# Wall Street or Pacific Stocks: A Time Series Analysis of Drivers of Sportfishing Effort

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# Fishery Importance

- Sportfishing is a historic and active pastime
- California CPFV Fishery is utilized by anglers from around the world
- Historical time series of participation records can be exploited to estimate the impact of both fishery and economic conditions on the demand for sportfishing

# Economic Background

Fleet

- Began in early 20th century
- Catch records collected post 1939
- Vessels operate near and offshore

California CPFV Statistics (Current)

- Ticket Price per trip: $94 / $88 (resident/ non-resident)
- Trip Expenditures per trip: $191 / $280
- Total Trip Expenditures: $75 million / $35 million
- Employment Direct Impact: 9418 jobs / 2,702 jobs
  - (Recreational Sportfishing Expenditure Study (NOAA, 2006))

# Economic Importance and Research Need

- Need to understand recreational fishery
- Ties into holistic management of fishery in general
- What is the impact of the general economy on recreation

Expenditure studies measure contribution to local, regional, and national economies.

Time Series:

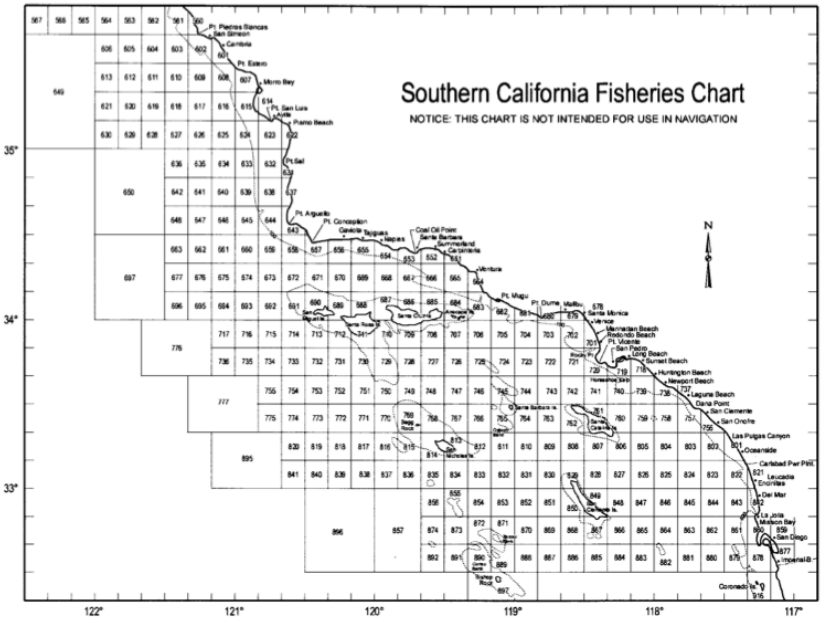
- Need for models accounting for macroeconomic trends and other time series
- Not accounting for these trends can lead to biases results and sub optimal management decisions.
- Economic factors may impact recreational target species and fishing ground choice

# Aggregate Monthly Demand for Sportfishing

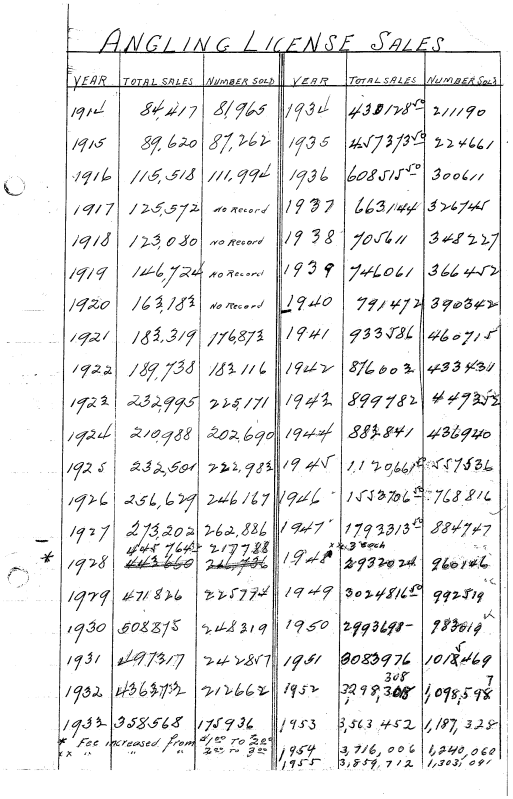
$$\begin{aligned}\ln effort_{rt} = \beta_r \ln income_t + \gamma_r \ln price_{rt} + \\ + \alpha' weather_{rt} + \delta' cpue_{rt} \\ + \ln effort_{rt-1} + \ln effort_{rt-12} + \varepsilon_{rt}\end{aligned}$$

- Fishing conditions are unobservable, but are held to be correlated with weather conditions and fish abundance or catchability
- Time-dependence structure within ARMA framework, used autocorrelations
- *effort* measures in anlger hours per California fishing license
- *income* defined as 2005 per capita income in California

# Regions




Log books cover California coast.

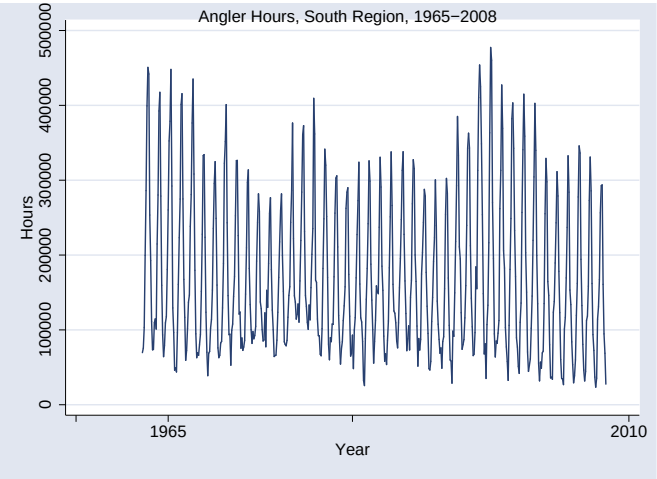


ANGLING LICENSE SALES

| YEAR | TOTAL SALES | NUMBER SOLD | YEAR | TOTAL SALES | NUMBER SOLD |
|---|---|---|---|---|---|
| 1914 | 84,417 | 81,965 | 1934 | 430128.50 | 211190 |
| 1915 | 89,620 | 87,262 | 1935 | 457373.50 | 224661 |
| 1916 | 115,518 | 111,994 | 1936 | 608515.50 | 300611 |
| 1917 | 125,572 | no Record | 1937 | 663144 | 326745 |
| 1918 | 123,080 | no Record | 1938 | 705611 | 348227 |
| 1919 | 146,724 | no Record | 1939 | 746061 | 366452 |
| 1920 | 163,183 | no Record | 1940 | 791472 | 390342 |
| 1921 | 183,319 | 176,873 | 1941 | 933586 | 460715 |
| 1922 | 189,738 | 183,116 | 1942 | 876003 | 433431 |
| 1923 | 232,995 | 225,171 | 1943 | 899782 | 447352 |
| 1924 | 210,988 | 202,690 | 1944 | 883841 | 436940 |
| 1925 | 232,501 | 222,983 | 1945 | 1,120,661.50 | 557536 |
| 1926 | 256,629 | 246,167 | 1946 | 1553706.50 | 768816 |
| 1927 | 273,202 | 262,886 | 1947 | 1793313.50 | 884747 |
| * 1928 | 445,764.50 ~~443,660~~ | 217,788 ~~216,736~~ | 1948 | x 3 each 2932024 | 960146 |
| 1929 | 471,826 | 225,774 | 1949 | 3024816.50 | 992519 |
| 1930 | 508875 | 248,319 | 1950 | 2993698 | 983019 |
| 1931 | 497317 | 242,857 | 1951 | 3083976 | 1018469 |
| 1932 | 436373.2 | 212,662 | 1952 | 3298,308 | 1,098,598 |
| 1933 | 358568 | 175936 | 1953 | 3,563,452 | 1,187,328 |
| * Fee increased from | | $1.00 to $2.00 | 1954 | 3,716,006 | 1,240,060 |
| xx " " | | 2.00 to 3.00 | 1955 | 3,859,712 | 1,303,091 |

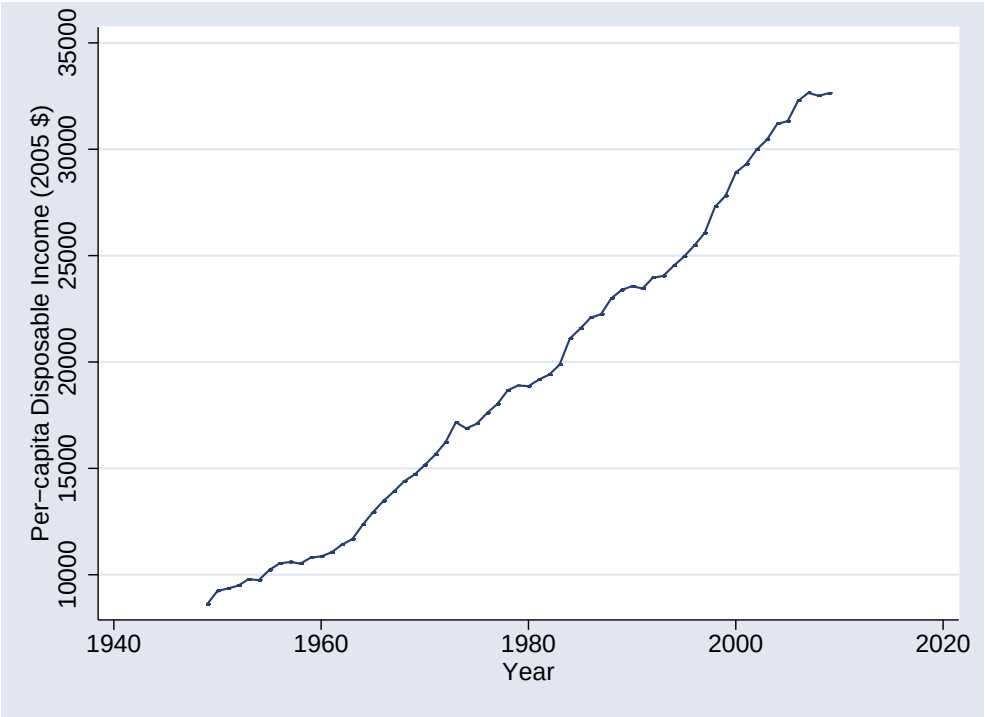
Vessel permits

# Effort



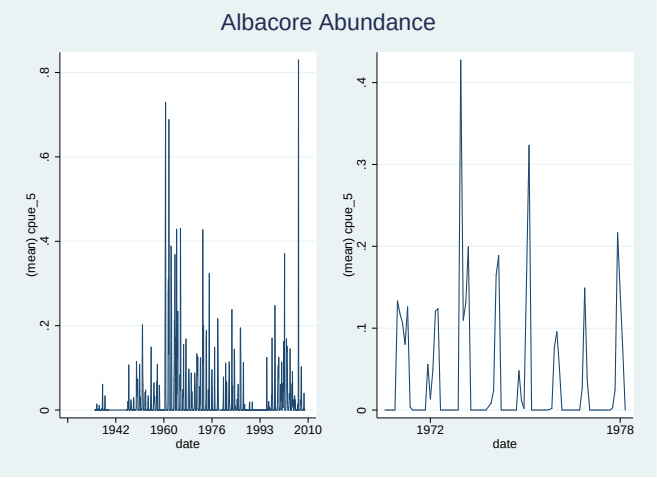

- No strong long term trend
- Strong seasonality. More popular species (i.e. tuna) fished in summer.
- Angler Hours for the CPFV Fleet from 1936 to Present.

# Income



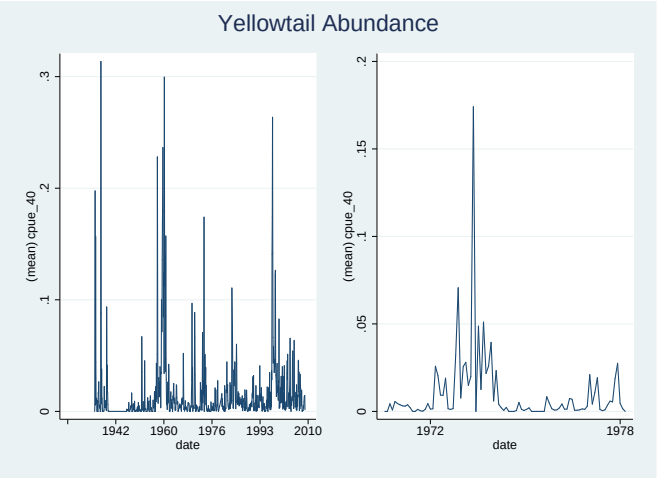

Real Per Capita Disposable Income (2005$) - California

# Fishing Quality



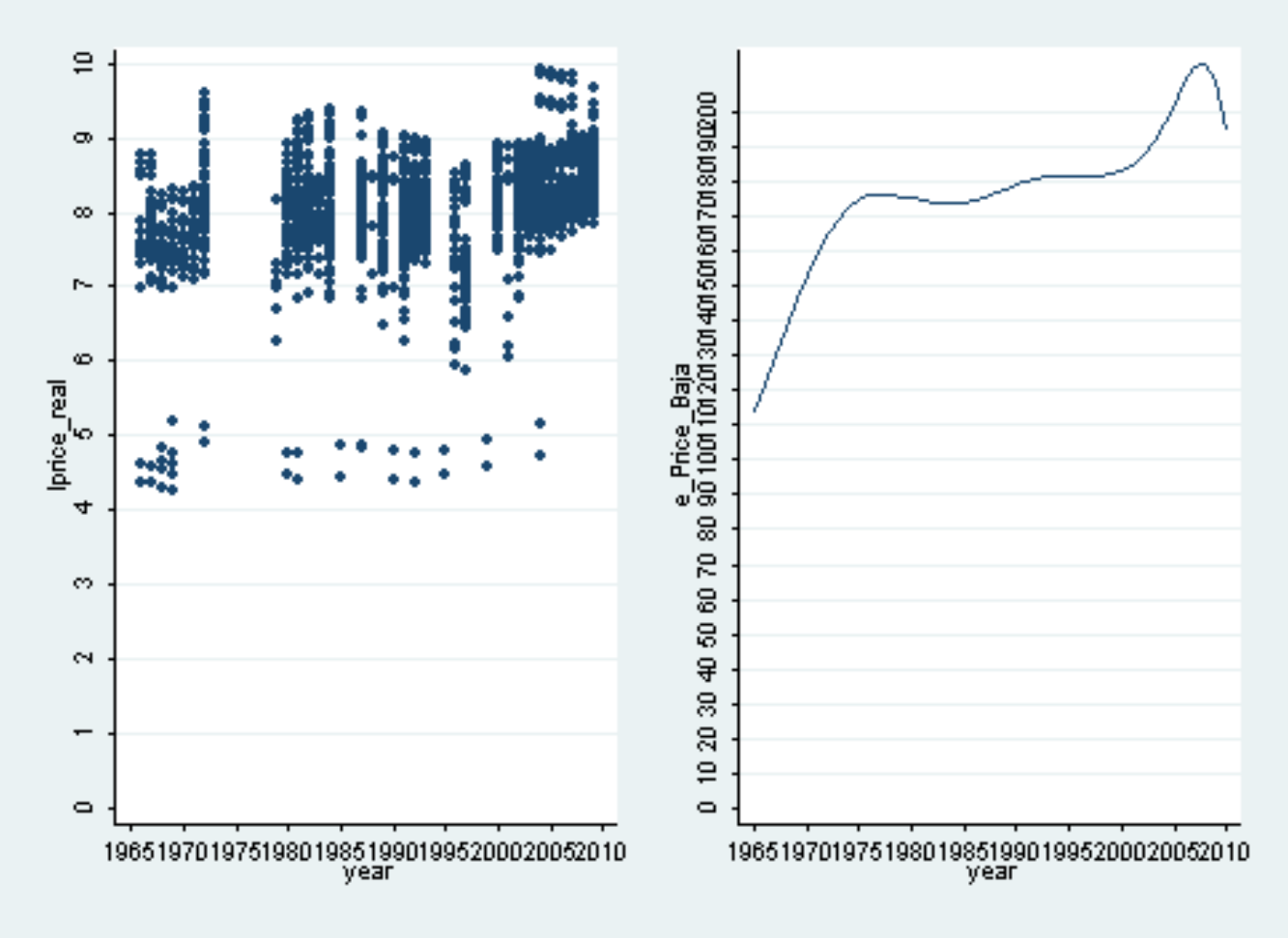

- San Diego based CPFV Albacore CPUE
- Sharp drop-off in mid-90's.
- Strong seasonal trend (high catch in summer). Albacore is highly-migratory.

# Fishing Quality



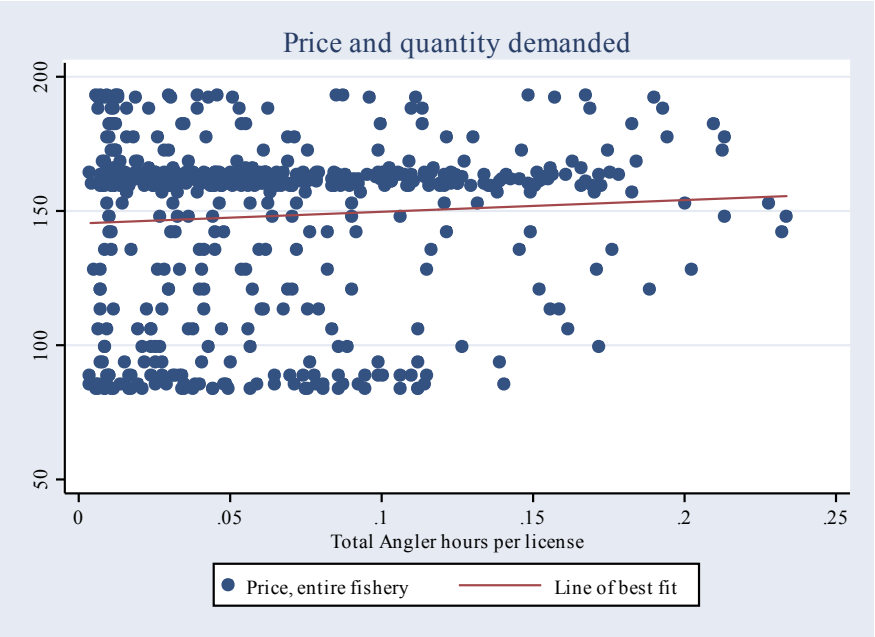

- Effort for over 150 vessels, over 250 species
- 10''x10'' blocks, 1936-present

# Prices




- Prices gathered from over 75 boats, 1800 prices, 1947-2010.

# Price and Quantity



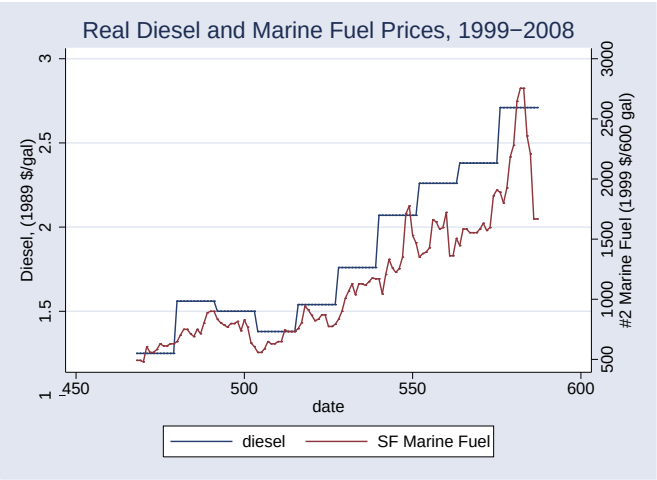

- Scatter of price and quantity
- Does not control for supply shocks
- Prices endogenous: exogeneity failed at $p<0.1$

# Second Stage Regression

| *angler_hours* | | | | | Joint | |
|---|---|---|---|---|---|---|
| Region | U.S. Trips | | Mexico Trips | | San Diego Based | |
| | Coef. | z | Coef. | z | Coef. | z |
| Price | -1.231* | -2.79 | -2.217* | -2.67 | -1.544* | -3.42 |
| Income | 0.631* | 3.43 | 1.54* | 4.60 | 0.838* | 4.61 |
| Troll Tuna CPUE | 0.002* | 2.27 | 0.004* | 2.98 | 0.003* | 3.56 |
| Albacore CPUE US | 0.104 | 0.86 | -0.185 | -1.00 | 0.045 | 0.41 |
| Albacore CPUE Mex | 0.045 | 0.22 | 0.234 | 0.64 | 0.291 | 1.45 |
| Yellowtail CPUE US | -0.310 | -0.83 | -0.844 | -1.41 | -0.541* | -1.55 |
| Yellowtail CPUE Mex | 0.086 | 0.22 | 0.506* | 1.87 | -0.283 | 1.73 |
| Rockfish CPUE US | 0.020 | 0.69 | 0.139* | 3.09 | 0.037 | 1.31 |
| Rockfish CPUE Mex | 0.049 | 1.49 | -0.264* | -5.09 | -0.010 | -0.32 |
| $R^2$ | 0.89 | | 0.88 | | 0.91 | |

# Fuel Prices

- Used as an instrument for effort
- Significant in first stage of 2SLS



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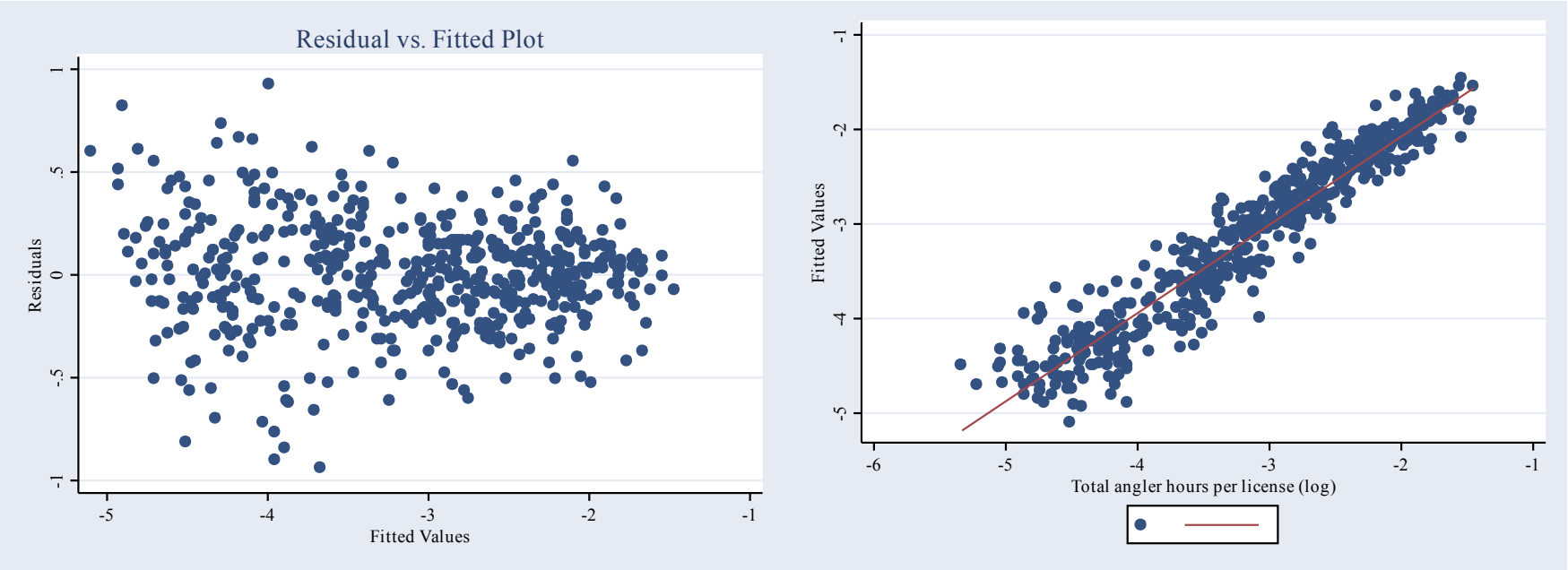
# Second Stage Regression

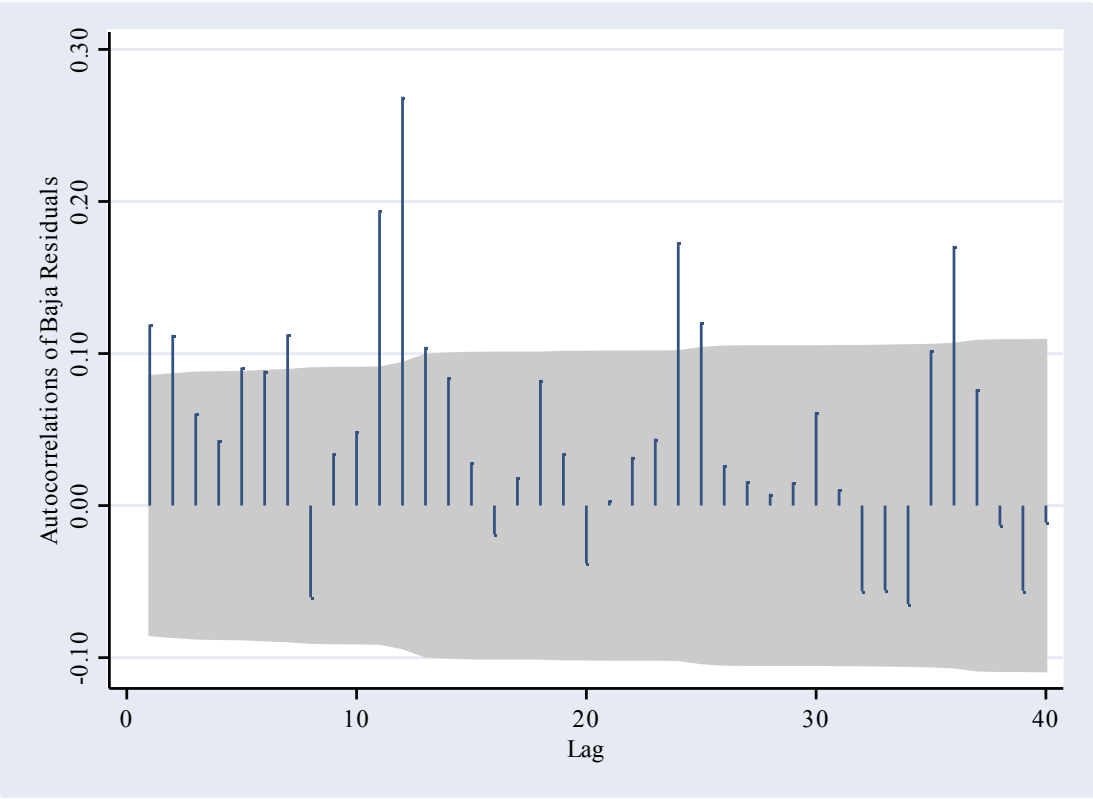
| *angler_hours* | | | | |
|---|---|---|---|---|
| Region | U.S. Trips | | Mexico Trips | |
| | Coef. | z | Coef. | z |
| SD Temp | 2.031* | 5.21 | 2.580* | 3.81 |
| SD Wind | -0.977 | -4.55 | -3.705* | -11.01 |
| Sea Surface Temp | -1.737* | -5.99 | -3.340* | -6.15 |
| ENSO | -0.040 | -2.95 | -0.031 | -1.46 |
| Effort 1 month lag | 0.228* | 6.10 | 0.478* | 13.22 |
| Effort 1 year lag | 0.665* | 18.00 | 0.217* | 7.32 |
| N | 537 | | 532 | |
| $R^2$ | 0.89 | | 0.88 | |

# Residuals




- No patterns in residuals, good fit.

# Time-structure of residuals




- Residuals positively correlated to 12-month's previous level of effort, after controlling for 12-month and 1-month autocorrelation.
- No other significant temporal pattern.

# Future Improvements

## Commercial Passenger Fishing Vessel.

- Additional Data
  - CA Department Fish & Game Saltwater Registration Numbers
  - More Pricing Data
  - Better local CPUE data

# Conclusion

- Income Elasticity ~0.8; Mexico more responsive.
- Price elasticity~-1.5; Mexico more responsive.
- Positively correlated to U.S. albacore troll fishery CPUE.
- Saltwater Sportfishing is strongly impacted by general macroeconomic trends.
- Studies that neglect to account for these forces may be biased and have sub-optimal policy implications
- Heterogeneity of effects by region
- Future work will utilize additional data and your helpful comments.

# Thank you!

- Hill and Schneider (1999)
- Fisherman's Landing and H&M
- California Dept. Fish & Game