THE FISHERY AS AN ECONOMIC BASE INDUSTRY AFTER THE NEWFOUNDLAND COD MORATORIUM[a]

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ABSTRACT

In a 2009 paper in *Land Economics*, Roy, Arnason and Schrank used a newly developed methodology based on cointegration analysis to establish and measure the role of the fishing industry as an economic base industry (and the only such base industry) for the Canadian province of Newfoundland over the period 1961-1994. Since that period, the groundfish harvesting sector has collapsed, although it has been replaced by a crustacean fishery that provides similar value added but is considerably less labor-intensive. At the same time, valuable petroleum deposits have been developed offshore which have resulted in considerable consequent economic activity, perhaps to the extent of establishing a new economic base industry. This study is based on the same methodology as in Roy, Arnason and Schrank, but documents the impact of both the major structural shifts within the fishing industry and the development of competing economic base sectors in petroleum extraction and its derivatives.

INTRODUCTION

The concept of an economic base has a long history, possibly originating with the mercantilist thought of the seventeenth century [1]. It is rooted in the notion that certain industries are fundamentally important to the economy as a whole in a way that other industries are not. The idea has been an important concept in certain streams of economic history and in regional and development economics [2,3].

The idea is intuitively attractive. Unfortunately, it is not particularly well formed. The relevant literature is not clear on the factors that make a base industry *basic*. Usually, the idea of a multiplier is involved [1]; however, all industries have a multiplier unless they are totally import-sourced. Basic industries are often conceptualized as having a multiplier that is particularly large. The mechanisms by which this multiplier is formed are rarely made explicit.

A few years ago, Ragnar Arnarson, Bill Schrank, and I addressed these issues in a paper that was delivered to the IIFET biennial conference in Portsmouth [4], and developed into a subsequent paper in *Land Economics* [5]. The paper extended our theoretical understanding of how an economic base industry could impact the broader economy. It also developed a statistical method for determining which industries are base industries, and for measuring their impact on the broader economy. This method was applied to the fishing industry in the province of Newfoundland in Canada, and the hypothesis that the fishery constituted an economic base industry in this province was accepted.

This paper is an update to the empirical study, using a more recent data series. The earlier study was based on data that ended in 1994 because of statistical redefinitions that were implemented subsequently. Since then, the economy of Newfoundland has experienced significant changes. The groundfish harvesting sector that was the core of the fishing industry has collapsed, although it has been replaced by a crustacean fishery that provides similar value added but is considerably less labour-intensive. At the same time, valuable petroleum deposits have been developed offshore which have resulted in considerable consequent economic activity, perhaps to the extent of establishing a new economic base. The motivation for this paper is to determine to what extent the statistical method developed in the previous paper reflects these changes.

BASIC THESIS

Historically, the fishery has been the mainstay of the Newfoundland economy. The first occupational census, collected in 1857, reveals that in that year fully ninety percent of the male labour force was engaged in the catching and curing of fish. Inevitably, this ratio declined as economic development proceeded, but was still quite substantial at the time of Confederation with Canada. Since then, however, census figures show a precipitous decline in the importance of the fishery in providing employment to the local labour force up to 1961 (after which the proportion appears to have stabilized). The census data suggest that only about five percent of the labour force in recent times make a living as fishers. Similarly, the value of fish landings presently accounts for about 3 percent of the gross domestic product of the Newfoundland economy.

This statistical story is sometimes used to justify the assertion that the fishery has not in recent times constituted an important part of the Newfoundland economy. There have nevertheless been suggestions that the fishery acts as an economic base industry, contributing both backward and forward linkages to other industries that would otherwise not exist; its importance to the economy would then be greater than its relative size would suggest.

One possible way to test whether a fishery is a base industry is to determine whether, even after accounting for the flow of productive resources from the primary factors of production (labor and capital) to the GDP, including those factors of production utilized in the fishing industry, the level of overall activity in the fishery continues to impact on the level of GDP.

This is the approach that we adopt. Since the relationship between an economic base and general activity is a long-run one, cointegration analysis is appropriate to this task. If a cointegrating vector relating the appropriate variables exists, then the hypothesis that the fishery is a base industry cannot be rejected. In that case, according to the Granger representation theorem [6], an error-correction model of the economy of Newfoundland and Labrador should be able to represent the overall dynamic relationship between GDP, primary factors of production, and the fishery.

A stable relationship between production and the utilization of primary factors of production, usually labor and capital, has been a standard feature of empirical macroeconomics since the pioneering work of Paul Douglas [7]. Generally, an aggregate production relationship can be represented in the form $Y_t = A_t + \alpha L_t + \beta K_t$, where output, labor and capital are expressed in logarithms and represented by the variables Y, L, and K respectively, and A_t represents exogenous factors such as the level of technology.

Our basic assumption is that if a particular activity acts as an economic base, it must positively affect this relationship, which would then be written as

$$Y_t = [A'_t + \theta F_t] + \alpha L_t + \beta K_t, \qquad \text{(Eq. 1)}$$

where F_t is a measure of the size of the basic activity (which we take to be the sole basic activity). The base industry contributes value added to the gross domestic product of the economy through its inputs of the primary factors of production that are employed in the industry; the size of the base-industry multiplier is reflected in the parameter θ, which measures the contribution of the base industry to GDP over and above its contribution to value added.

Our objective is to test for the existence of a long-run relationship between the GDP of a region, the inputs of the primary factors labor and capital in the region, and the output of the economic base — here the fishery. One way to do this is through the definition of a vector autoregressive (VAR) model incorporating these variables. The specifics of this model are documented in [5] and are not repeated here.

In that paper, we established that even after allowing for the effects of primary factors of production such as labour and capital, the fishing industry contributed significantly to the growth of the economy. While the output elasticity that can be ascribed to this effect, at about 0.09, is not large, it is nonetheless impressive in comparison to the relative size of the value of fish landings in the economy (and would imply an output multiplier around 3). The result suggests that the fishing industry in Newfoundland has an importance greater than is indicated by its relative share of employment or production.

MOTIVATION

This conclusion was based on time series that spans the period 1961–1994. Unfortunately, the Canadian economic accounts were redefined beginning in 1995 in order to harmonize economic statistics with Canada's NAFTA partners. Since a statistical break can mimic a unit root, we decided not to incorporate the redefined data into the analysis at that time.

However, the Newfoundland economy has experienced significant changes since this period [8]. Two of these changes deserve particular mention. First, in 1992 a moratorium was imposed on the large Northern Cod fishery, and it remains closed to this day. Subsequently, several other groundfish stocks were closed to fishing for various periods of time. Groundfish catches declined from 270,000 metric tonnes in 1991 to 22,000 metric tonnes (mainly of low value species such as redfish and skate) four years later. Recovery has since been limited, and by 2010 less than 40,000 metric tonnes of groundfish were being harvested. In some ways, an expanding crustacean (mainly crab and shrimp) fishery has made up for this decline. However, these fisheries are more narrowly focused and less labour intensive; they do not have the employment impact of the earlier cod fishery. While these fisheries may be locally important, they do not insinuate themselves into the broader economy in the way that the cod fisheries did.

The second change of note was the beginning of offshore oil extraction in 1997. The production of oil and natural gas now amounts to 28 percent of the province's gross domestic product. This economic development *has* insinuated itself into the broader economy, to the extent that oil and gas may have established itself as an economic base industry, along with (or even instead of) the fishing industry.

These developments lead naturally to the following questions: is the fishing industry any longer a base industry; and has oil extraction joined or supplanted fishing as a base industry. It is these two questions on which the current paper attempts to shed some light.

This study is based on the same methodology as in [4,5], but uses more recently developed time series. We have been able to gather statistically consistent times series addressing these questions for the period 1981–2010. Series for gross domestic product, employment, and capital stock, along with appropriate price deflators, were obtained from Statistics Canada (Provincial Economic Accounts, Labour Force Survey, and Fixed Capital Flows and Stocks respectively). Fisheries production is based on value of landings as reported in Canadian Fisheries Annual Statistical Review, deflated by a Divisia price index constructed by the author based on the implicit species prices derived from the landings data.

THE FISHING INDUSTRY AS AN ECONOMIC BASE

In [4,5], we estimated a vector autoregression among the four variables over the period 1961–94 that tested down cleanly into two cointegrating relationships. One of these can be interpreted as an expansion path relationship connecting labour and capital. The other was a relationship among all four variables as in (Eq. 1) above, the parameter θ reflecting the economic-base impact of the fishing industry on the broader economy.

We were unable to replicate this result over the period 1981–2010. In the first place, the specification of the underlying vector autoregression did not proceed as consistently as before – itself a yellow flag indicating the possibility of model misspecification. Secondly, we were able to isolate one cointegrating relationship at most (depending on the specification), and this relationship was usually difficult to interpret. The best estimate is presented in Table I, along with the estimate of (Eq. 1) generated by the old series in [4,5].[b] While the estimate of the economic base parameter θ is similar in the two cases, estimates of the production parameters α and β are now much higher (and implausibly so) with the newer series.

Table I: Estimate of the Economic Base Relationship

$$Y_t = [A'_t + \theta F_t] + \alpha L_t + \beta K$$

	Old Series	New Series
θ	0.088	0.073
α	0.612	3.04
β	0.204	1.62

More importantly, while a likelihood-ratio test of the null hypothesis that $\theta = 0$ (no economic-base effect for the fishing industry) was strongly rejected over the original period, we can now accept that hypothesis at any reasonable significance level (see Table II; the test with the new series is based on the specification that is least favourable to the null hypothesis).

Table II: Test H_0: θ = 0

	Old Series	New Series
χ^2	9.203	0.188
p-value	0.002	0.665
Decision	Reject	Accept

In conclusion, while there is clear evidence of an independent effect of the fishing industry over the broader economy that can be interpreted as an economic-base effect over the period 1961–94, a similar effect cannot be established over the period 1981–2010, most of which coincides with the northern cod moratorium.

OIL PRODUCTION AS ECONOMIC BASE

If the fishing industry is no longer an economic base for the Newfoundland economy, one may speculate if it has been replaced in this role by some other industry. Given the growing importance of offshore oil production to the Newfoundland economy, this industry would be an obvious candidate. To test this hypothesis, we reestimated the model in [4,5] with data from the period 1981–2010, but with oil production replacing the logarithmic output of the fishing industry.[c]

The results were quite similar to the model estimated in [4,5]. Two cointegrating relationships were found: one which could be interpreted as an expansion-path relationship, and the other a production relationship as in (Eq. 1), with oil production acting as the output of the base industry F_t. The actual estimates were:

$$L_t = 7.10 + 0.50K_t \qquad \text{(Eq. 2)}$$

for the expansion path, and

$$Y_t = [-16.03 + 0.23F_t] + 1.47L_t + 0.74K_t \qquad \text{(Eq. 3)}$$

for the production relationship, where F_t is measured in barrels of oil. The elasticity of the economic base effect is approximately 0.2 at the mean value over the production period. A test of the null hypothesis of no economic base effect is decisively rejected with a *p*-value of 0.0004 ($\chi^2 = 12.69$).

We have two specific concerns about these results. First, unlike the fishing industry, oil production generates a considerable amount of economic rent, both to the resource owner (the Crown) and probably to the operator as well. The θ parameter may reflect, at least in part, these economic rents. This should be factored out of the estimates in order to obtain a residual that can be ascribed to an economic-base effect. However, while calculating the rent accruing to the Crown might be reasonably straightforward, estimating the amount left with the operators would be challenging.

The second concern relates to the production parameters attached to the primary factors of production, which are rather high, particularly with respect to labour. While this clearly warrants further investigation, we can speculate that these high values may be due to changes in the quality of the labour force (and to a lesser extent that of physical capital) over this period. Since labour input is measured as employed persons, with no adjustment for labour quality, the tremendous increase in the education and skills of the labour force that took place over this period would cause the labour coefficient to be biased upward.

How important this may be to the broader analysis is not clear. But it does raise a more general question as to whether this kind of model can be applied to an economy that is experiencing transformative change. While the literature on modeling structural breaks in a cointegration framework is voluminous (see [9] for a survey), this literature is mainly confined to single-equation models, and largely to structural breaks in a deterministic dummy rather than to the cointegrating vector itself. If the parameters (with respect to either the primary factors or the economic base industries) are shifting over time, as is likely the case here, an alternative approach is needed. Recently, [10] has proposed a time varying cointegration model through expansions of Chebyshev polynomials, which could be applied to this situation.

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ENDNOTES

[a] Financial assistance from the Vice-President (Research) and the Faculty of Arts at Memorial University of Newfoundland, and from the Social Sciences and Humanities Research Council of Canada, is gratefully acknowledged.

[b] The underlying VAR has two lags in levels with a deterministic trend with the old series, but only one lag in levels and no deterministic trend with the new series.

[c] Data for oil production in barrels was obtained from the Canada-Newfoundland and Labrador Offshore Petroleum Board. Because production did not begin until 1997, we did not use logarithms for this data series.