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Combining Performance Measures to Investigate Causes of Capacity Changes in Fisheries

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Purposes of the paper

- Identify appropriate indicators for fishing capacity in a **multi-species** fishery
- Establish a **link** between these indicators and fishing capacity
- Estimate technical efficiency and capacity utilisation



Agenda

- Theoretical approach
- Selection of capacity indicators
- Overview of the case study
- Results
- Benefits in a broader perspective

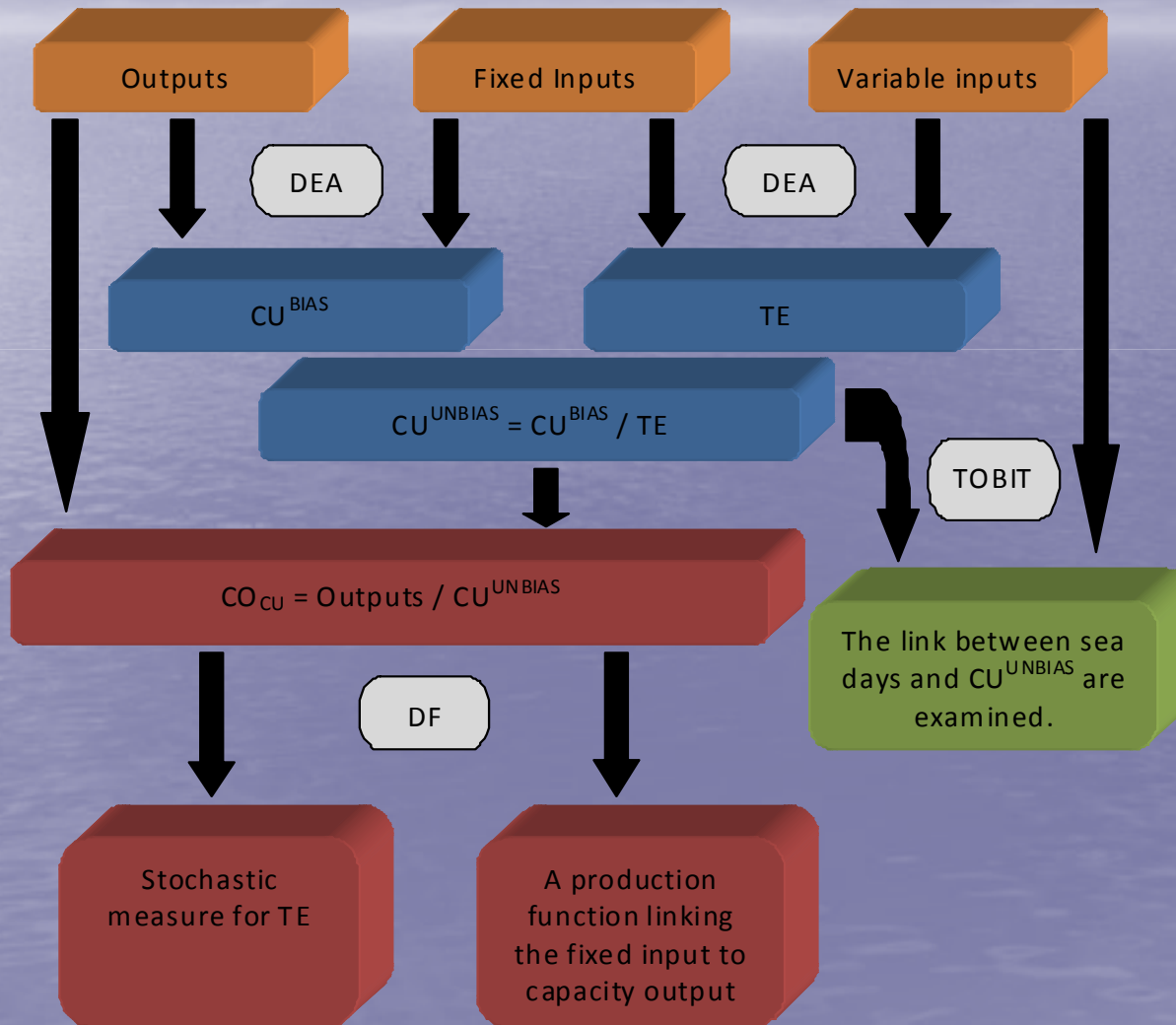


Theoretical Approach

- DEA is used to identify technical efficiency and capacity utilisation
- TOBIT is used to identify reasons, other than sea days, for unbiased capacity utilisation
- The Distance Function creates a link between capacity indicators and capacity



Flow diagram illustrating methodology in WP3





Selection of capacity indicators

These are selected using:

- Data Envelopment Analyses
- Correlation Analyses



Selection of capacity indicators

Two rules are used to select the capacity indicators:

- The higher efficiency score, the better
- If two columns of efficiency scores based on different input variables are highly correlated, then the input resulting in the lowest average efficiency score is excluded.

Based on these rules, horse power (HP) and gross tonnage (GT) have been selected as inputs.



Overview of the case study

-Otter trawlers fishing in the North Sea

	Number of vessels	Length m	Engine Power KW	Gross tonnage	Flatfish		Gadoids		Nephrops		Other	
					kg	euro	kg	euro	kg	euro	kg	euro
2001	68	24	560	130	51,384	111,940	70,707	104,186	13,880	131,820	630,480	150,015
2002	63	25	620	157	38,906	83,575	107,664	131,922	19,069	209,540	545,985	169,836
2003	69	24	556	143	65,187	143,449	93,792	93,587	16,543	136,506	316,662	116,622
2004	66	24	607	157	66,331	131,997	90,483	90,564	21,332	142,428	441,033	138,931
2005	67	24	578	151	62,639	140,217	75,531	92,623	23,202	183,637	471,028	139,717
Average	333	24	583	147	57,110	122,767	87,372	102,211	18,766	160,023	479,839	142,577





Results

- Data Envelopment Analyses
- TOBIT Analyses
- Distance Functions

Three different analyses is estimated, having different outputs:

- Plaice, cod and Nephrops, measured in kg (PCN_KG)
- Flatfish, gadoids and Nephrops, measured in value (PCN_EURO)
- Flatfish, gadoids and Nephrops, measured in price adjusted value (PCN_EURO_PA)

The inputs included are GT and HP as inputs.



Results - DEA

- Productivity measures for the three models

Model	Average efficiency score		
	CU ^{BIAS}	TE	CU ^{UNBIAS}
PCN_KG	0.37	0.47	0.75
FGN_EURO	0.33	0.48	0.67
FGN_EURO_PA	0.33	0.46	0.69

- The productivity measures are robust to the choice of output
- The measured inefficiencies are due to both technical inefficiency and less than optimal effort use.



Results - TOBIT

- Regression results showing the percentage change in CU^{UNBIAS} with a change in x

Variable	FGN_KG	FGN_EURO	FGN_EURO_PA
Sea days	0.0047	0.0027	0.0026
Homeport_NW	-0.0150	-0.0280	-0.0739
Mat_steel	-0.0455	-0.0353	-0.1033
Cons-year_1995	0.1818	-	-

- Sea days are the most significant variable, showing that the productivity related to unbiased capacity utilisation will increase with between 0.27 and 0.47 percent by using an extra sea day



Results – Distance function

- Input elasticities for an average vessel

Input	Model	Dependent variable		
		Plaice	Cod	Nephrops
HP	FGN_KG	0.14	-0.44	-1.61
	FGN_EURO	0.11	-0.45	-0.84
	FGN_EURO_PA	0.10	-0.42	-0.80
GT	FGN_KG	0.27	-0.81	-3.01
	FGN_EURO	0.36	-1.49	-2.79
	FGN_EURO_PA	0.35	-1.44	-2.76

- All model show the same trend
- Indicates that large vessels catch more plaice, but less cod and Nephrops; vice versa for smaller vessels



Results – Distance Function

- Elasticity of substitution for the three models

Elasticities of Substitution	FGN_KG			FGN_EURO			FGN_EURO_PA		
	plaice	cod	Nephrops	plaice	cod	Nephrops	Plaice	cod	Nephrops
Plaice	-	-3.18	-11.77	-	-4.13	-7.71	-	-4.11	-7.86
Cod	-0.31	-	3.70	-0.24	-	1.87	-0.24	-	1.91
Nephrops	-0.08	0.27	-	-0.13	0.54	-	-0.13	0.52	-

- Indicate - joint production between cod and Nephrops
 - non-joint production of plaice and cod
 - non-joint production of plaice and Nephrops



Benefits in a broader perspective

- Multi-species contrary to single species
- Method can be used to establish certainty about the input regulators (in this case it confirms that GT and HP is appropriate measures for regulation)
- Usefull when managers combine input and output based regulation.