ESTIMATION OF INCOME AND EMPLOYMENT MULTIPLIERS FOR MARINE-RELATED ACTIVITY IN THE SOUTHERN NEW ENGLAND MARINE REGION

Thomas A. Grigalunas and Craig A. Ascari

ABSTRACT

This paper summarizes some results of a Sea Grant-funded economic input-output study of marine-related activity in the Southern New England Marine Region. Data were obtained from 390 personal interviews; in addition, a wealth of secondary data was used. Type I and Type II income and employment multipliers were estimated for each of the nineteen marine-related industries included in the model. The results provide a basis to assist analysts concerned with assessing the impacts on regional income and employment of marine-related policies or developments proposed for the Region.

INTRODUCTION

Those who are concerned with marine policy often are interested in evaluating the primary and secondary economic effects resulting from proposed, ocean-related developments and policies. Fisheries management, offshore oil and gas development, marine military spending and tourism and recreation are only a few of the areas where decision makers frequently are called upon to evaluate the regional economic implications of policies or to compare alternative proposed developments.

There are a number of economic models that can be used to assess secondary effects.[1] Economic input-output models, however, have some special attributes that make them particularly useful for the purposes of regional analysis. One principal advantage input-output models have over other models is the detailed treatment of regional industries. Thus, while most aggregate regional economic models result in a single multiplier to be applied to all changes in economic activity, input-output models provide an estimate of a multiplier for each industry. This is an important consideration since industries differ considerably both with respect to the share of payments to regional households and industries and in the portion of payments that leak outside the region in the form of imports of goods and services.

The purpose of this paper is to present a summary of some findings of an input-output study of marine-oriented economic activity in the Southern New England Marine Region (SNEMR). Following a description of the study area, the application of the input-output approach to marine-oriented activity in the SNEMR is summarized. The income and employment multipliers are presented, and a comparison is made with other studies. The final section contains a summary and concluding comments.

THE SOUTHERN NEW ENGLAND MARINE REGION

The SNEMR includes all of Rhode Island, New London County in Connecticut, Cape Cod and the Islands, Bristol County, and a portion of Plymouth County in Massachusetts (see map). The region covers 3,178 square miles and has a coastline of some 960 miles.

The region considered in this paper is identical to that defined in a 1967 study (Rorholm, et al.). In that study, delineation of the SNEMR was based on the following general rationale:

> It is almost a self-contained labor market, it orients significantly toward its own central cities in wholesale and retail trade and its coastal waters south and west of Cape Cod differ in biological and physical characteristics from those to the northeast and to the west of the region.

Since the earlier study was published, considerable residential and economic development has taken place in sections of the region, particularly in Cape Cod and southern Massachusetts, and a vastly expanded highway system has been installed. For these reasons, the regional labor market is probably less self-contained than in 1967. Nonetheless, for purposes of consistency, the SNEMR covered in this study includes the same geographic area as in the 1967 study.

The population of the SNEMR was 1,876,275 in 1976, a 13 percent increase over the 1965 population of 1,654,652 (Grigalunas, Rorholm). Average employment in the region amounted to 672,282 in 1976 compared with 526,057 in 1965 (Grigalunas, Rorholm). Estimated total personal income in 1976 was $11.71 billion, a 39 percent increase over the estimated 1965 regional personal income of $8.25 billion (in 1976 dollars).

APPLICATION OF INPUT-OUTPUT APPROACH TO SNEMR

Brief Description of the Input-Output Framework

Input-output or inter-industry models have been widely used (see, e.g., Chenery and Clark,

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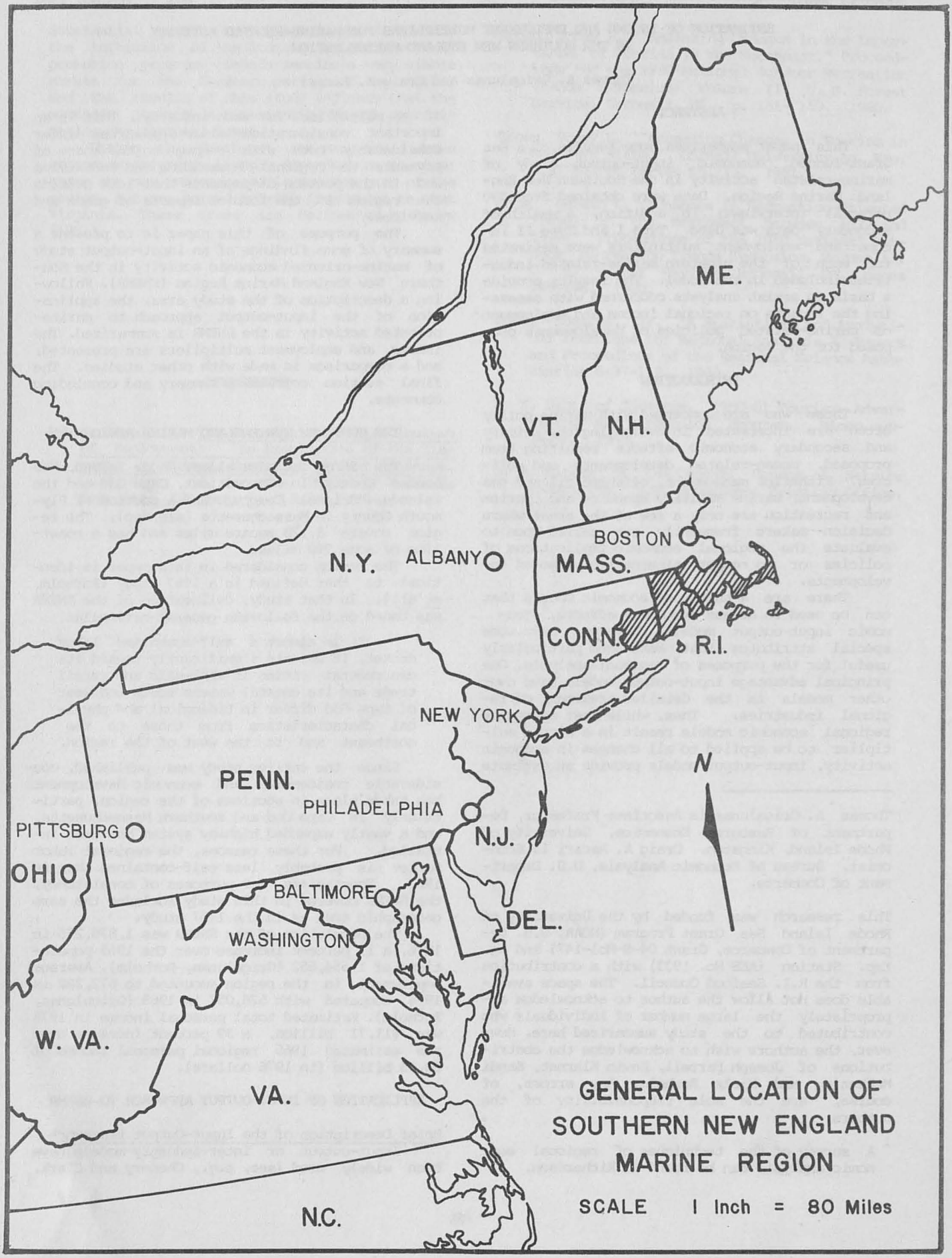
[1] A survey of the techniques of regional economic analysis can be found in Richardson.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GENERAL LOCATION OF
SOUTHERN NEW ENGLAND
MARINE REGION
SCALE 1 Inch = 80 Miles

Leontief, Miernyk (1965), and Richardson, and it is not necessary to provide here a detailed presentation of the characteristics, assumptions and limitations of the model. Essentially, input-output analysis is a simplified theory of production for estimating the quantitative interdependence among the economic activities in a region. The interdependence among industries is represented by a set of linear equations whose coefficients reflect the structural characteristics of the regional economy. The solution of the set of equations yields a matrix, each element of which indicates the direct, indirect and induced changes in the output of industry i as a result of a change in the final demand for industry j.

In matrix notation the solution of the basic input-output model can be expressed as follows:

$$X = (I-A)^{-1}Y$$

where A = an n x n matrix of technical coefficients,
I = an n x n identity matrix,
Y = a vector of final demand,
X = a vector of total output necessary to support the final demand Y, and
$(I-A)^{-1}$ = an n x n matrix of interdependency coefficients.

Model Industries and Data Sources

The SNEMR input-output model includes nineteen marine-oriented industries which cover six general categories of marine-related activity: commercial fishing, marine recreation and tourism, marine manufacturing, marine military, marine research and education, and miscellaneous marine activity (Table 1).[2]

In addition to the above-mentioned industries, households and local government are considered endogenous to the model. Five final demand and five payments sectors are included as exogenous components of the model. The final demand sector includes state and federal government, exports (New England and Rest of World), and investment.

Primary data based on personal interviews with approximately 390 establishments, as well as secondary data obtained from relevant surveys of marine businesses, were used in the analysis.[3] Additionally, supplemental employment and output data were required for 1976 for certain industries.

Employment data for the fish-harvesting industries were obtained from unpublished National Marine Fisheries Service reports. Data on employment and budgetary expenditures for local governments were obtained from individual town reports. Due to the unavailability of regional data for marine insurance and finance establishments, it was necessary to use national data in estimating the direct employment coefficient for this industry. Sources for this information were the U.S. Department of Commerce and U.S. Department of the Treasury.

With the exception of industry 20 (Other Economic Activity), primary and secondary data were used directly in estimating employment interactions and multipliers for all industries of the model. Employment for industry 20 was obtained by subtracting total employment[4] for all industries in the SNEMR.

All employment data were converted to full-time equivalents and expressed in man-years. With the exception of local government, marine research and education, and marine military, output was reported as sales for all industries. For these industries output was reflected by total budgetary expenditures.

In 1976 the marine-oriented industries included in this study had a gross output of approximately 4 billion dollars, of which 1.2 bil-

Table 1
Marine-Oriented Industries
Southern New England Marine Region, 1976

- Fishing Industry
  - Commercial Fishing - Finfish
  - Commercial Fishing - Lobster
  - Commercial Fishing - Mollusk
  - Fish Processing
  - Seafood Wholesale & Retail
- Marine Recreation and Tourism
  - Eating & Drinking Establishments
  - Hotels and Motels
  - Other Marine Wholesale and Retail
  - Marinas and Boatyards
  - Amusements
  - Charter Fishing
- Marine Manufacturing
  - Ship and Boat Building
  - Other Marine Manufacturing
- Marine Military
- Marine Research & Education
- Other Marine Industries
  - Marine Construction
  - Water Transportation
  - Marine Finance & Insurance
  - Other Marine Activity

[2] It is recognized that some overlapping exists among industries in Table 1. Water transportation, for example, includes ferries that could be grouped under tourism and recreation.

[3] Establishments are defined as individual facilities or places of business. A firm, on the other hand, may include one or more establishments which may produce different products or services. Where possible during our interviews, information was obtained at the establishment level.

[4] Total employment for all industries in the SNEMR was determined through the analysis of employment data obtained from the following sources: State of Rhode Island and Providence Plantations, Department of Employment Security; State of Connecticut, Employment Security Division; Commonwealth of Massachusetts, Division of Employment Security.

lion dollars went to personal income. In terms of gross output, Ship and Boat Building was the largest industry with sales of 665.95 million dollars. Marine Construction was the smallest, with sales of 5.25 million dollars. With respect to employment, Ship and Boat Building was again the largest industry with full-time equivalent employment of 25,037. Marine Construction was the smallest, with full-time equivalent employment of 142. Total full-time equivalent employment for all marine-oriented industries in the SNEMR in 1976 was 65,352.

Results[5]

-- Income Multiplier -- The income multiplier measures the change in income in a given industry in response to a change in final demand. Income interactions and multipliers for the SNEMR are presented in Table 2. Direct income effects are shown in column 1, Table 2. These effects represent the direct change in payments to households resulting from a change in final demand for the output of each endogenous industry. They were derived from the households row of the direct purchases matrix. For illustrative purposes, let us assume that there is a million dollar change in the demand for charter fishing. As indicated below, the direct effect is a $366,100 change in income payments to households originating in that industry.

The direct and indirect income effects are shown in column 2, Table 2. These were computed by multiplying each column entry in the inverse matrix (households exogenous) by the corresponding households coefficient from the direct purchases matrix, and summing the products of the multiplication. For example, the direct and indirect income effects of a million dollar change in final demand for charter fishing is $567,200 (= .5672 x $1 million).

Indirect income effects, shown in column 3, Table 2, were obtained by subtracting the direct income effects from the direct plus indirect effects. These represent the changes in income in all industries which supply the primary impact industry.

The Type I income multiplier (column 4, Table 2) measures the direct and indirect income effects per dollar direct income change in each endogenous industry. It was derived by computing the ratio of direct and indirect income effects to direct income effects. Each entry shows the total income change within the region associated with a dollar direct income change in the corresponding industry listed at the left. For example, assume a change in final demand for charter fishing sufficient to cause an income change of one million dollars in that industry. The direct and indirect income effects of this change will result in a change in total regional income of $1.55 million.

The direct, indirect, and induced income effects are shown in column 5, Table 2. These effects represent the total change in income within the region in response to a change in final demand for the output of each endogenous industry. For example, a million dollar change in the demand for charter fishing will lead to a $798,200 change in total regional income. These effects were derived by considering households endogenous to the model. The interdependency coefficients in the households row of the augmented inverse matrix represent the direct, indirect and induced income effects. Induced income effects, shown in column 6, Table 2, represent changes that result when consumers, in response to changes in income, adjust their consumption patterns accordingly.

The Type II income multiplier (column 7, Table 2) measures the direct, indirect, and induced income effects per dollar direct income change in each endogenous industry. It was derived by computing the ratio of direct, indirect, and induced income effects to direct income effects. The interpretation of the Type II income multipliers is analogous to that of the Type I.

The Type I multipliers range from 6.10 to 1.07. The Type II multipliers range from 8.60 to 1.51. Of particular interest are the multipliers for the seafood wholesale and retail and fish processing industries. Both the Type I and Type II multipliers for these industries rank 1 and 2, respectively, and are significantly larger than those for the rest of the industries within the region. The large Type I and II multipliers for the seafood wholesale and retail and fish processing industries reflect two factors. First, these industries have a high proportion of purchases within the region, especially from the three fish harvesting industries, which have a high proportion of payments to regional households as personal income. Secondly, it can be seen from the small direct income effects that these two industries are particularly capital-intensive. Thus, a very large increase in final demand would be necessary to engender a one unit change in income for either seafood wholesale and retail or fish processing.

The Type II income multipliers are significantly larger than the Type I for each industry of the model due to the inclusion of the induced effects of household income and consumption. Clearly, failure to include the induced effects can considerably understate the potential impacts of changes in regional economic activity, especially for those industries in which the share of payments to households is substantial.

-- Employment Multiplier Estimation -- The employment multiplier measures the change in employment within the region per unit change in employment in a given industry in response to a change in final demand. Employment multipliers were estimated using employment-production functions of the form: $E_i = a + bX_i$; where E_i = full-time equivalent employment (in man years) in industry i, and X_i = gross output (in $ million) of industry i. Regression results are presented in Table 3 and the employment interactions and multipliers are shown in Table 4.

The alpha coefficient or employment intercept indicates the level of employment if production were to fall to zero. In seven cases the

[5] Because of space limitations the transactions matrix and the matrices of technical and interdependency coefficients are not presented here. Readers interested in further details are refered to Grigalunas (1978).

Table 2: Income Interactions and Multipliers, SNEMR, 1976

Sector	Direct Income Effect (1)	Direct & Indirect Income Effect (2)	Indirect Income Effect (3)	Type I Multi-plier (4)	Dir., Indir. & Induced Income Effect (5)	Induced Income Effect (6)	Type II Multi-plier (7)
1. Comm. Fishing -Finfish	.5720	.7466	.1746	1.31	1.0554	.3088	1.85
2. -Lobster	.5025	.6838	.1813	1.36	.9624	.2786	1.92
3 -Mollusk	.6687	.8125	.1438	1.22	1.1441	.3316	1.71
4. Fish Processing	.1302	.4986	.3684	3.83	.7027	.2041	5.40
5. Seafood, Whlsl. & Retail	.0905	.5520	.4615	6.10	.7781	.2261	8.60
6. Eating & Drinking Establishments	.3479	.5686	.2207	1.63	.7997	.2311	2.30
7. Motels & Hotels	.3923	.5739	.1811	1.46	.8044	.2305	2.05
8. Other Marine Whlsl. & Retail	.1674	.3350	.1676	2.00	.4714	.1364	2.82
9. Marinas & Boatyards	.3190	.5007	.1817	1.57	.7037	.2030	2.21
10. Amusements	.4408	.5957	.1549	1.35	.8380	.2423	1.90
11. Charter Fishing	.3661	.5672	.2011	1.55	.7982	.2310	2.18
12. Ship & Boatbuilding	.5291	.5677	.0386	1.07	.7992	.2315	1.51
13. Other Marine Manf.	.3462	.4676	.1214	1.35	.6581	.1905	1.90
14. Marine Military	.7642	.8267	.0625	1.08	1.1643	.3376	1.52
15. Marine Res. & Educ.	.7308	.7936	.0628	1.09	1.1176	.3240	1.53
16. Marine Construction	.4095	.5358	.1263	1.31	.7538	.2180	1.84
17. Water Transportation	.5350	.7256	.1906	1.36	1.0216	.2960	1.91
18. Marine Ins. & Finance	.4554	.5919	.1365	1.30	.8334	.2415	1.83
19. Other Marine Activity	.2135	.4798	.2663	2.25	.6749	.1951	3.16
20. Other Econ. Activity	.3683	.4654	.0971	1.26	.6545	.1891	1.78
21. Local Government	.3972	.6897	.2925	1.74	.9251	.2354	2.33

1. Derived from the households row of the technical coefficients matrix (Appendix B in Ascari, 1979).
2. Derived by multiplying each column entry in the inverse matrix (households exogenous; Appendix C in Ascari) by the corresponding household coefficient from the technical coefficients matrix and summing the product of the multiplication.
3. Column 2 minus column 1.
4. Column 2 divided by column 1.
5. Derived from the households row of the augmented inverse matrix (Appendix D in Ascari, 1979).
6. Column 5 minus column 2.
7. Column 5 divided by column 1.

intercept was statistically significant and positive. Miernyk has termed this phenomenon "overhead employment," yet notes that the interpretation should not be taken literally (Miernyk, 1967). It may be explained by the fact that when demand temporarily falls off, businesses will retain skilled labor in order to avoid the high transactions costs often incurred in recruiting new labor when demand for the firm's product increases.

The beta coefficient or slope of each function represents the direct employment effect. With two exceptions, all estimated coefficients were significant at the .05 level. The direct and indirect employment effects were obtained by multiplying each column entry in the inverse matrix (households exogenous) by the beta coefficient for each corresponding industry and summing the products of the multiplication. The direct, indirect, and induced employment effects were derived from the augmented inverse matrix in a manner analogous to that for determining the direct and indirect employment effects.

It is emphasized that when interpreting the Type I and Type II multipliers, a unit income (or employment) change reflects different final demand changes for each industry. For example, a million dollar direct income change in charter fishing would require a change in sales to final demand of $2.73 million, while a similar income change in marine military would require a change in sales to final demand of $1.31 million. The reciprocal of the household (or direct employment) coefficient represents the final demand change necessary to engender a unit change in income (or employment) for a given industry. An analyst attempting to assess the change in regional income or employment as a result of a change in the level of activity of a marine industry can use either of two approaches, depending on the availability of data. The Type I or II multiplier can be used, if information is available on the direct change in income or employment for the industry of interest. Alternately, the interdependency coefficients (column 5 in Tables 2 and 4) can be used to estimate the direct, indirect, and induced changes in regional income and employment, if information is available on the change in final demand for the industry. For decision-making purposes, a clear understanding of input-output multipliers is obviously necessary if they are to be interpreted correctly.

COMPARISON OF MULTIPLIERS WITH RELATED STUDIES

Income Multipliers.

The specialized nature of this study precludes any comprehensive comparison of multipliers with those derived in other studies. However, several studies of marine-oriented activities in New England have included some industries similar to those defined for the present study. Table 5 compares Type II income multipliers estimated in this study to those estimated for comparable industries in three related studies.

An earlier study of the Southern New England Marine Region (Rorholm et al., 1967) included several industries with characteristics similar to those included in the present study. With the exception of marine research and education, the multipliers estimated in the present study are somewhat larger than those estimated for comparable industries in the earlier study, though the differences are slight.

The income multipliers estimated by Callaghan and Comerford (1978) in their study of commercial fishing in Rhode Island are very comparable to those estimated for similar industries in this study. It is interesting to note that the income multipliers estimated for the fish processing industry in both studies are significantly larger than those for the other comparable industries. The multipliers estimated in this study are consistently larger than those estimated for comparable industries by Callaghan and Comerford.

The King and Storey (1974) study of economic activity on Cape Cod included several industries similar to those included in this study. The multipliers estimated in this study are again larger than those estimated for comparable industries by King and Storey.

Differences in magnitude between the income multipliers estimated in this study and those estimated in the above mentioned studies reflect the larger region considered in the present study. When defining the "size" of a region for purposes of regional analysis, activity mix rather than geographic area is the more important criterion. Generally, the more self-sufficient a region, the larger the income multipliers. A self-sufficient region will import fewer goods and services and thereby have fewer leakages of income from the area. On this basis, one would therefore expect the SNEMR multipliers to be greater than those of Callaghan and Comerford and King and Storey. One would also expect the 1976 SNEMR multipliers to be greater than the 1965 SNEMR multipliers due to the greater regional activity mix in 1976 vis-a-vis 1965.

Employment Multipliers.

To the best knowledge of the authors, no input-output studies exist in which employment multipliers have been estimated for industries similar to those included in this study.

Though no comparison of employment multipliers with those estimated in related studies was possible, the reasonableness of the multipliers may be assessed by considering the income multipliers estimated in the study and the employment characteristics of the industries composing the model.

As stated earlier, the income multipliers estimated in this study are consistent with those estimated in related studies, thus reflecting the reasonableness of the interdependency coefficients estimated in the SNEMR model. Some insight into the employment characteristics of the industries composing the model is provided by the information presented in Table 6. The figures are consistent with what one would expect of these activities. The more labor-intensive industries, such as commercial fishing-finfish, hotels and motels, marine military, and marine research and education, have high employment-to-output ratios. Those industries within these bounds represent a spectrum of relatively labor-intensive and capital-intensive operations. Given that the em-

Table 3: Sectoral Employment-Production Functions, SNEMR, 1976

Sector	Number of Observations	Regression Equation*	R^2
1. Commercial Fishing-Finfish	9	E = 2.2783 + 17.3689X (2.6087)(1.5577)	.29
2. Commercial Fishing-Lobster	13	E = 1.2822 + 18.5810X (1.2495)(4.9399)	.69
3. Commercial Fishing-Mollusk	19	E = 2.4176 + 11.1767X (2.4617)(6.0115)	.68
4. Fish Processing	18	E = 28.3430 + 6.7558X (3.2674)(5.5289)	.66
5. Seafood Wholesale & Retail	50	E = 4.1389 + 4.7391X (2.3080)(10.2391)	.69
6. Eating & Drinking Establish.	7	E = 9.0067 + 17.2105X (1.1461)(1.8465)	.41
7. Hotels & Motels	5	E = -13.3438 + 51.0022X (-.4906)(5.7467)	.92
8. Other Marine Whlsl. & Ret'l	64	E = 2.4787 + 6.8697X (4.2629)(9.2917)	.58
9. Marinas & Boatyards	68	E = .4735 + 33.1190X (.5466)(18.7919)	.84
10. Amusements	7	E = -4.9706 + 36.0204X (-.4163)(8.1615)	.93
11. Charter Fishing	14	E = .1462 + 42.0490 (1.1047)(12.2439)	.93
12. Ship & Boat Building	22	E = 14.8937 + 21.5050X (2.8400)(19.1068)	.95
13. Other Marine Manufacturing	28	E = 1.6535 + 26.3735X (.3251)(6.8726)	.65
14. Marine Military	4	E = -1273.54 + 91.9251X (-1.7560)(11.5977)	.99
15. Marine Research & Educ.	11	E = -75.9164 + 60.7635X (-.4077)(4.2241)	.66
16. Marine Construction	6	E = 3.9271 + 22.5894X (.4211)(2.6929)	.64
17. Water Transportation	11	E = -16.1613 + 35.1624X (-.5980)(4.2355)	.67
18. Marine Insurance & Finance	n/a	n/a n/a	n/a
19. Other Marine Activity	5	E = -5.3121 + 27.4164X (-.8971)(8.5076)	.96
20. Other Economic Activity	n/a	n/a n/a	n/a
21. Local Government	94	E = -101.492 + 70.4397X (-3.7990)(37.0673)	.94

*E = full-time equivalent employment (in man years),
X = gross annual output (in millions of dollars).
T-statistics are in parentheses.

Table 4: Employment Interactions and Multipliers, SNEMR, 1976

Sector	Direct Employment Effect (1)	Direct & Indirect Employment Effect (2)	Indirect Employment Effect (3)	Type I Multiplier (4)	Dir., Indir. & Induced Employment Effect (5)	Induced Employment Effect (6)	Type II Multiplier (7)
1. Comm. Fishing -Finfish	.000017	.000029	.0000112	1.71	.000062	.000033	3.65
2. -Lobster	.000019	.000034	.000015	1.79	.000065	.000031	3.42
3 -Mollusk	.000011	.000020	.000009	1.82	.000057	.000037	5.18
4. Fish Processing	.000087	.000025	.000016	3.29	.000045	.000022	6.43
5. Seafood, Whlsl. & Retail	.000005	.000024	.000010	4.80	.000049	.000025	9.80
6. Eating & Drinking Establishments	.000017	.000034	.000017	2.00	.000060	.000026	3.53
7. Motels & Hotels	.000051	.000070	.000019	1.37	.000095	.000025	1.86
8. Other Marine Whlsl. & Ret'l	.000007	.000021	.000014	3.00	.000036	.000015	5.14
9. Marinas & Boatyards	.000033	.000048	.000015	1.45	.000070	.000022	2.12
10. Amusements	.000036	.000051	.000015	1.42	.000078	.000027	2.17
11. Charter Fishing	.000042	.000059	.000017	1.40	.000085	.000026	2.02
12. Ship & Boatbuilding	.000022	.000026	.000004	1.18	.000051	.000025	2.32
13. Other Marine Manf.	.000026	.000038	.000012	1.46	.000059	.000021	2.27
14. Marine Military	.000092	.000098	.000006	1.07	.000156	.000038	1.48
15. Marine Res. & Educ.	.000061	.000067	.000006	1.10	.000103	.000036	1.69
16. Marine Construction	.000023	.000033	.000010	1.43	.000057	.000024	2.48
17. Water Transportation	.000035	.000050	.000015	1.43	.000082	.000032	2.34
18. Marine Ins. & Finance	.000015*	.000025	.000010	1.67	.000052	.000027	3.47
19. Other Marine Activity	.000027	.000054	.000027	2.00	.000075	.000021	2.78
20. Other Econ. Activity	.000038*	.000049	.000011	1.29	.000070	.000021	1.84
21. Local Government	.000070	.000102	.000032	1.46	.000127	.000025	1.81

*Represents direct employment coefficient derived from computing the ratio of employment/output for the sector. Insufficient data precluded the estimation of employment-production functions for these sectors.

1. Each entry represents the beta coefficient of the estimated employment-production function for the corresponding sector.
2. Derived by multiplying each column entry in the inverse matrix (households exogenous; Appendix C in Ascari, 1979) by the corresponding direct employment coefficient and summing the products of the multiplication.
3. Column 2 minus column 1.
4. Column 2 divided by column 1.
5. Derived by multiplying each column entry in the inverse matrix (households endogenous; Appendix D in Ascari, 1979) by the corresponding direct employment coefficient and summing the products of the multiplication.
7. Column 5 divided by column 1.

Table 5: Comparison of Type II Income Multipliers: SNEMR 1976; SNEMR 1965; Rhode Island 1975; Cape Cod 1971

Sector	SNEMR 1976	SNEMR 1965[a]	RHODE ISLAND 1975[b]	CAPE COD 1971[c]
Commercial Fishing-Finfish	1.85		1.47	1.34
Commercial Fishing-Lobster	1.92	1.76[d]	1.45	n/a
Commercial Fishing-Mollusk	1.71		1.32	1.31
Fish Processing	5.40	4.15[e] 9.84[f]	3.87	n/a
Eating & Drinking Estab.	2.30	n/a	n/a	1.42
Hotels & Motels	2.05	n/a	n/a	1.43
Marinas & Boatyards	2.21	2.09	n/a	1.57
Charter Fishing	2.18	1.92	n/a	1.51
Marine Research & Education	1.53	1.63	n/a	1.30
Water Transportation	1.91	n/a	n/a	1.27
Ship & Boat Building	1.51	1.40	n/a	n/a
Marine Military	1.52	1.45	n/a	n/a

[a] Rorholm, et al., 1967
[b] Callaghan and Comerford, 1978
[c] King and Storey, 1974
[d] Includes all commercial fishing activity.
[e] Fresh fish processing.
[f] Frozen fish processing.

Table 6: Employment Per One Million Dollars of Output and Average Output Per Employee, SNEMR, 1976

Sector	Employment Per Million Dollars of Output	Average Output Per Employee
1. Commercial Fishing-Finfish	42.17	$ 23,417
2. Commercial Fishing-Lobster	24.37	41,034
3. Commercial Fishing-Mollusk	16.85	59,347
4. Fish Processing	13.03	76,746
5. Seafood Wholesale & Retail	8.11	123,305
6. Eating & Drinking Estab.	30.85	32,415
7. Hotels & Motels	45.75	21,858
8. Other Marine Whlsl. & Ret'l	12.18	82,102
9. Marinas & Boatyards	34.53	28,960
10. Amusements	32.93	30,367
11. Charter Fishing	48.39	20,665
12. Ship & Boat Building	28.48	35,112
13. Other Marine Manufacturing	29.04	34,435
14. Marine Military	72.96	13,706
15. Marine Research & Education	53.35	18,744
16. Marine Construction	27.05	36,969
17. Water Transportation	27.80	35,971
18. Marine Ins. & Finance	15.00*	66,667
19. Other Marine Activity	22.31	44,823
20. Other Economic Activity	38.31	26,103
21. Local Government	57.95	17,256

*Reflects national ratio.

ployment multipliers are a product of the interdependency coefficients and employment-output characteristics of the industries composing the model, one may, therefore, place confidence in the reasonableness of the employment multipliers estimated in the present study.

It may be interesting to look at those industries whose growth would have the greatest impact on regional income and employment. Growth in marine military, marine research and education, water transportation and the three fish-harvesting industries would have the greatest impact on regional income as indicated by the interdependency coefficients (Column 5, Table 2). This is due to the high proportion of payments to households by these industries as evidenced by the large direct income coefficients (Table 2) and the interactions these industries have with other economic activities in the Region. Growth in marine military, marine research and education, and hotels and motels would have the greatest impact on regional employment as indicated by their direct, indirect, and induced employment effects (Table 4).

SUMMARY AND CONCLUSIONS

Policy decisions relating to commercial fishing, marine military activity, defense related shipbuilding, tourism and recreation and other uses of the ocean will affect regional output, income and employment. Those individuals concerned with marine policy often want to understand the primary and secondary regional effects of proposed ocean-related policies and developments. There are a number of economic models that can be used for regional impact analysis, and each has its strengths and weaknesses with respect to data requirements, level of industry aggregation and usefulness. An important advantage input-output economic models have over other regional models is the disaggregated treatment of industries.

This paper has presented some results of an input-output study of marine-related activity in the Southern New England Marine Region. Data for the study were obtained from 390 personal interviews; in addition a wealth of secondary data was used. Type I and Type II income and employment multipliers were estimated for each of the nineteen marine-related sectors included in the model.

The results provide a basis to assist analysts concerned with assessing the regional impacts of marine-related policies or developments proposed for the SNEMR. Hypothesized changes in final demand for an industry can be converted, via the industry multipliers, into estimates of the primary and secondary impacts on regional income and employment. The information on regional effects can be used in conjunction with other information, for example, information on environmental and fiscal effects or national economic effects, to compare alternative proposed developments and policies.

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