
ID 499	-501	0.924
ID 508	1838	0.7279
ID 524	-24133	<.0001
ID 541	-2989	0.5522
ID 542	-12254	0.0267
ID 564	-352	0.9457
ID 734	5817	0.2718
ID 735	6872	0.19
ID 736	-20291	0.0006
ID 741	0	.

Comments

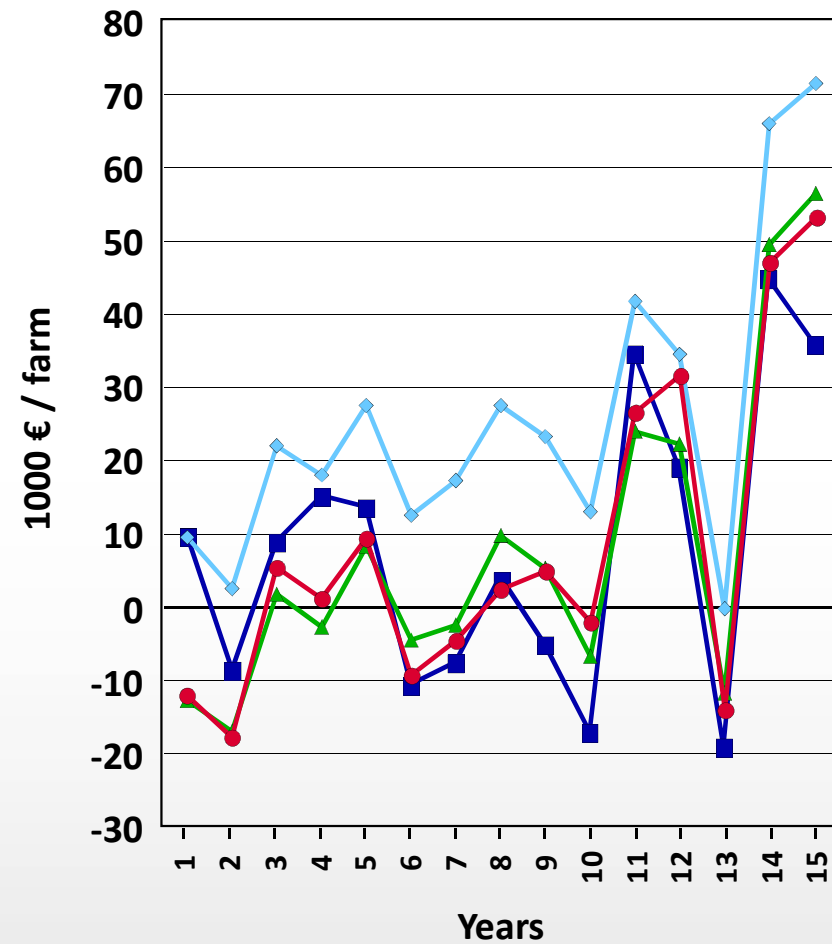
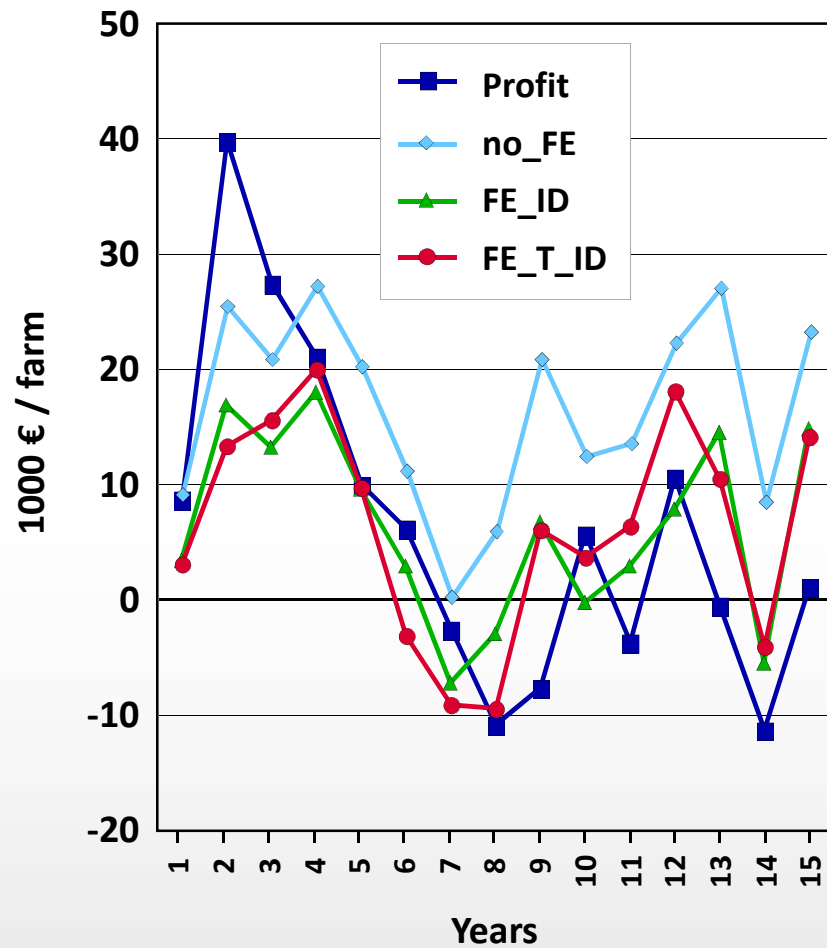
- **Statistically significant parameters and correct signs for covariates, partly for time, not at all for farm_ID's**
- **Coefficients for farm_ID not sufficient to identify / rank performance of farms**

Appropriate ex-post income forecast for best performing farms, not at all for worst performers (see below)

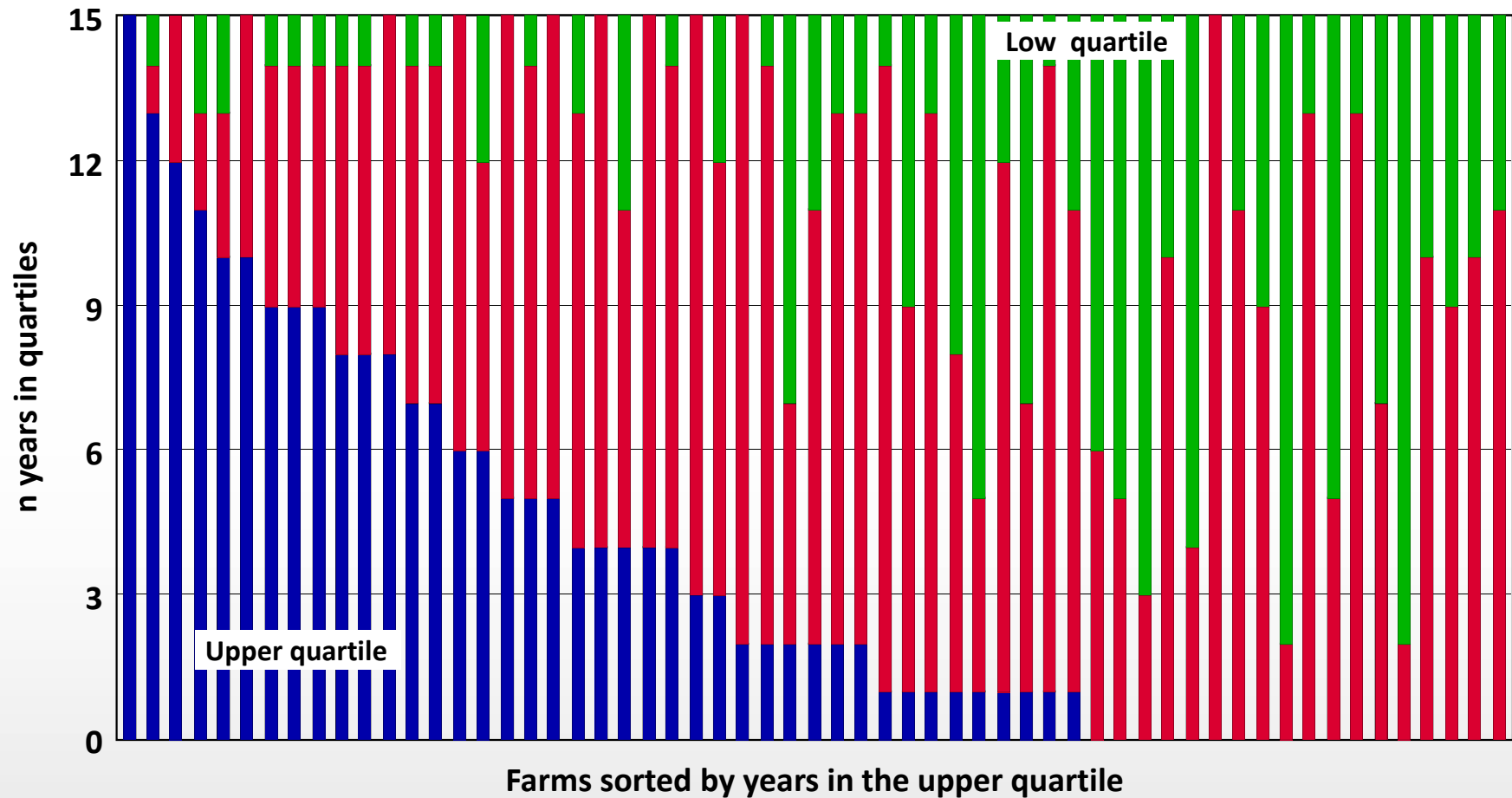
Profit (€) and forecast – example of best performers, different specifications wrt fixed effects



Profit (€) and forecast – example of worst performers



Share of farms being in quartiles



4 Conclusions

Estimation of standard income for taxation purposes

- Existing standard method (economic farm value) not appropriate → statistically not significant
- Proposed standard income in most farms considered not higher than allowance → no income taxes
- Income based on regression results
 - Positive, but higher variation, closer to ,real' profit
 - If ,real' income is larger than estimates farmers have to prove their ,real' income based on bookkeeping data

Conclusions (2)

GLM Model application wrt farm performance

- Statistically significant parameters and right signs for covariates, partially for time, not at all for farm dummies
- Coefficients for farm dummies not sufficient to identify / rank performance of farms

Delivers appropriate ex-post income forecasts for best performing farms, not at all for worst performers

- Only 1 farm (of 59) being in the upper quartile in the whole period
- Staying in the same quartile is rare due to rather high variation of income in time

Sources:

Wesche R (2009) Besteuerung der Land- und Forstwirtschaft. AID infodienst, Heft 1247 / 2009