A Competition Barometer for Danish Agriculture

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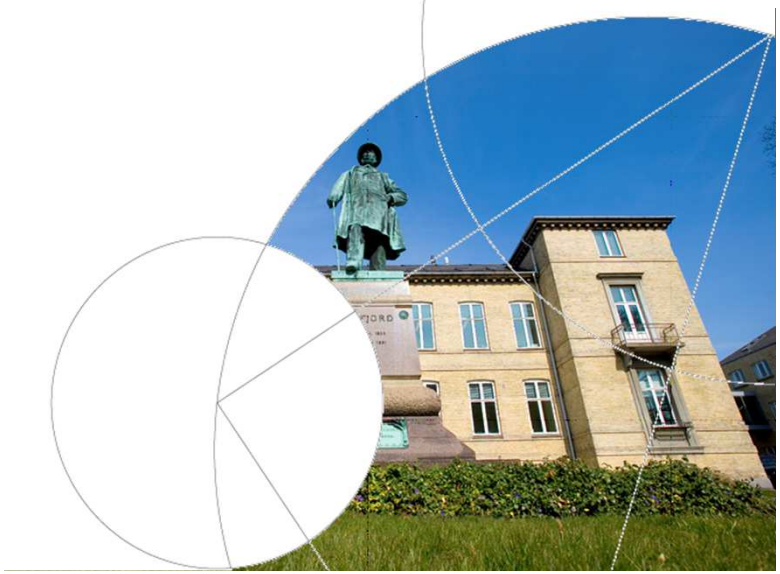


Background

- Analysis of the competitiveness of Danish Agriculture, as indicated by the efficiency of the individual farmers
  - Undertaken as part of a research contract between IFRO and the Danish Ministry of Food and Agriculture
  - Utilizing non-parametric (relative) benchmarking techniques
  - Comparisons with farmers in other European countries
    - FADN data
    - Made available through Statistics Denmark

- <u>Differences from previous analysis:</u>

  1. Distinguish between frontier differences and average efficiencies relative to national frontiers

  2. Consider variable-specific measures

  - more successful with the former than with the latter (which will not be presented here)

Data

- Farm level data from Farm Accountancy Data Network (FADN)
- Annual data 2004-2012
- 3 farm types considered based on FADN classifications (following traditions of earlier studies)
  - Crop production
  - Milk production
  - Pig production
- Minimum size requirements to ensure relevance of comparisons with Denmark
  - Crop production > 100 ha
  - Milk production > 100 dairy cows
  - Pig production > 400 LU
  - As a consequence the results are not necessarily representative for the overall production in the other countries!
- Only countries with a "sufficient" number of farms available in the given type and size are included

Benchmarking models

- Efficiency measurement using Data Envelopment Analysis (DEA)
  - Input oriented (cost reduction given output production)
  - Assuming constant returns to scale
  - Annual frontiers
- Distinguish between frontier differences and average efficiencies relative to national frontiers

Inputs:

- Salary costs
  - Only include farms with hired labour
  - Use the average salary paid to hired labour as hourly wage for own labour
- Variable costs (incl. energy, feed, fertilizer, seed, …)
- Capital costs (4% of assets + rent of land)

Outputs:

- Revenue from primary production
- All other revenue (incl. subsidies)

Sample sizes

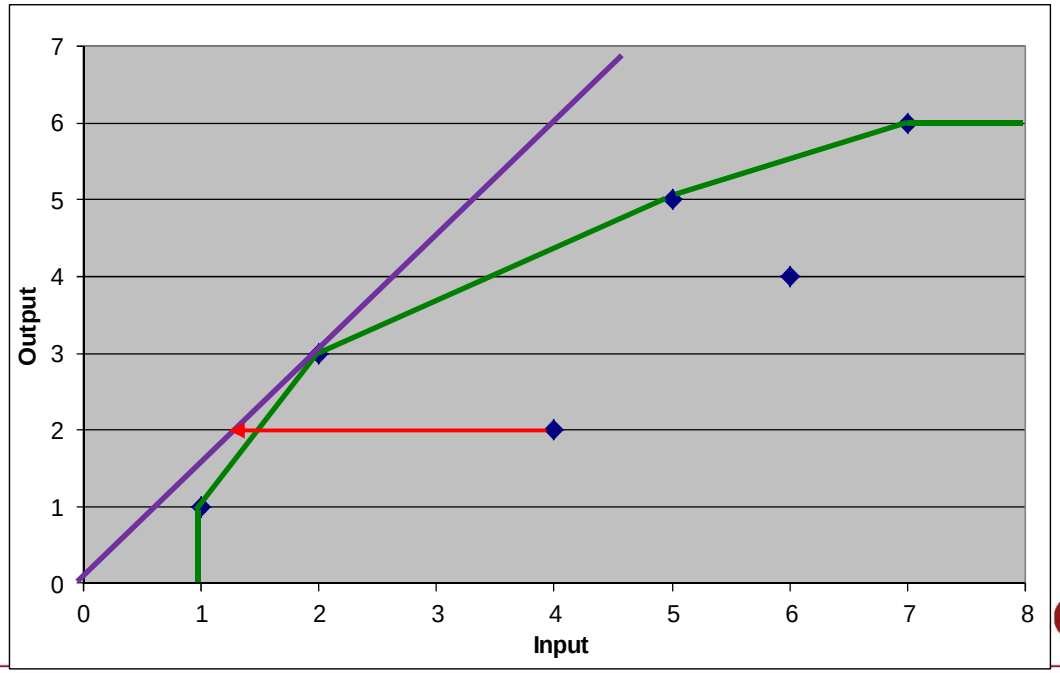
Pigs	BGR	DAN	DEU	ESP	FRA	ITA	NED	POL	ROU	SVE	UKI
2004		303	34	28	43	55	74	13		13	25
2005		330	43	29	38	62	73	15		17	24
2006		334	53	27	38	72	69	19		21	23
2007	17	344	80	30	49	51	70	25	21	18	25
2008	21	342	82	32	49	37	61	23	18	26	28
2009	18	348	107	35	61	30	76	16	19	39	31
2010	21	332	107	34	59	44	68	20	18	39	26
2011	18	348	92	33	62	46	58	19	26	43	31
2012	28	348	90	38	63	60	67	21	26	40	25

Milk	SVK	BGR	CZE	DAN	DEU	ESP	EST	FRA	HUN	IRE	ITA	LVA	NED	SVE	UKI
2004	51		64	163	199	29	21	11	31	18	124	25	53	27	208
2005	63		62	211	206	34	31	15	34	17	151	29	45	29	200
2006	73		68	241	235	48	32	20	32	14	145	31	57	32	199
2007	59	16	53	259	252	71	30	25	33	25	151	33	74	35	224
2008	66	16	69	278	295	68	28	36	33	36	107	40	80	39	233
2009	42	12	60	315	349	75	22	32	33	37	103	41	95	46	262
2010	53	20	61	285	393	95	60	41	28	43	129	41	100	56	228
2011	47	25	65	296	372	109	59	41	26	52	111	45	105	62	261
2012	49	26	72	310	455	98	57	49	27	51	136	46	108	73	277

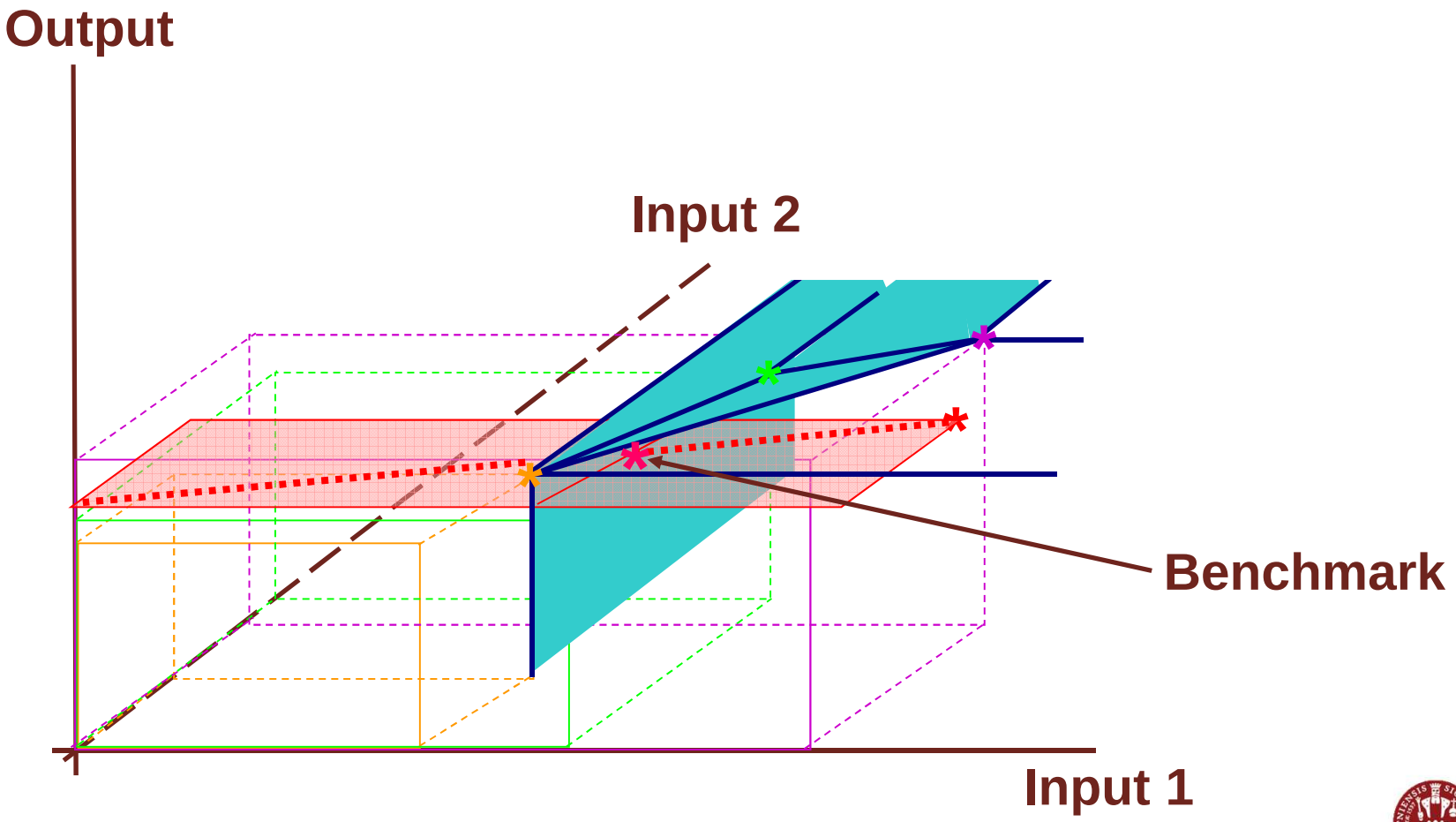
Crops	BGR	CZE	DAN	DEU	ESP	EST	FRA	HUN	ITA	LTU	LVA	NED	POL	ROU	SVE	SVK	UKI
2004		147	94	386	122	62	493	349	230	221	120	42	186		31	117	331
2005		137	112	415	142	64	479	341	263	219	130	39	231		25	120	322
2006		140	119	466	146	58	465	336	270	216	135	46	252		25	113	280
2007	237	171	126	498	149	58	476	378	234	234	141	56	271	220	37	103	292
2008	277	187	127	510	161	64	483	376	160	230	144	60	306	228	36	114	330
2009	316	216	134	628	174	63	495	363	172	210	149	65	359	366	41	118	316
2010	602	196	165	613	169	75	492	372	167	212	151	75	331	1075	47	117	320
2011	657	205	182	597	178	78	489	387	171	206	155	64	334	1137	49	147	311
2012	668	188	178	650	201	77	487	377	175	222	144	66	356	1105	48	131	287

Data Envelopment Analysis (DEA)

- Deterministic/non-parametric relative benchmarking technique
- Few assumptions re. the input-output relationship
  - Observed values are attainable
  - Convexity
  - Free disposability
- Estimates an efficient (best-practice) frontier as the convex envelopment of the observed units
- Measures efficiency for all units relative to this frontier

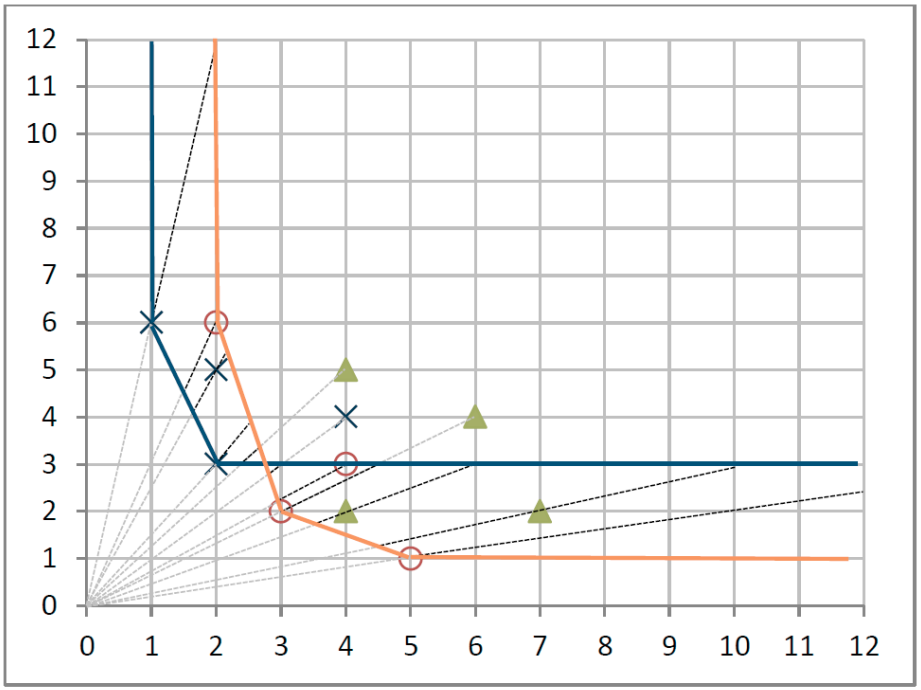


3D illustration of DEA



Estimating frontier differences

Global frontier differences:



To find the Global Frontier difference between the frontiers (estimated best practice) for e.g. Denmark and Germany, we take the geometric mean of the distances between the two frontiers for all observations

These results were also validated through the use of so-called "Program Efficiency" measures

- Different technique (assumptions), similar overall conclusions

Results: Global Frontier Differences - crops

	BGR vs DK	CZE vs DK	DEU vs DK	ESP vs DK	EST vs DK	FRA vs DK	HUN vs DK	ITA vs DK	LTU vs DK	LVA vs DK	NED vs DK	POL vs DK	ROU vs DK	SVE vs DK	SVK vs DK	UKI vs DK
2004		1.52	1.70	2.00	1.80	1.90	2.51	2.33	2.92	2.52	0.82	2.74		1.05	2.43	1.39
2005		1.37	1.73	1.39	1.96	1.60	3.87	2.58	2.22	1.66	0.73	2.01		0.91	2.19	1.19
2006		1.49	1.86	1.95	1.61	1.89	2.62	1.74	2.02	1.88	0.76	1.71		0.93	2.01	1.16
2007	2.87	2.31	2.11	2.24	2.65	2.59	3.97	2.47	5.43	4.56	1.53	2.58	3.47	1.34	2.63	1.54
2008	5.34	2.49	2.94	3.40	2.29	3.19	7.84	2.77	4.70	3.22	1.72	3.50	6.22	1.52	3.01	2.36
2009	5.00	2.87	3.27	2.17	2.10	2.51	5.38	2.91	3.09	3.01	1.70	3.64	4.24	1.48	2.70	2.08
2010	4.18	1.87	2.64	2.09	1.89	2.59	3.10	2.18	3.16	1.92	1.65	2.67	3.85	1.15	2.39	1.87
2011	3.49	2.38	2.38	2.14	2.46	2.65	3.97	2.24	3.00	2.25	0.98	2.91	5.78	1.19	3.10	2.19
2012	2.82	1.71	2.50	1.77	2.04	2.23	3.93	2.01	2.70	2.03	1.00	2.75	3.87	1.06	2.32	1.68

A value larger than 1 indicates that the frontier (estimated best practice) for the country in question is better than the one for Denmark

- The best performing crop producers in Denmark are generally worse than the best performing crop producers in most (almost all) other countries (in the given size group)!

Results: Average managerial efficiencies - crops

	BGR	CZE	DAN	DEU	ESP	EST	FRA	HUN	ITA	LTU	LVA	NED	POL	ROU	SVE	SVK	UKI
2004		0.75	0.70	0.63	0.51	0.79	0.64	0.60	0.41	0.70	0.67	0.82	0.55		0.85	0.58	0.52
2005		0.75	0.60	0.57	0.56	0.69	0.62	0.40	0.38	0.65	0.69	0.86	0.55		0.80	0.58	0.59
2006		0.69	0.54	0.51	0.42	0.76	0.57	0.50	0.45	0.56	0.68	0.80	0.67		0.78	0.55	0.67
2007	0.55	0.66	0.73	0.64	0.57	0.71	0.64	0.47	0.47	0.54	0.62	0.76	0.67	0.49	0.82	0.64	0.69
2008	0.41	0.68	0.72	0.59	0.43	0.78	0.62	0.33	0.55	0.57	0.64	0.71	0.62	0.39	0.83	0.64	0.64
2009	0.40	0.54	0.68	0.51	0.54	0.77	0.63	0.41	0.42	0.67	0.64	0.80	0.52	0.40	0.78	0.64	0.63
2010	0.46	0.67	0.70	0.56	0.59	0.74	0.66	0.54	0.48	0.61	0.73	0.67	0.63	0.45	0.80	0.55	0.63
2011	0.52	0.58	0.72	0.63	0.54	0.74	0.68	0.52	0.52	0.64	0.67	0.83	0.62	0.31	0.80	0.61	0.62
2012	0.51	0.72	0.69	0.56	0.47	0.79	0.67	0.43	0.50	0.73	0.75	0.85	0.60	0.43	0.78	0.50	0.64

Average DEA efficiencies relative to the frontier (estimated best practice) within each country separately

- The Danish crop producers are, on average, not even particularly close to the best performing crop producers in Denmark

Results: Global Frontier Differences - milk

	BGR vs DK	CZE vs DK	DEU vs DK	ESP vs DK	EST vs DK	FRA vs DK	HUN vs DK	IRE vs DK	ITA vs DK	LVA vs DK	NED vs DK	SVE vs DK	SVK vs DK	UKI vs DK
2004		1.07	1.84	2.29	1.23	1.53	1.43	0.73	1.64	1.60	0.53	1.19	1.14	1.47
2005		0.97	1.61	1.94	1.01	1.36	1.33	0.60	1.74	1.30	0.70	1.09	1.31	1.44
2006		1.14	1.92	2.11	1.06	1.35	1.57	0.63	1.82	1.34	0.79	1.13	1.09	1.35
2007	1.63	1.03	1.87	2.04	1.27	1.57	1.63	0.53	1.90	1.44	0.77	1.12	1.15	1.49
2008	1.99	1.05	1.63	2.09	1.18	1.40	1.48	0.68	2.14	1.41	0.81	1.22	0.98	1.36
2009	1.93	1.22	2.12	1.76	1.00	1.68	1.57	1.08	2.94	1.67	1.07	1.35	0.96	1.82
2010	1.71	1.20	2.45	1.85	1.44	1.94	1.77	0.92	2.49	1.53	1.00	1.51	1.10	1.54
2011	2.59	1.28	1.89	1.50	1.44	1.80	1.52	1.06	2.65	1.74	1.18	1.19	0.78	1.37
2012	1.81	1.46	1.85	1.48	1.32	1.73	1.63	0.87	2.05	1.47	0.88	1.12	1.98	1.38

- The best performing milk producers in Denmark are generally worse than the best performing milk producers in most (almost all) other countries (in the given size group)!

Results: Average managerial efficiencies - milk

	BGR	CZE	DAN	DEU	ESP	EST	FRA	HUN	IRE	ITA	LVA	NED	SVE	SVK	UKI
2004		0.87	0.84	0.78	0.83	0.89	0.93	0.90	0.91	0.71	0.83	0.87	0.91	0.72	0.74
2005		0.85	0.82	0.79	0.74	0.86	0.89	0.83	0.88	0.63	0.85	0.83	0.90	0.81	0.72
2006		0.76	0.83	0.72	0.74	0.87	0.90	0.84	0.88	0.69	0.87	0.82	0.88	0.76	0.74
2007	0.90	0.81	0.82	0.78	0.75	0.87	0.89	0.76	0.89	0.59	0.85	0.86	0.91	0.81	0.75
2008	0.85	0.83	0.77	0.77	0.70	0.92	0.89	0.85	0.88	0.63	0.84	0.86	0.83	0.80	0.75
2009	0.85	0.78	0.81	0.75	0.74	0.96	0.85	0.85	0.86	0.55	0.87	0.68	0.89	0.82	0.68
2010	0.83	0.79	0.84	0.66	0.73	0.82	0.88	0.81	0.88	0.55	0.85	0.82	0.85	0.84	0.78
2011	0.79	0.69	0.82	0.76	0.81	0.83	0.85	0.84	0.86	0.53	0.81	0.77	0.88	0.86	0.79
2012	0.78	0.67	0.84	0.76	0.79	0.87	0.87	0.83	0.89	0.63	0.90	0.82	0.89	0.74	0.78

- The Danish milk producers are, on average, not amongst the ones that are closest to the best performing milk producers in their own country

Results: Global Frontier Differences - pigs

	BGR vs DK	DEU vs DK	ESP vs DK	FRA vs DK	ITA vs DK	NED vs DK	POL vs DK	ROU vs DK	SVE vs DK	UKI vs DK
2004		1.16	0.98	1.04	1.77	0.94	0.97		0.65	0.97
2005		1.34	0.92	1.14	2.33	1.03	1.45		0.84	0.98
2006		1.39	1.23	1.24	2.37	1.00	2.17		0.90	0.96
2007	1.62	1.27	1.33	1.14	2.13	0.91	1.22	2.75	0.94	1.02
2008	1.22	1.65	1.38	1.27	2.07	1.11	1.42	2.04	0.95	1.25
2009	1.37	1.88	2.36	1.52	2.25	1.32	1.60	1.81	1.12	1.40
2010	1.35	1.48	1.12	1.40	1.98	1.14	1.22	2.41	1.01	1.11
2011	1.35	1.36	1.25	1.51	1.91	1.16	1.60	2.82	0.99	1.17
2012	1.46	1.28	1.31	1.29	3.02	1.10	1.38	4.09	0.91	0.96

- The best performing pig producers in Denmark are generally worse than the best performing pig producers in most (almost all) other countries (in the given size group)!

Results: Average managerial efficiencies - pigs

	BGR	DAN	DEU	ESP	FRA	ITA	NED	POL	ROU	SVE	UKI
2004		0.80	0.87	0.83	0.91	0.69	0.89	0.94		0.91	0.85
2005		0.81	0.88	0.73	0.93	0.61	0.88	0.93		0.90	0.88
2006		0.79	0.75	0.87	0.92	0.64	0.89	0.66		0.89	0.88
2007	0.62	0.77	0.78	0.83	0.90	0.61	0.85	0.84	0.60	0.92	0.84
2008	0.76	0.73	0.77	0.84	0.93	0.67	0.88	0.91	0.88	0.94	0.92
2009	0.87	0.82	0.69	0.49	0.88	0.72	0.83	0.92	0.74	0.89	0.88
2010	0.76	0.81	0.78	0.88	0.92	0.72	0.82	0.93	0.73	0.81	0.93
2011	0.94	0.86	0.83	0.92	0.89	0.72	0.87	0.92	0.72	0.84	0.90
2012	0.83	0.84	0.83	0.81	0.93	0.50	0.91	0.92	0.63	0.86	0.96

- The Danish pigs producers are, on average, not even particularly close to the best performing pigs producers in Denmark

Conclusions: Empirical results for Denmark

- The best performing Danish farmers, in all three farm types, are generally worse than the best performing farms in most, if not all, the other European countries
  - Note that we are here not considering technical efficiency (like milk/cow, yield/ha or pigs/sow)
  - Instead we are looking at multi-dimensional relationships between various costs and various revenues
    - Some form of economic efficiency
  - If input prices in Denmark are higher than in the other countries, but the output prices more or less the same, then the technical efficiency has to be much higher to compensate for that
- The average performance within Denmark (closeness to own best practice) is not superior either
- Since the analysis is designed to be relevant in comparison with Denmark, it is difficult to provide overall/generalizable conclusions for other countries

Re. input prices

- Consider e.g. the following results from an earlier (related) study:

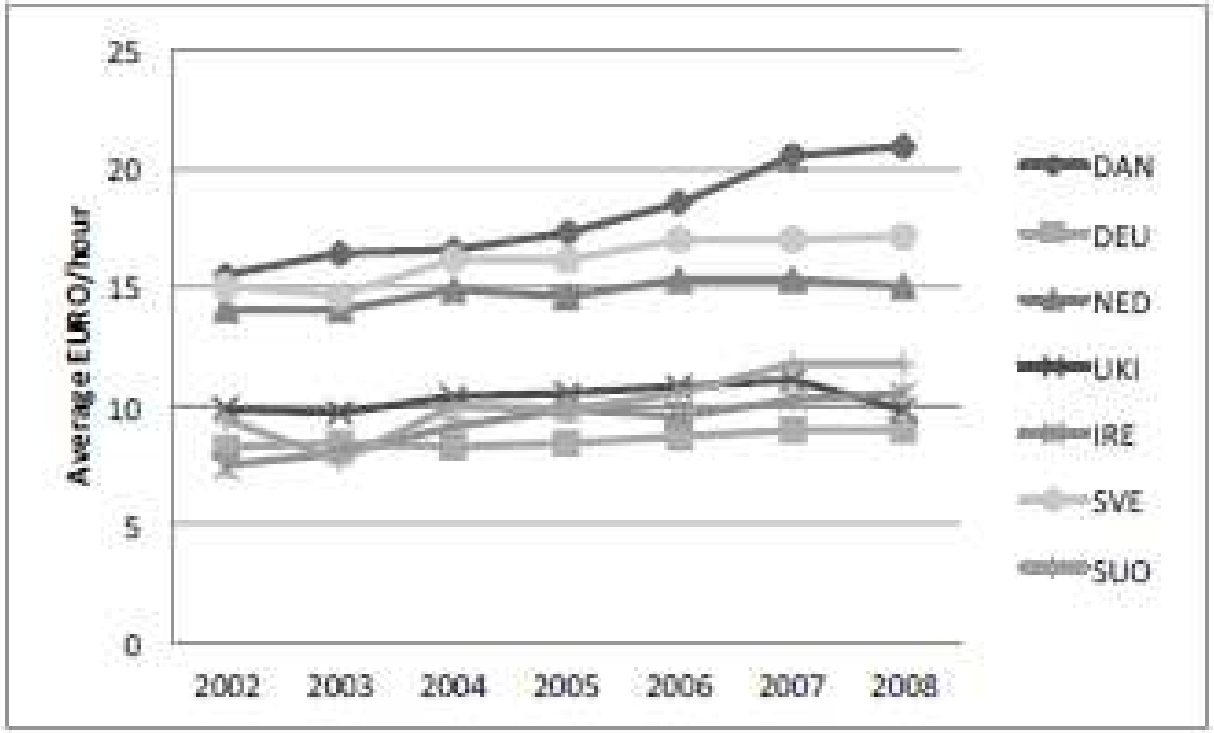
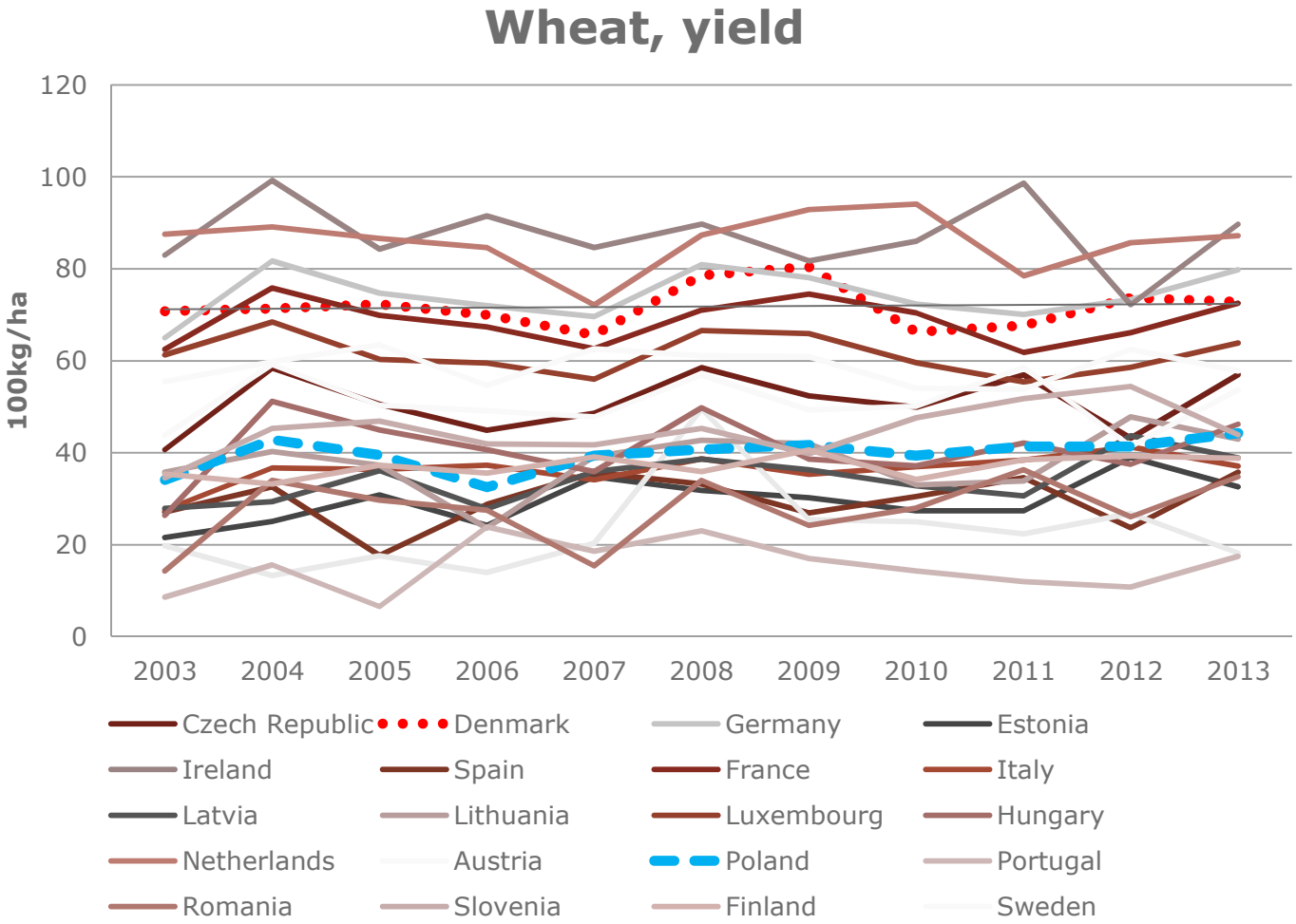


Figure 2: Average salary levels on dairy farms in different countries, 2002-2008.

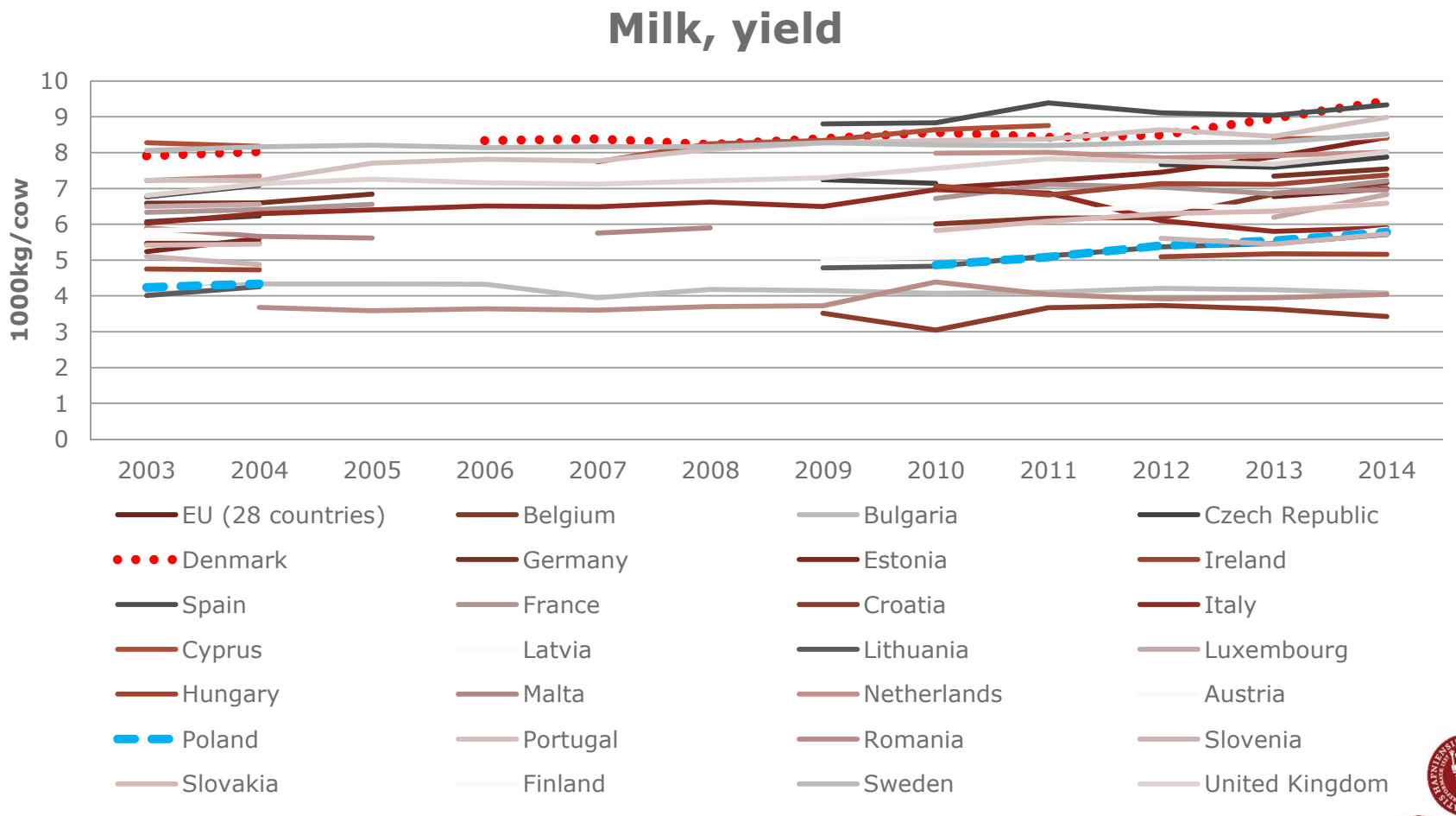
Re. technical efficiency 1

- Consider e.g. the following results from Eurostat:

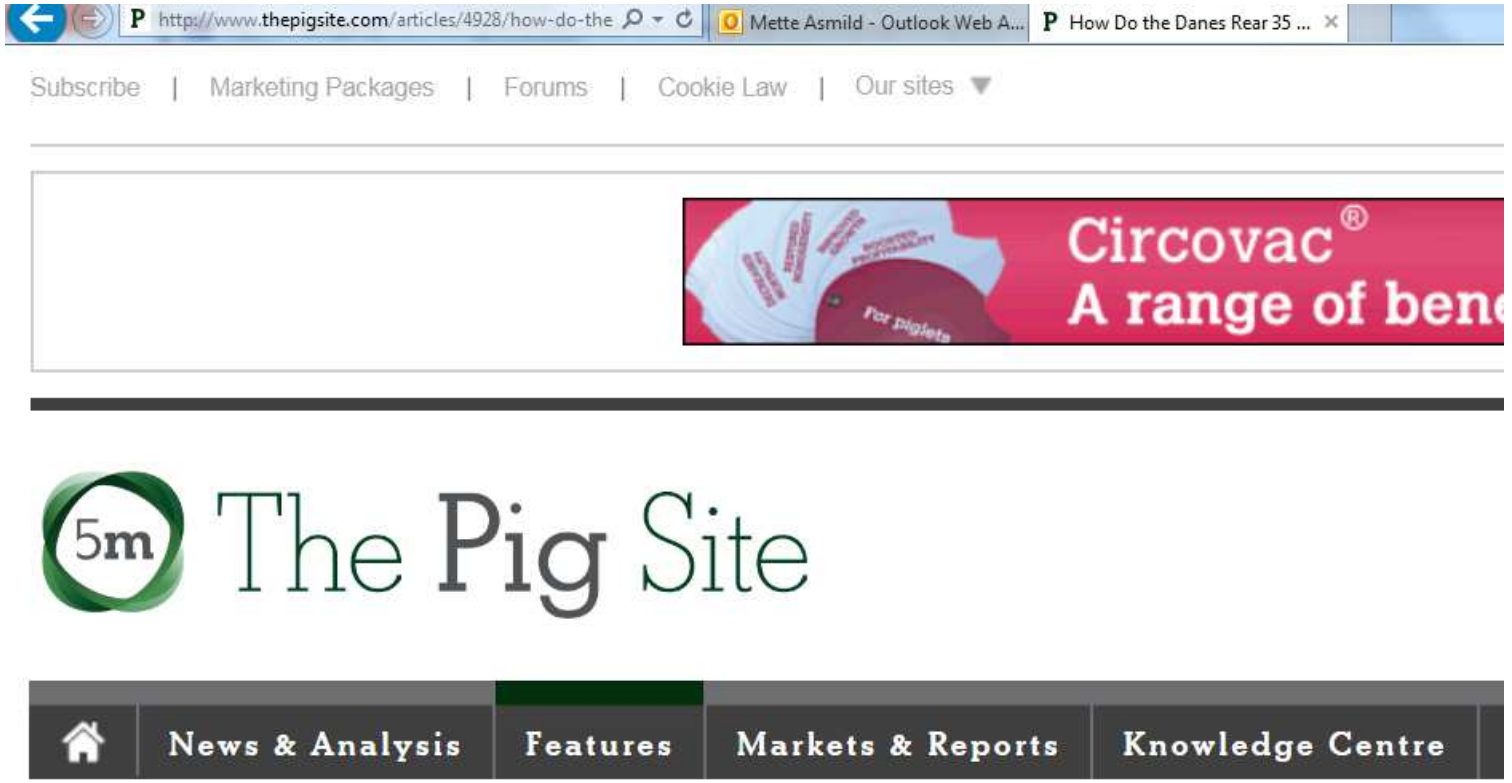


Re. technical efficiency 2

- Consider e.g. the following results from Eurostat:



Re. technical efficiency 3



Conclusions: Interest in the results

- These results have generated a lot of interest and public debate in Denmark amongst both politicians but especially within the industry
- Interestingly enough, the industry has not yet really realized that the Global Frontier Difference results could be useful for them:
  - If the best performers in Denmark are doing worse than the best performers in all other counties, then this could be used to argue that they are operating in a tougher environment (due to prices, regulations, etc.) and thus do not have a chance of being competitive without help
  - Perhaps they have focused too much on being criticized for managerial inefficiency
- Yesterday the new Danish government announced that they will ease a lot of especially environmental regulations for farmers!
- Note also that A LOT of Danish farmers are currently struggling to survive/going bankrupt
  - So clearly there are some problems with the relationship between costs and revenues
- The conventional wisdom that Danish farming is very efficient may have to be reconsidered (and moving away from a narrow focus on technical efficiency may be needed)