PARADOXES

IN ICELAND´S HERRING FISHERY

Stock, catch and fleet dynamics

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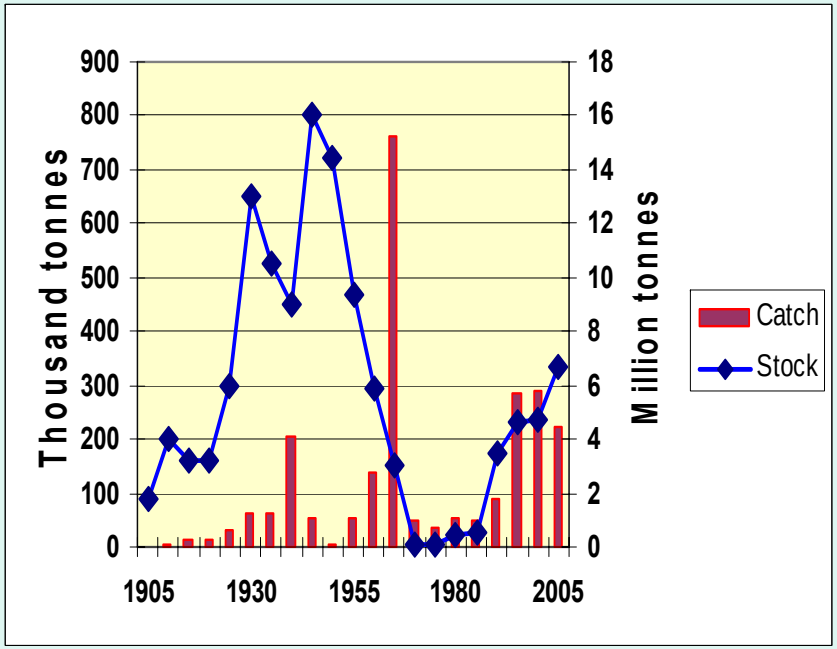
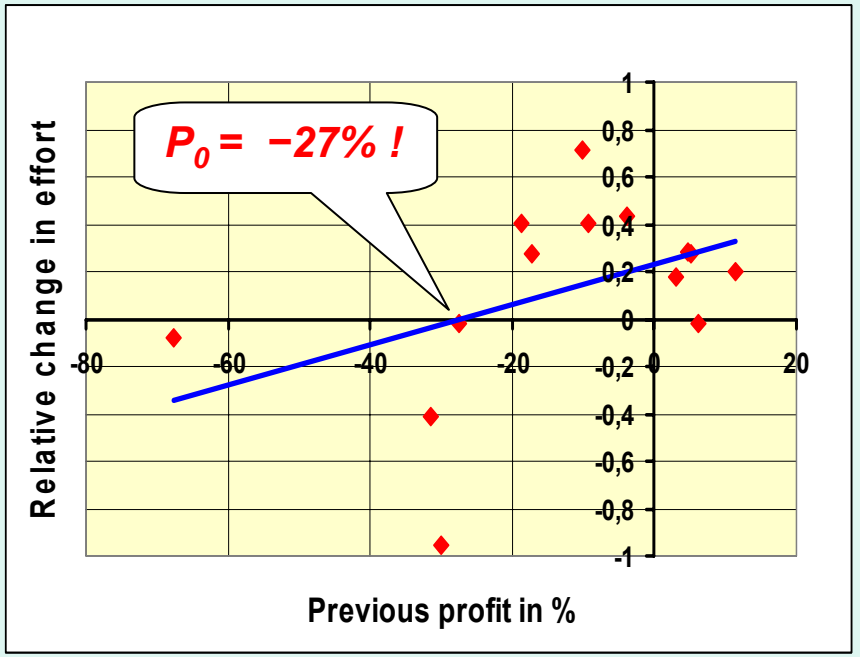
Presented at the XVIIIth EAFE conference in Reykjavik, Iceland, July 9-11, 2007



History



Model

- **The herring fishery was not significant in Iceland until Norwegian fishermen brought their tradition and technique to the country in the beginning of the 20th century. After a slow beginning it became a big industry in the 1930s with many salting stations and reduction factories along the north coast. Parallel to an increasing trawler fleet in demersal fisheries it was an industrial revolution which, however, came to a halt in the late 1940s and early 1950s. Then a dramatic chain of events rolled up with a sudden rise and fall.**

- ***Sources*: ICES, Ministry of Fisheries in Iceland, Fisheries Association of Iceland, Iceland´s Marine Research Institute (HAFRO)**

Paradoxes: Cause and Effect

- The first graph shows how Iceland´s herring catches fluctuated with a slowly increasing trend during the first half of the 20th century while the total spawning stock gradually became one of the largest fish stocks in the world. Then the catch boomed in the 1960s but the stock declined at the same time and collapsed in the end. This paradox can be understood by an escalating effort and the shoaling behaviour of the herring, common to many pelagic species. The short period of very large catches in the fifties and sixties before the bust was the consequence of a technological revolution: larger boats with sonar and power block. It took more than twenty years of an almost total fishing ban to rebuild the stock. During the last two decades the stock has stabilized because of international quota agreements and improving oceanic conditions. The stock in question is the spring-spawning part of the Atlanto-Scandian herring but the catch includes summer spawners and occasional small additions of North Sea and North American herring. Other European fleets, especially from Norway and Russia, played a bigger role than Iceland in the development of the fishery most of the time.

- The second graph relates effort changes to previous profits (or losses) with a one year lag according to available data during the years 1955-1969. The estimated model is another paradox: the threshold value is negative, meaning that the fishery continued to expand in spite of negative profits. This peculiar result can be explained by characteristic factors of the monetary policy in Iceland at that time: government intervention, inflation, negative real interest, subsidized funds and controlled foreign exchange rate.

- These circumstances promoted overinvestment in new vessels with modern fishfinding instruments and powerful gear which resulted in waxing catch despite waning stock. In the short-run it was an economic benefit but may have contributed to the collapse of the stock and a long-run crisis in the Icelandic economy.

Model Specification and Estimation

- **Specification:** $\frac{\Delta E_i}{E_i} = k(P_i - P_0) = kP_i - kP_0$

where the effort *E* is defined as the product of the total number of vessels participating in the herring fishery, their mean GRT and the mean number of days at sea. The difference $\Delta E_i = (E_{i+1} - E_i)$ is between the current year (*i*+1) and the previous year (*i*). P_i is profit as a percentage of revenue in a sample of annual accounts, P_0 some threshold value - which may be interpreted as an opportunity cost - and *k* a constant. The model simply states that the relative change in effort each year is proportional to the profit margin the year before above (or below) the threshold.

- **Estimation:**

$$\frac{\Delta E}{E} = 0{,}233 + 0{,}0086 \times P$$

$$(0{,}123) \quad (0{,}0050)$$

$$R = 0{,}44$$

which means that k = 0,0086 and $P_0 = -0{,}233/0{,}0086 = -27\%$ *(with moderate significance)*

Regression Statistics	
Multiple R	0,439
R Square	0,193
Adjusted R Square	0,126
Standard Error	0,386
Observations	14

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 80,0%*	*Upper 80,0%*
Intercept	0,233	0,123	1,893	0,083	0,066	0,399
X Variable 1	0,009	0,005	1,694	0,116	0,002	0,015

Original Data

Year	Building	Number of	Mean	Mean days	Iceland´s	Total	Stock	Sample	Revenue	Cost	Profit	Profit	Icel. Effort
A.D.	cost index	vessels (N)	GRT (G)	at sea (D)	Yield/ktons	Yield/M tons	M tons	size (n)	R/ M ISK	C/ M ISK	Π/ M ISK	P / %	MGD
1955	0,99	132	73	50	39,5	1,24	7,54	54	12,95	15,38	-2,43	-18,8	0,48
1956	1,04	187	77	47	81,7	1,5	9,23	59	19,79	20,56	-0,77	-3,9	0,68
1957	1,18	234	77	54	100,7	1,23	8,36	76	23,18	27,16	-3,98	-17,2	0,97
1958	1,28	241	79	65	106,3	0,86	7,16	53	18,99	24,22	-5,24	-27,6	1,24
1959	1,38	224	73	74	184,4	1,03	6,04	36	26,62	25,83	0,79	3,0	1,21
1960	1,47	258	81	68	144,5	0,94	4,9	67	26,76	44,85	-18,09	-67,6	1,42
1961	1,62	220	89	67	296,5	0,7	3,59	48	60,21	57,31	2,91	4,8	1,31
1962	1,82	224	100	75	450,4	0,82	2,81	52	103,10	97,77	5,33	5,2	1,68
1963	1,93	226	109	87	281,8	0,77	2,26	69	101,72	111,24	-9,52	-9,4	2,14
1964	2,23	233	133	97	468,9	1,22	2,77	98	334,45	368,30	-33,85	-10,1	3,01
1965	2,57	218	145	163	608	1,42	2,94	93	616,02	545,53	70,49	11,4	5,15
1966	2,99	185	192	174	716,4	1,75	2,57	83	654,44	613,87	40,57	6,2	6,18
1967	3,1	153	230	172	374,6	1,14	1,17	71	313,14	411,45	-98,31	-31,4	6,05
1968	3,39	103	258	134	79,5	0,28	0,226	64	268,62	349,02	-80,40	-29,9	3,56
1969	4,2	20	260	30	4,2	0,03	0,083	49	330,57	351,18	-20,61	-6,2	0,16

Monetary unit is the Icelandic *krona* (IKR) in millions and the unit of effort is one million GRT-days. Financial data (R, C, Π, P) refer to the sample only. In 1969 the total herring fleet was 87 vessels but only 20 caught the spring-spawning stock. That year was be dropped in some calculations and estimations.