The Geographic Distribution of Commercial Fishing: Locational Fundamentals versus Increasing Returns

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Introduction

Economic geography studies the distribution of economic activity across space. In this paper we examine the distribution of commercial fishing activity across a region in light of two competing theories: locational fundamentals and increasing returns.

1. Locational Fundamentals: distribution of activity is determined by natural endowments unique to each region. Theory implies a stable equilibrium in the distribution of activity and the size of specific locations is robust to large shocks.

2. Increasing returns (agglomeration): advantages of size may arise from thick input markets, proximity to output markets, labor market pooling, and knowledge spillovers. Theory implies increasing concentration of activity over time.

Commercial fishing is an industry strongly subject to forces consistent with both theories.

Locational fundamentals
A crucial input to commercial fishing is wild fish stocks, which are distributed more or less exogenously according to oceanographic, biological, and climatic factors.
In addition, relatively few places along a given coastline are suited to a fishing harbor. Ports with the best access to fishing grounds and the best natural harbors should host more of the coast-wide level of fishing activity.

Increasing returns
Commercial fishing involves specialized inputs to production (bait, ice, labor). The cost of providing these inputs would likely decline with higher density of fishing activity.
In addition, knowledge spillovers may be important as fishermen coordinate fishing activity and cooperate in locating mobile fish stocks. In this case, fishing activity would tend to move to larger ports over time, as vessels seek locations where the cost of doing business is lower.

In cases where locational fundamentals dominate, the distribution of activity will stay in a stable equilibrium over time and should be resistant to shocks. In cases where increasing returns dominate, the distribution of activity will tend to move to larger ports over time and we should observe non-stationarity in the time series as shocks will have permanent effects.

The distinction between these two types of growth processes has some implications for the incidence of fishery policy effects. If fishery management actions have the effect of reducing fishing capacity or the total allowable harvest, then the relative magnitude of impacts on different ports will differ depending on which growth process governs inter-port dynamics. If locational fundamentals dominate than the impact of regulations will be felt evenly across all ports, or at least proportionately. If increasing returns dominate, then impacts will be felt disproportionately in smaller ports as higher costs of doing business will likely induce exit or movement to larger ports.

Study Area

11 ports in central and northern California

Data

PacFIN – Pacific Fisheries Information Network: Pacific States Marine Fisheries Commission, California Department of Fish and Wildlife, NOAA National Marine Fisheries Service (pacfin.psmfc.org)

- Landings receipts submitted to CDFW by the first receiver of the catch
- 1981-2009
- Landings revenue aggregated across all fisheries at the port level

Test 1: Growth as a function of initial conditions (increasing returns)

The first test is similar to a test for beta-convergence in the economic development literature (e.g. Young et al. 2008). Tests for beta-convergence test whether the rate of economic growth is (negatively) correlated with the initial level of income in a cross-section of economies, i.e., whether poor countries have higher average growth rates than those of rich countries. In our study, we apply tests similar to regression-based beta-convergence tests (for one recent example see Fuwa 2011). We estimate an equation similar to:

$$\Delta ln(Revenue_i) = \alpha_i + \beta_0 ln(Revenue_{i0}) + \beta X_i$$

where $\Delta ln(Revenue_i)$ is the growth rate in landings revenue at port i over the time period of the analysis (1981-2009), ($Revenue_{i0}$) is initial landings revenue at port i and X_i is a set of other explanatory variables specific to port i. The sign and significance of the coefficient of the logarithm of initial revenue (β_0) provides the test. $\beta_0 > 0$ would be evidence that the distribution of fishing activity (measured by port-level landings revenue) is shifting towards larger ports, possibly because of agglomerative processes. $\beta_0 < 0$ would be evidence that the distribution of fishing activity is shifting towards smaller ports, possibly as a result of some dispersive process such as congestion effects. If $\beta_0 = 0$, then port size does not affect revenue growth and further testing may be needed to determine if the distribution of activity is stable over time.

Results of Test 1

	Estimated Coefficient (Standard Error)	p-value
$ln(Revenue_{i0})$	-.014 (.024)	0.572
Intercept	.203 (.371)	0.584

Test 2: Stable equilibrium

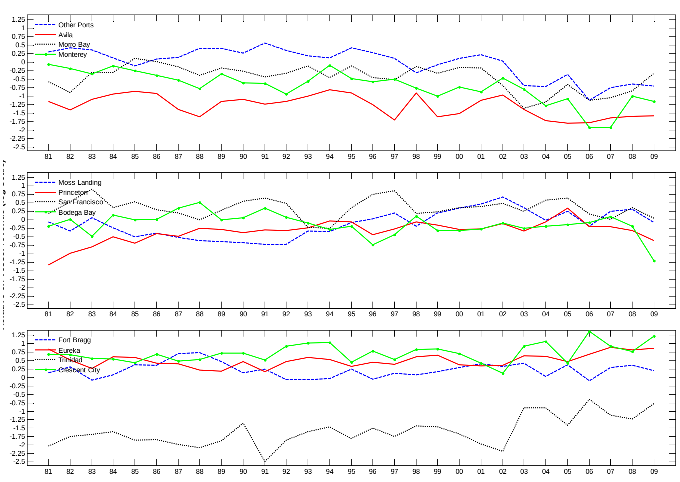
The second test assesses the degree to which the distribution of landings revenue is stable over time. We perform unit root tests to assess whether the time series describing the relative distribution of landings revenue is stationary over the 29 year time period of analysis. A non-stationary time series indicates that the distribution of landings revenue is not stable over time. In this case, shocks to commercial fishing industry would have permanent effects on the distribution of landings revenue, a result that would not be consistent with the locational fundamental theory. This approach is consistent with the conceptual framework in Gabaix and Ioannides (2004). Several previous studies have applied unit root tests to time series of city size distributions (e.g., Clark and Stabler 1991, Black and Henderson 2003, Bosker et al. 2008).

We use the DF-GLS test, a modified Dickey-Fuller test that transforms the data using generalized least squares (DF-GLS) proposed by Elliott, Rothenberg, and Stock (1996). For the DF-GLS test, the null hypothesis is that a unit root exists. Our test follows the basic form of Dickey-Fuller type unit root test (after the GLS transformation mentioned above):

$$(2) \qquad \Delta y_t = \mu + \alpha y_{t-1} + \Sigma_{j=1}{}^{k}(\beta \Delta y_{t-j}) + e_t$$

Where t indicates the time period, Δy_t is the first difference of the time series of interest, and et is a random error term. The terms μ, α, and β are estimated parameters in the regression equation, with the significance of α forming the basis of the test. If $\alpha = 0$, then shocks to the time series are permanent and the time series has a unit root. In our context, it indicates that the distribution of landings revenue is not resilient to shocks and is likely not determined by locational fundamentals. We perform the test of on the log of the ratio of port-specific revenue to average revenue (i.e., $y_t = ln\{revenue_p/average\ revenue\}$). Note that the unit root test is performed on the time series of each of the 11 ports. Panel unit root tests that combine information from all ports are possible and we will use them in future research.

Relative revenue $y_t = ln\{revenue_p/average\ revenue\}$



Results of Test 2

Port	*DF-GLS*	*Critical Value*	*Lags*
Avila	-2.722*	-3.098	1
Morro Bay	-2.328*	-3.098	1
Monterey	-2.945*	-3.098	1
Moss Landing	-3.952	-2.482	8
Princeton	-1.459*	-3.098	1
San Francisco	-4.531	-3.098	1
Bodega Bay	-2.761*	-3.098	1
Fort Bragg	-1.821*	-3.098	1
Eureka	-1.803*	-3.098	1
Trinidad	-3.163	-3.098	1
Crescent City	-3.198	-3.098	1

*Indicates evidence of non-stationarity. The null hypothesis for the DF-GLS test is that a unit root exists. Failure to exceed the critical value is evidence of non-stationarity. Critical Values for the DF-GLS test are dependent on the lag order of the regression. Critical values at the 10 percent level of significance are used here.

Conclusion

The results of our two tests of the locational fundamentals versus increasing returns theories are somewhat conflicting. The first test indicates that port revenue growth is not a function of initial conditions. This result is evidence that stable locational fundamentals, such as access to particular fishing grounds or high quality harbors, are more important the increasing returns in determining the location of fishing activity. The second test, however, shows that landings revenue at 7 out of 11 ports show evidence of a unit root process, which indicates that location is affected by shocks. This can be interpreted as evidence in support of the increasing return theory. Future work will incorporate longer time series and panel unit root tests to improve these tests.

References and Related Literature

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