

Sustainability of the Sardine Fishery in Zamboanga: A Bioeconomic Approach

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Outline of the Report

- Problem
- Theoretical Framework
- Empirical Method
- Background Information
- Results




Problem Statement and Objectives

- **Problem.** Would an equilibrium level of effort be achieved in the open access fishery of Zamboanga
- **Limitation.** Coverage (Single specie only). One firm.
- **Objectives.**
  - Describe the firm activity in the Zamboanga Sardine Fishery in terms of effort levels and yields through time
  - Determine the initial conditions on yield and effort which may encourage cooperation on the operationalization of an individual transfer quota scheme for the fishery.




Theoretical Framework and Method

- **Theoretical Framework**
  - Open access analysis of a fishery (single specie), using a monetized yield function (Anderson 1976)
  - Assumes that the long-run marginal cost function of the representative firm reaches minimum marginal cost (perfectly competitive model)
- **Empirical Method**
  - Regression which accounts for heterogenous variance, parameter used to estimate the equilibrium effort level




Background Information




Will a 1.9 million metric ton maximum sustainable yield for the Fishery in RP sustain a commercially profitable sardine industry in Zamboanga?

Consequence: Roughly 128,250 (45%) metric ton annual yield for all Deep Sea Coastal Sardine Fishing Firms

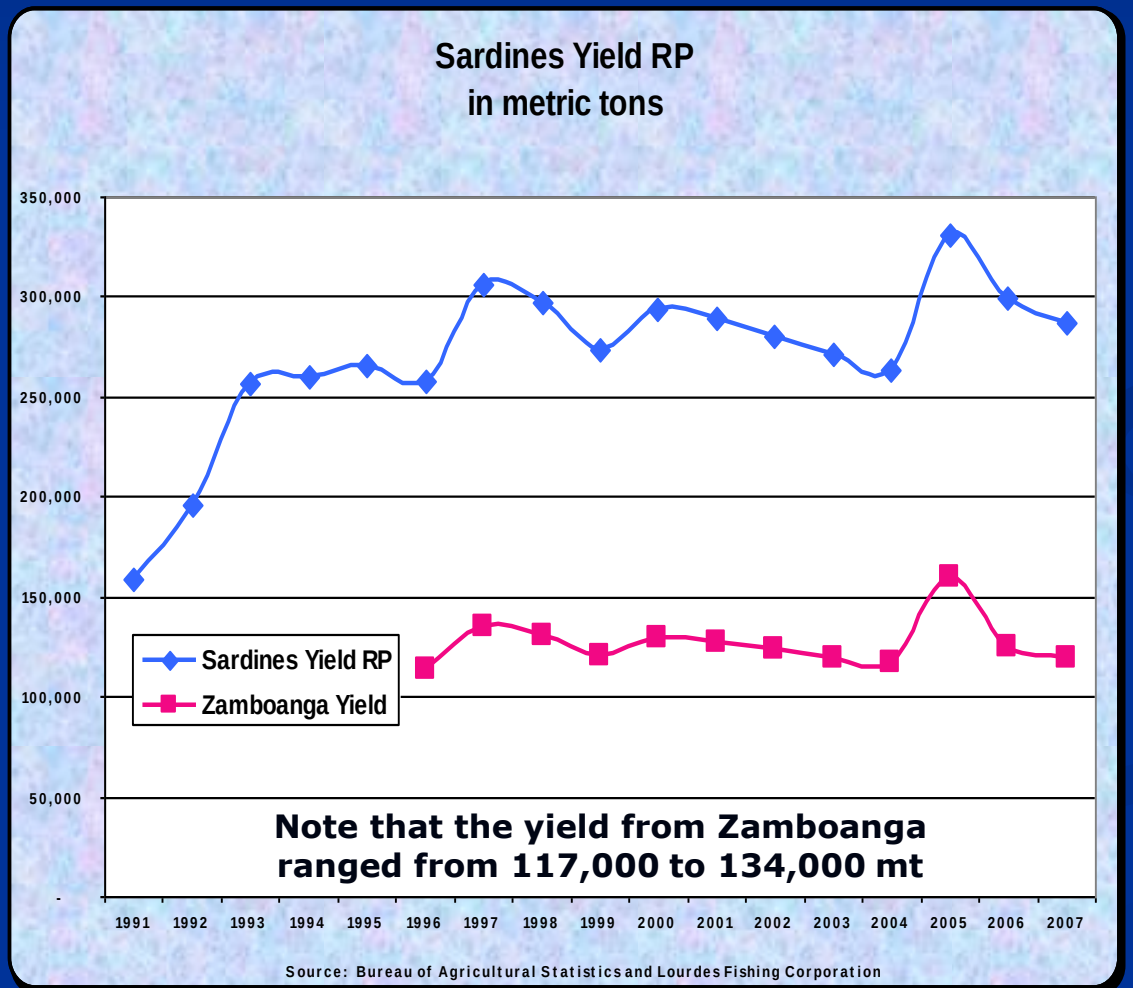
Fishery contributed 23% of GVA (constant) in 2006 to 2007

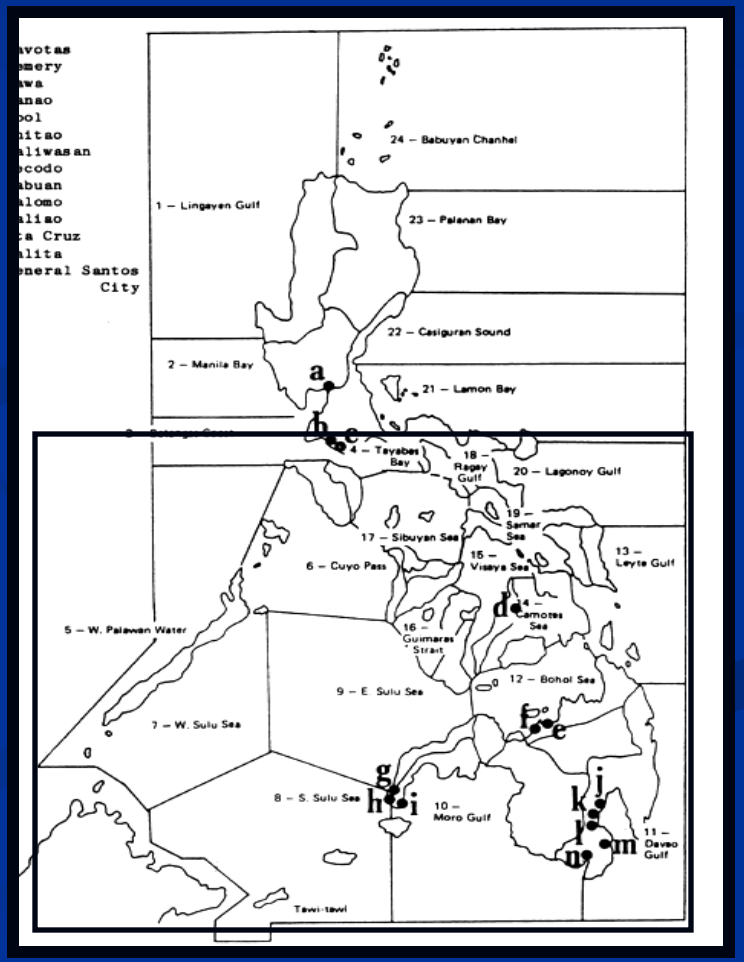
INDUSTRY	AT CURRENT PRICES			AT CONSTANT PRICES		
	2006	2007	Gr. Rate (%)	2006	2007	Gr. Rate (%)
1. AGRICULTURE INDUSTRY	851,109	932,673	9.6	238,511	250,522	5
a. AGRICULTURE	721,286	789,159	9.4	183,686	191,931	4.5
Palay	134,431	150,667	12.1	40,987	43,430	6
Corn	45,469	55,010	21	14,494	16,054	10.8
Coconut including copra	39,087	46,063	17.8	8,302	8,244	-0.7
Sugarcane	27,653	23,131	-16.4	6,136	5,462	-11
Banana	37,194	45,292	21.8	6,192	6,819	10.1
Other crops	222,026	239,919	8.1	43,559	46,608	7
Livestock	111,360	116,976	5	28,397	29,072	2.4
Poultry	64,007	68,330	6.8	25,016	25,091	0.3
Other Agriculture Services	40,058	43,771	9.3	10,603	11,151	5.2
b. FISHERY	129,823	143,514	10.5	54,825	58,591	6.9
2. FORESTRY	4,343	4,669	7.5	1,326	1,488	12.2
GVA AGRI, FISHERY AND FORESTRY	855,452	937,342	9.6	239,837	252,010	5.1

Source: NSCB

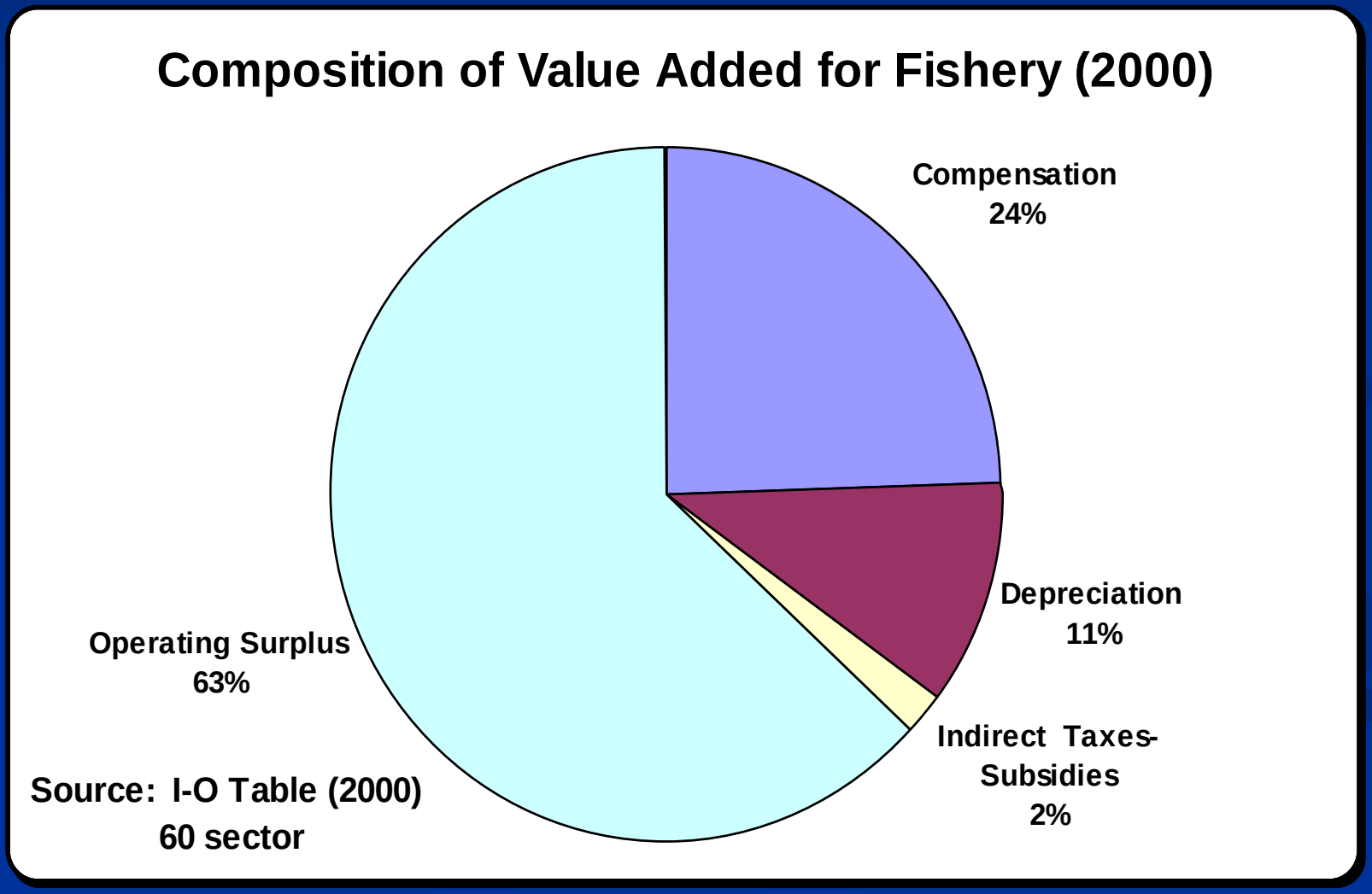
Sardine deep sea coastal fishing production contributed about **3.4% to 3.5%** of GVA (constant) of Agriculture, Fishery and Forestry

Deep Sea Coastal Fishing Firms from Zamboanga account for 44% to 45% of Total (RP) Sardine Harvest

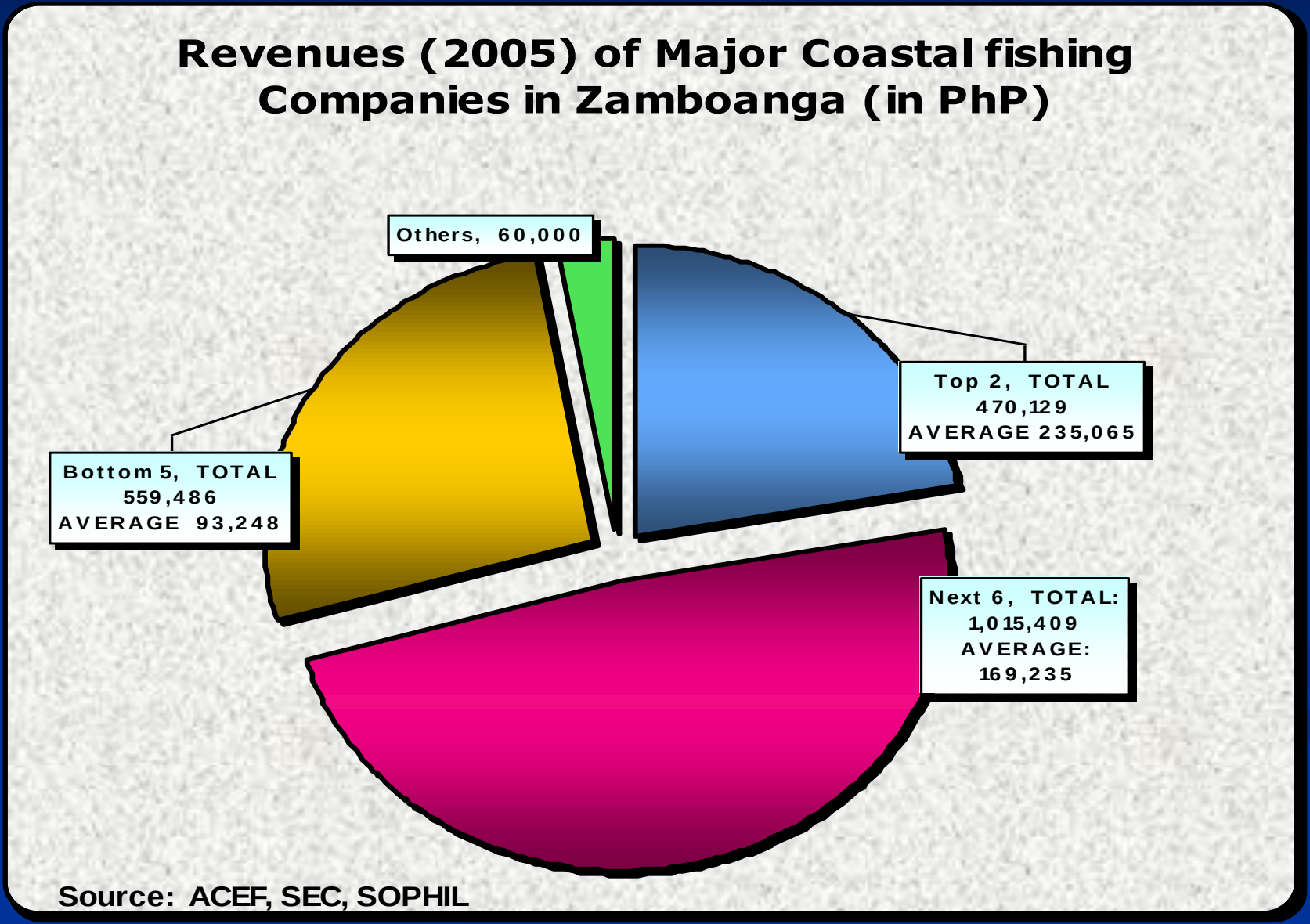




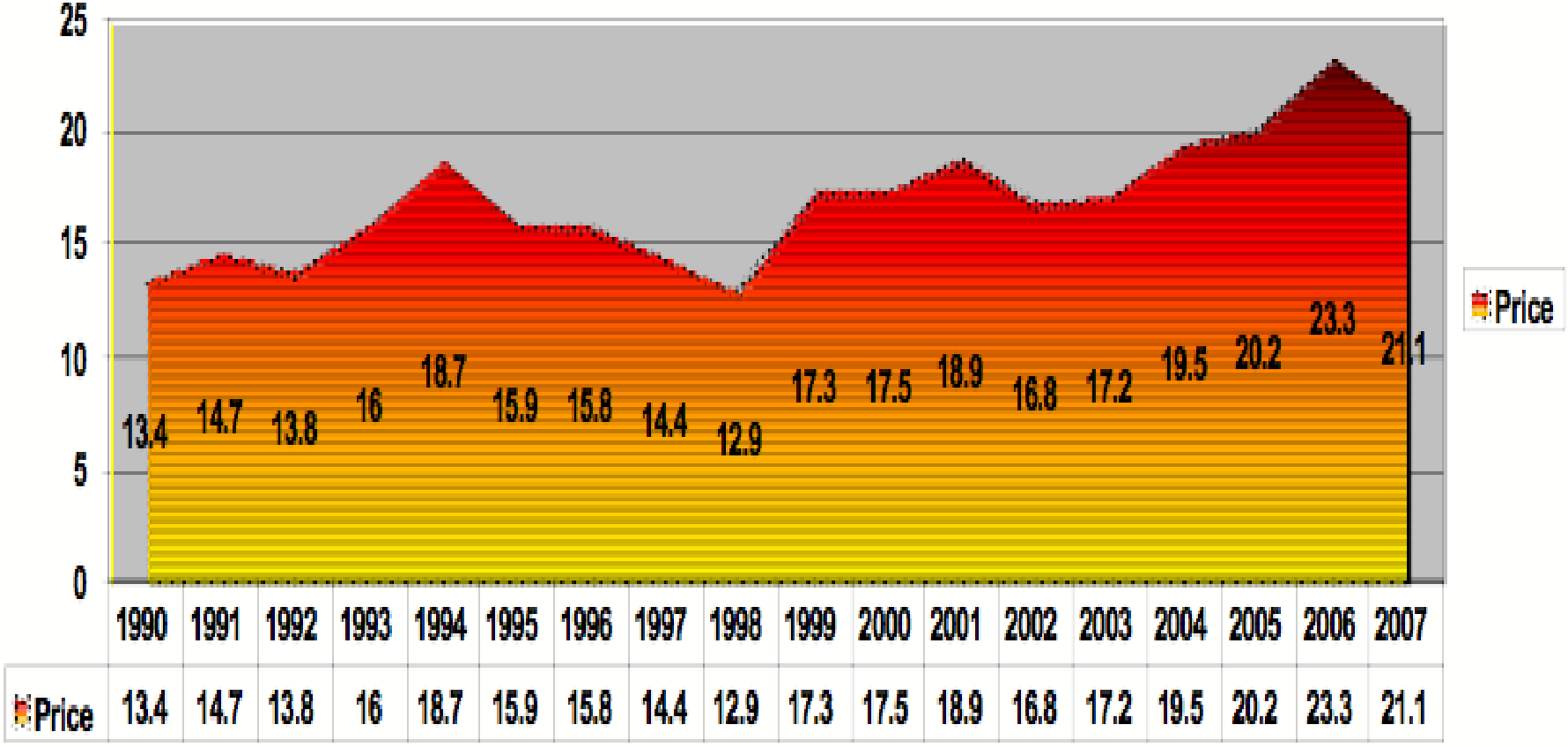
Labor comprises about 69% of Factor Inputs for Fishery



Top 8 Firms contributed close to 75% of total Zamboanga Sardine Revenues in 2005



Sardine Prices (1990-2007)

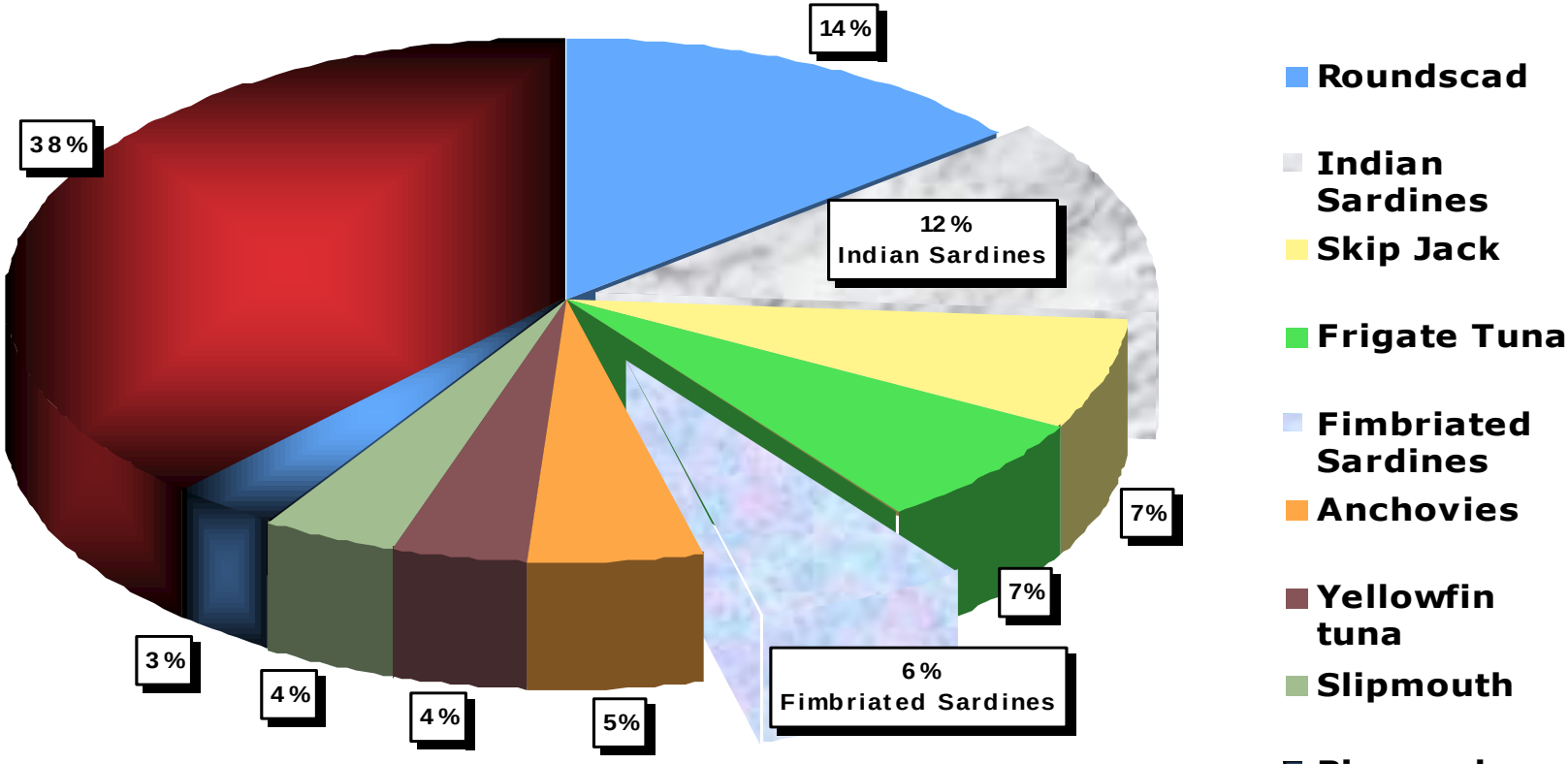


	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Price	13.4	14.7	13.8	16	18.7	15.9	15.8	14.4	12.9	17.3	17.5	18.9	16.8	17.2	19.5	20.2	23.3	21.1

Prices started to increase in 2005. Current prices are higher than the 1990 to 2004 levels.

Sardines contributed 18% to Total Marine Production in 2001

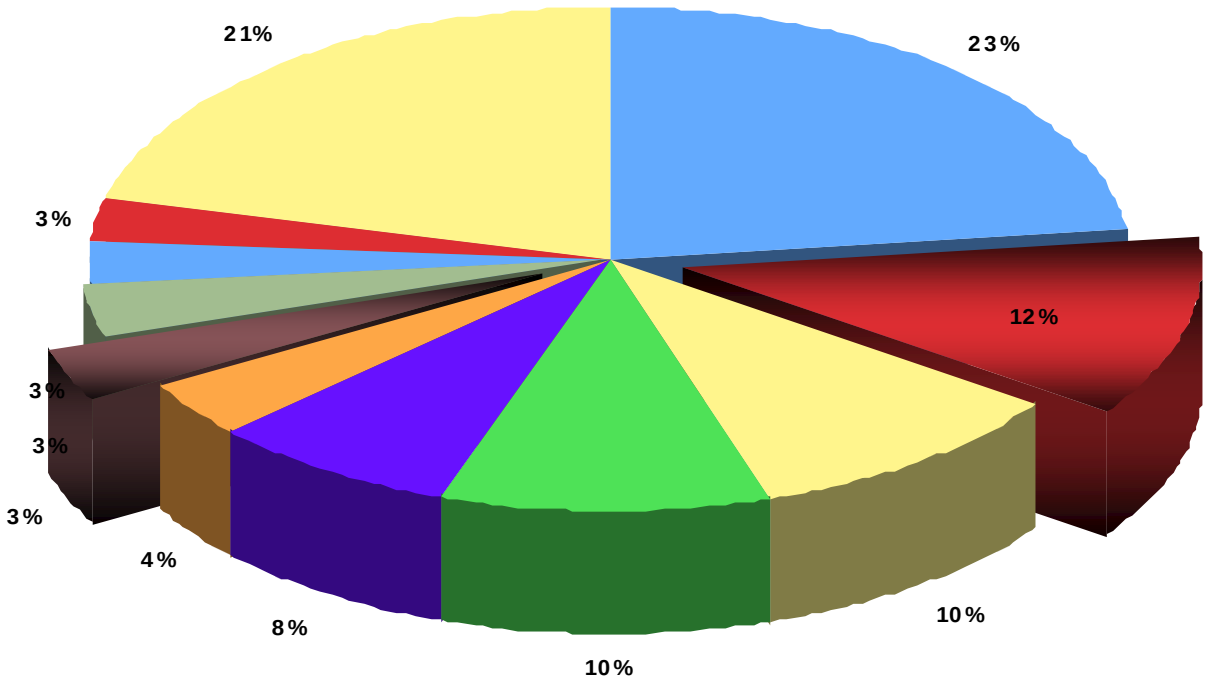
Percentage Contribution of Top Species to Total Marine Production Philippines, 2001



Source: BAS Statistical Database

Sardines contributed 15% to Total Marine Production in 2003

Percentage Contribution of Top Species to Total Marine Production Philippines, 2003



Source: BAS Statistical Database

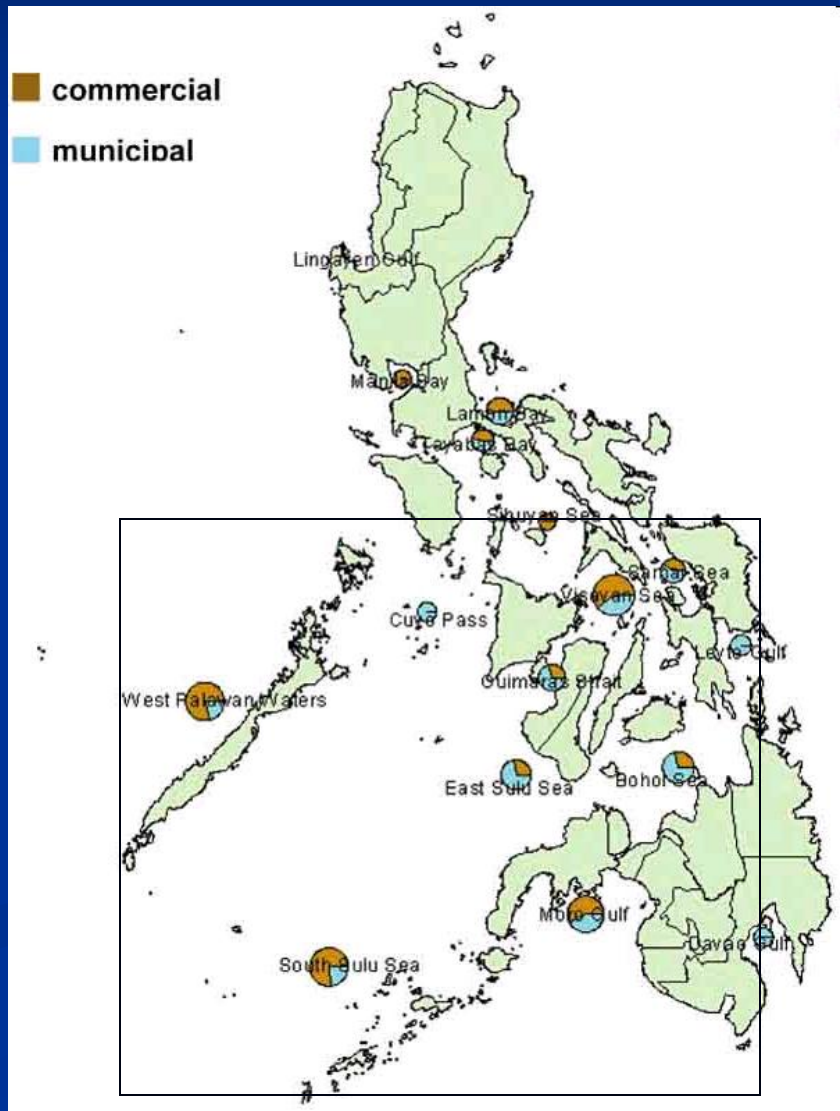
Selling Price of Fishing Firms to Canneries (1998)		
Industry Players	Price Range (Php)	
	Off-Peak Season	Peak Season
YL Fishing Corporation	Php 12-14	Php 10-11
Mega Fishing Corporation (Mega)	PhP 12-13	Php 9-10
Oceanic Fishing Ventures	Php 12-15	Php 8-9
Zamboanga Universal (555)	PhP 12-16	Php 10-11
Century Fishing Corporation	Php 12-15	Php 9-11
Lourdes Fishing Corporation	Php 12-14	Php 9-11
Nany Fishing Corporation	Php 12-13	Php 9-10
E&L Fishing Corporation	Php 12-15	Php 9-12
Toprose Fishing Corporation	Php 12-14	Php 10-11
OLC Fishing	Php 12-13	Php 9-10
Jordan Fishing	Php 12-15	Php 10-11
Sugo Fishing	Php 12-16	Php 10-11
Merly Fishing	Php 12-13	Php 9-10
AMR Trade and Industrial (Ligo)	Php 12-15	Php 9-10
Source: ACEF, 2005		

Observations on Major Firms

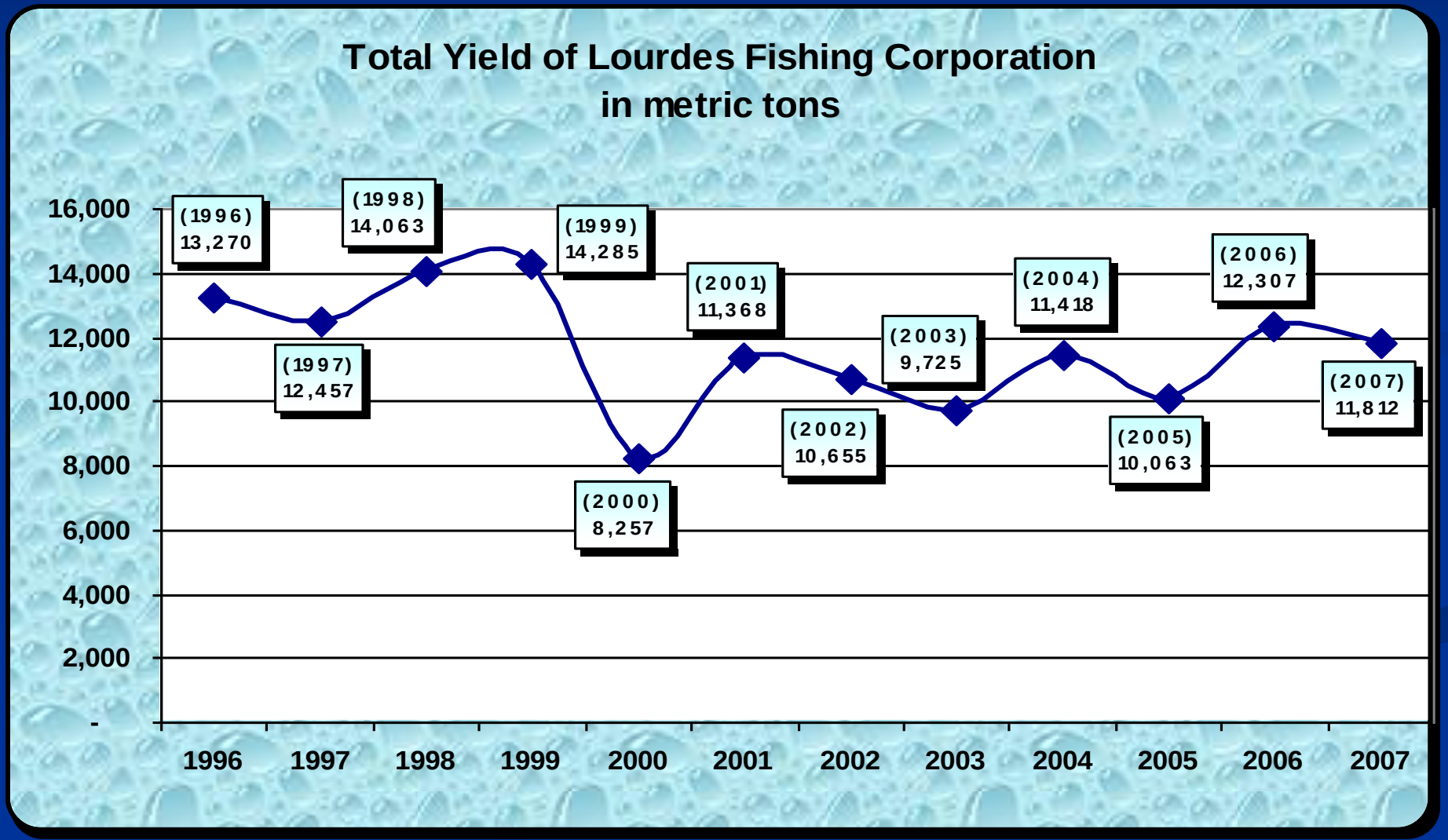
- Close to perfect competition
- Prices negotiated by deep sea coastal fishing firms are not very different from each other
- Increase in yield in 2005 may be a reaction to the increase in price
- Price is exogenous to the industry
- Labor is an important factor input

Consequences of these Observations to the Model

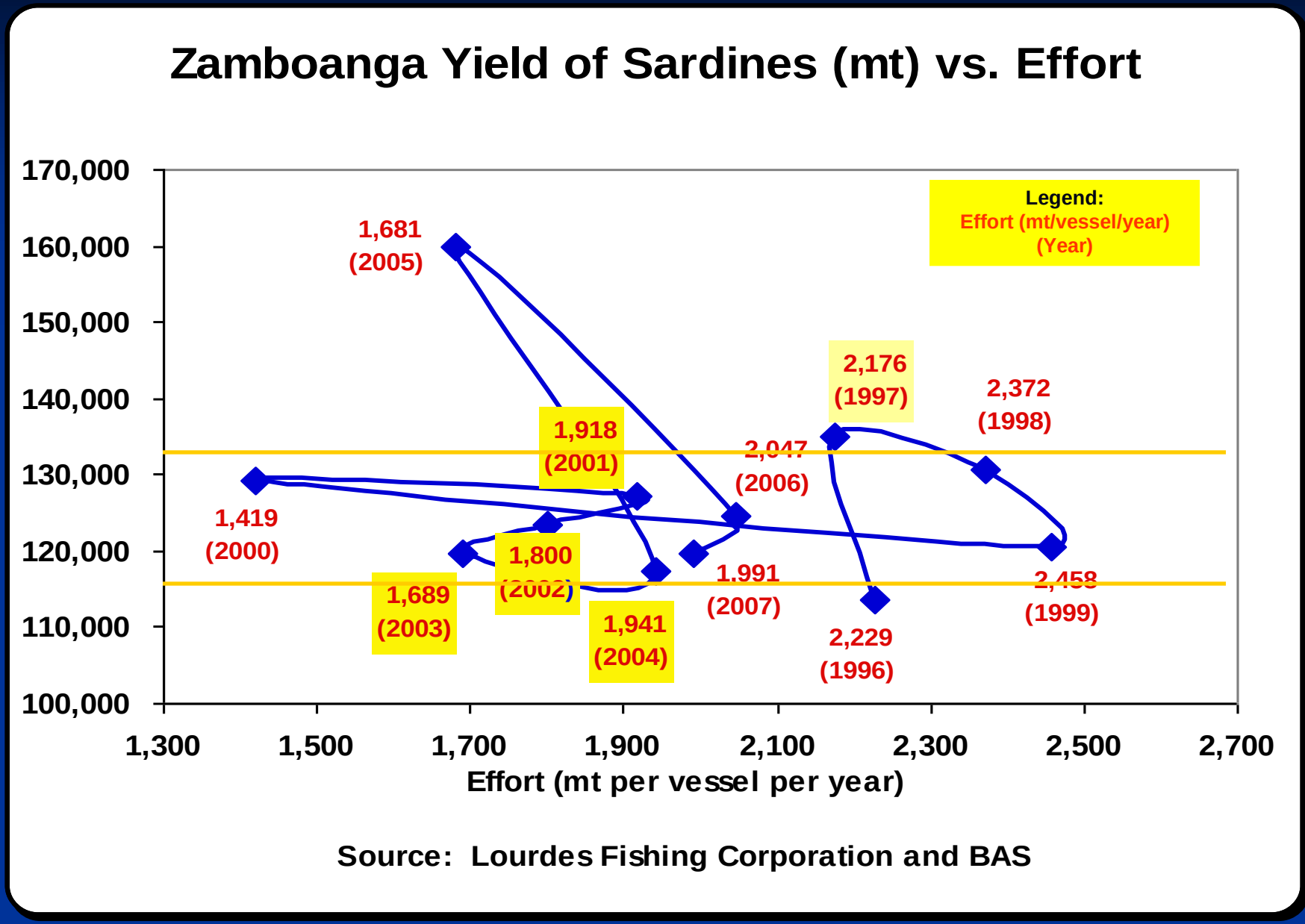
- Absence of a dominant firm(s), exogenous price, close to random distribution of economic activity – Marshallian demand and supply situation
- Make use of a representative firm for the analysis of effort
- Equilibrium level may be reached in terms of effort productivity



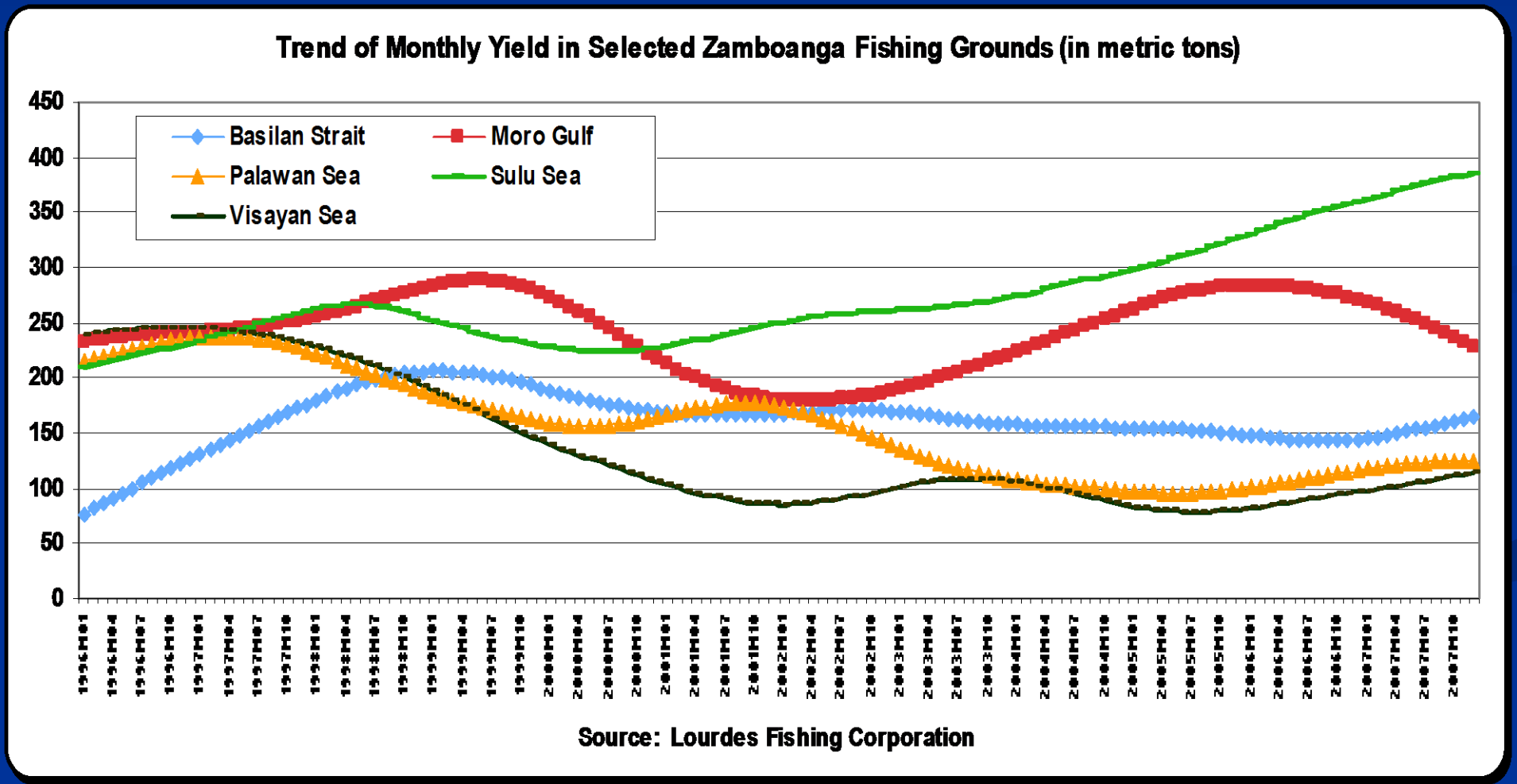
The yield of the representative firm ranged from 9,700 mt to 12,350 mt from 2001 to 2007



Most effort levels can be found within the Zamboanga yield of 117,000 to 134,000 mt



Sulu sea and Moro Gulf seem to be higher yield locations



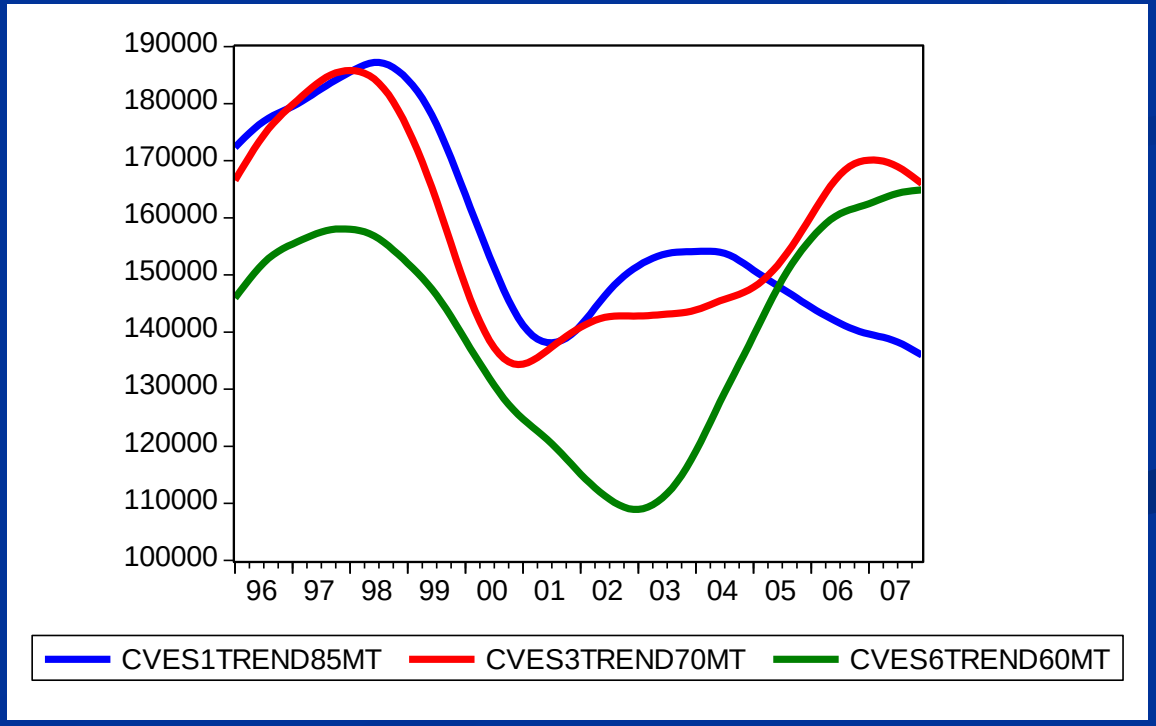
Catcher Vessel 1 – 85.37 Tons

Catcher Vessel 3 – 69.96 Tons

Catcher Vessel 6 – 59.64 Tons

Effort per vessel

Trend of monthly yield for smaller catcher vessels ranged from 110 mt to 190 mt from 1996 to 2007



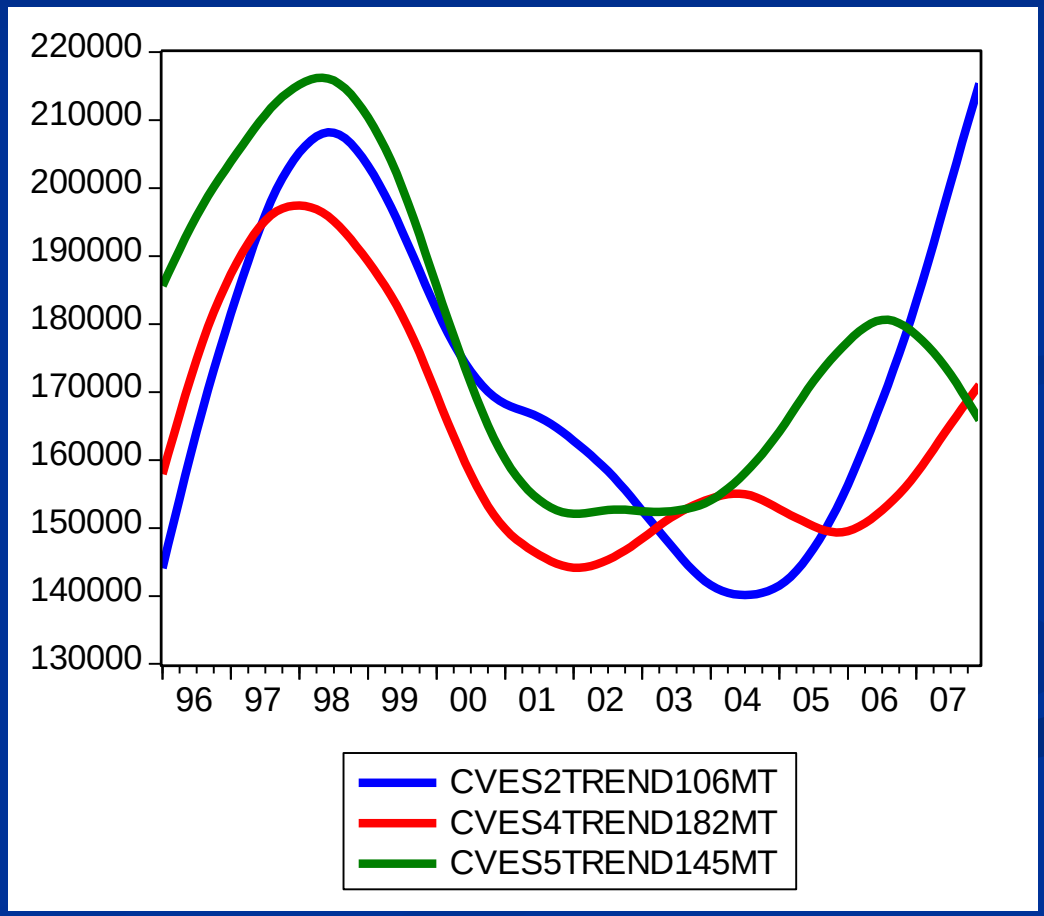
Effort per vessel

Catcher Vessel 4 – 182.22 Tons

Catcher Vessel 5 – 145.24 Tons

Catcher Vessel 2 – 106.03 Tons

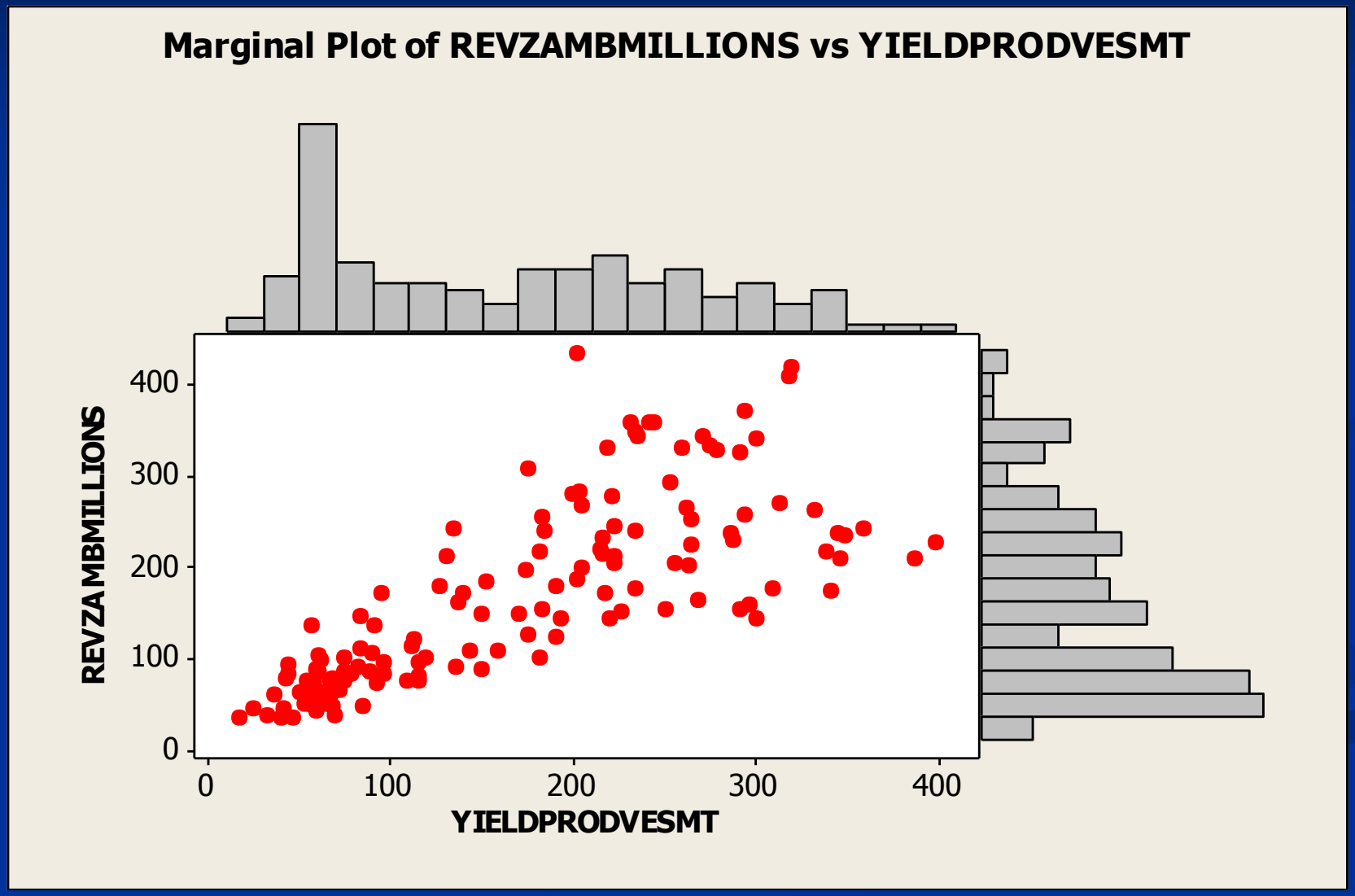
Trend of monthly yield for larger catcher vessels ranged from 140 mt to 215 mt from 1996 to 2007



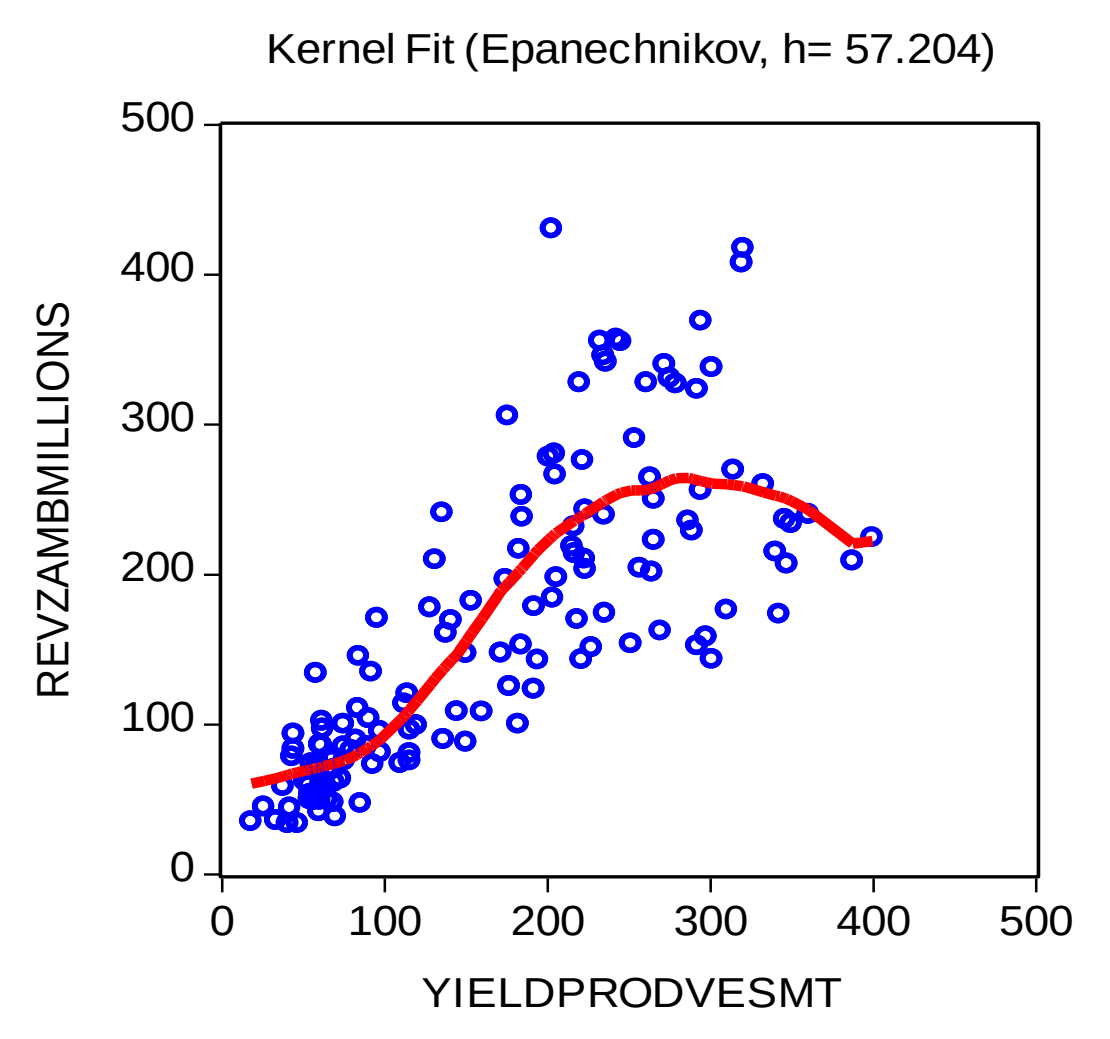
Results



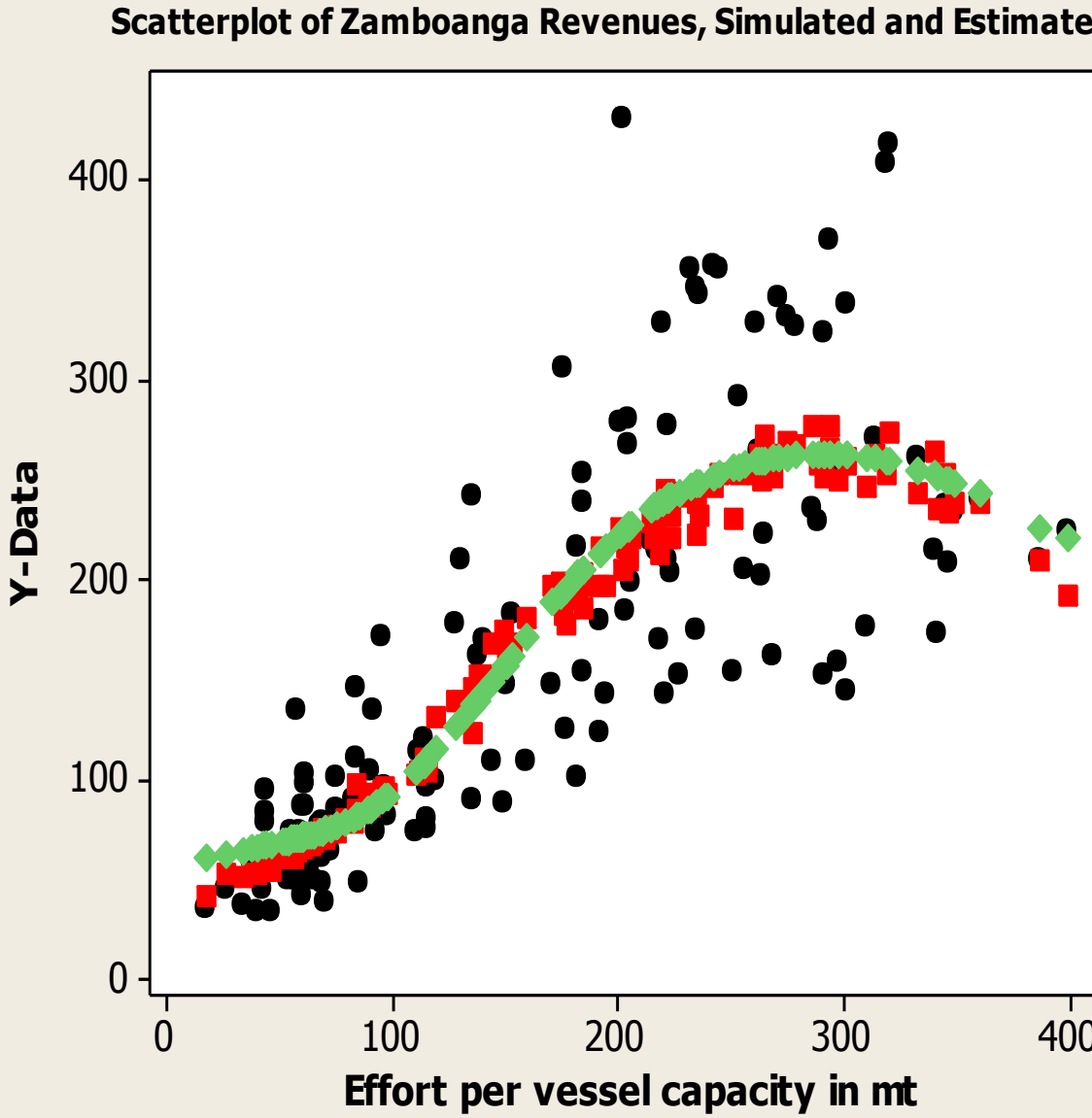

Basic Data


Marginal Plot of REVZAMBMILLIONS vs YIELDPRODVESMT
REVZAMBMILLIONS
0
100
200
300
400
YIELDPRODVESMT
0
100
200
300
400

Simulated Monetized Yield Function as Basis



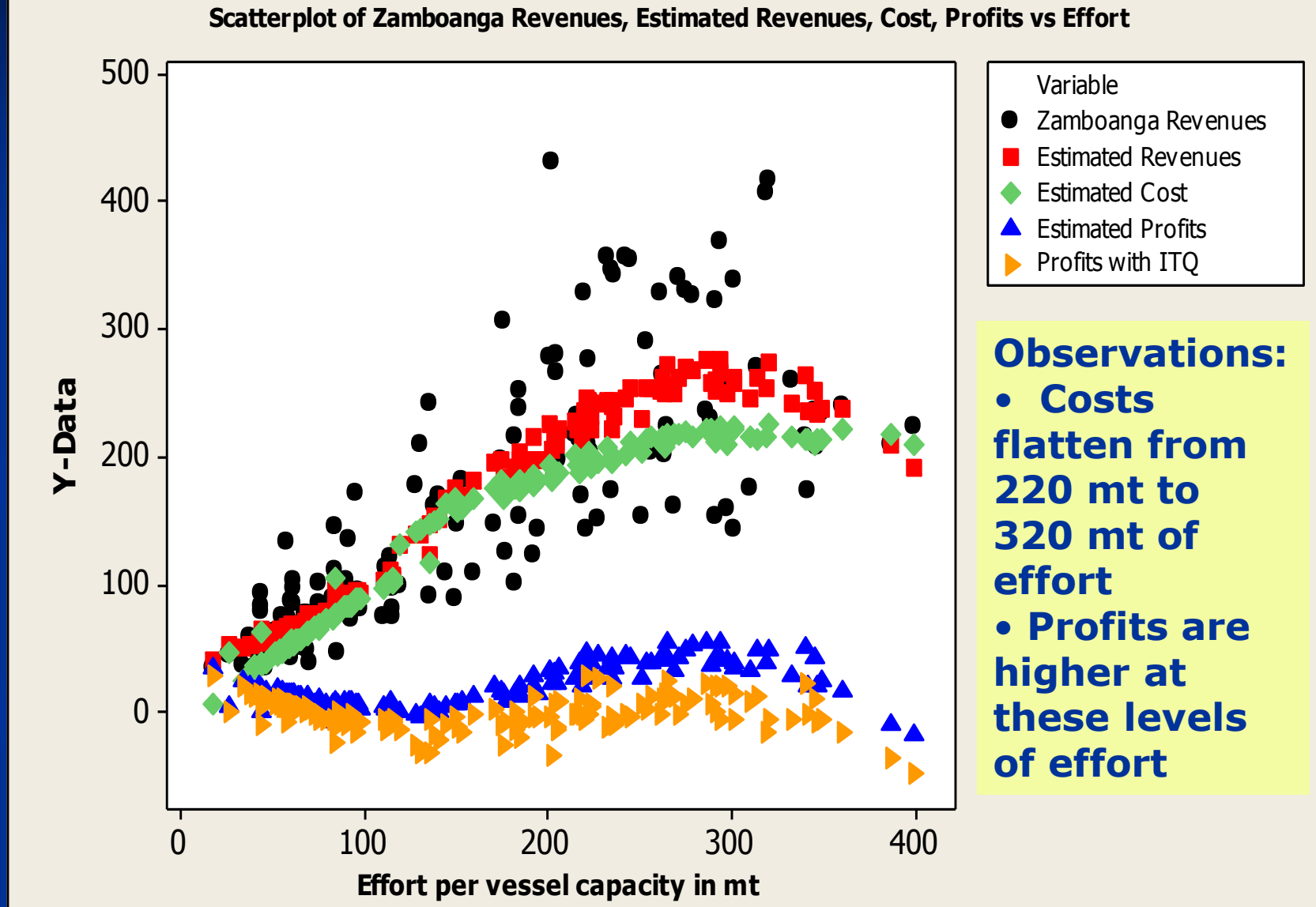
Results



Basis for Regression Procedure:

- **Simulate the scatter plot**
- **Have a structural equation to capture the relevant features of the monetized yield function**

Results



Observations:

- **Costs flatten from 220 mt to 320 mt of effort**
- **Profits are higher at these levels of effort**

Regression Equation

- Monetized Yield = *f* (effort, seasonality, price ratio)
- Zamboanga Revenues = α + β_1 effort - β_2 effort^2 + β_3 seasonality - β_4 price corporation/price Zamboanga
- The equation used is actually the equation to achieve open access equilibrium.
- Variation in monthly yields as a function of depleting stocks had to be captured, not fully captured by the seasonality variable . We cannot assume homogenous variance. Thus, the estimation procedure had to capture this characteristic of the variance for both revenues and yield or harvest.
- The price variable is the ratio of the price of the corporation (estimate for marginal cost), and, Zamboanga price as estimate of Total Cost (Anderson 1976)

Regression Results

Dependent Variable: LOG(REVZAMBMILLIONS)
Method: ML - ARCH (Marquardt) - Normal distribution
Sample: 1996M01 2007M12
Included observations: 144

	Coefficient	Std. Error	z-Statistic	Prob.
C	12.77	7.01	1.821507	0.069
YIELDPRODVESMT	0.013	0.001	10.94086	0.000
(YIELDPRODVESMT)^2	-2.15E-05	2.54E-06	-8.455501	0.000
FACTOTYIELD	0.139	0.073	1.911228	0.056
PRICECORP/PRICEZAMB	-9.34	7.03	-1.328988	0.184
Variance Equation				
C	0.037	0.015	2.487087	0.013
RESID(-1)^2	0.412	0.118	3.495769	0.0005
GARCH(-1)	0.203	0.165	1.232260	0.22
R-squared 0.797		Adjusted R-squared 0.786		

Regression Results

RESULTS							
MSY and MEY	Effort Level (in metric tons)	Profits (in PhP Millions)				Harvest or Yield (PhP Millions)	
		Profit with Linear Cost Function		Profit with Curvilinear Cost Function		Actual	Estimated
		Without ITQ	With ITQ	Without ITQ	With ITQ		
MSY (1)	286.52 (period: 2004.04)	41.44	10.80	54.19	23.54	235.71	276.26
Open Access (1)	294.28 (period: 1997.08)	41.41	8.09	54.18	20.86	256.30	276.03
MEY	263.14 (period: 2003.08)	39.26	4.87	45.28	11.09	264.58	261.75
	253.74 (period: 2004.08)	38.02	0.25	39.55	1.78	290.53	253.43
	221.76 (period: 2001.08)	36.48	0.59	39.80	3.91	276.03	243.15

Notes:
(1) Uses monthly weighted average of effort (effort per vessel and capacity). Effort levels were calculated from the monetized harvest function

Interpretation of Results

- An ITQ can be operationalized.
- A maximum efficient yield at effort level 263 mt per vessel per month would amount to 127,029 mt annual yield for all Zamboanga firms with each firm yielding a 4.2% monthly net profit level
- At the open access equilibrium level of 294 mt per vessel per month, yield would reach 142,002 or 11% more than the MSY. But monthly net profits would increase to 7.6%.

Conclusion

- The results call for a need to review productivity per vessel so as to increase yield without necessarily increasing cost
- Capital equipment investment or an improvement in yield practices, i.e. incorporate seasonality
  - Use of a sonar
  - Freezing facility near port, owned by Mega Fishing

References

- Anderson, Lee G. (1995) "Privatizing Open Access Fisheries: Individual Transferrable Quotas." Chapter 20. *Handbook of Environment and Natural Resources*
- Anderson, Lee G. (1976) "The Relationship of Firm and Fishery in Common Property Fisheries." *Land Economics*. Vol 52. No. 2 (May 1976). Pp. 179-191
- Conrad, Jon M. (1995) "Bioeconomic Models of the Fishery." Chapter 18. *Handbook of Environment and Natural Resources*
- USAID (2004). "In Turbulent Seas."
- DA and BFAR (2005). "Comprehensive National Fisheries Industry Development Plan."