European Research Studies Journal
Volume XXV, Issue 4, 2022

pp. 351-363

Economic Importance of Marinas on the Polish Baltic Sea Coast

Submitted 14/11/22, 1st revision 29/11/22, 2nd revision 17/12/22, accepted 30/12/22

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Abstract:

Purpose: *This paper identifies the economic importance of the Polish Baltic Sea coast marinas. The investigated marinas are among the most prominent port structures and represent each section of the sea coast. In determining the economic impact of marinas, three effects were identified, i.e., direct, indirect and induced. These effects are discussed in terms of output, added value and employment.*

Design/Methodology/Approach: *The economic importance of marinas was determined using an input-output method, often referred to as the Leontief model. The extent of the economic impact of the port was referred to the coastal sub-regions, i.e., Koszaliński, Słupski and Gdański, which are NUTS 3 territorial units. The regionalisation of the national input-output table was carried out using the Flegg location coefficient (FLQ). A comparative analysis was carried out, taking marinas in Spain and Italy as the object of comparison. The research was based on local statistics and survey results.*

Findings: *The strength of the impact of the studied marinas is less than their initial economic impetus. The direct and induced effect had the most significant impact on the economy of the sub-regions, with the indirect effect being of minor importance. The greater strength of the impact of the Valencia Region's marinas may result from the input-output table regionalisation technique adopted and the greater self-sufficiency of port cities in Spain. The dominance of the direct effect should be linked to the extensive network of links created by nautical tourism. The minor importance of the indirect effect is due to the limited inter-sectoral linkages. On the other hand, the lower significance of the induced effect in the case of Polish marinas is related to the lower level of development of the national economy and the failure to include investment expenditures in the model.*

Practical Implications: *The results of the study provide information for decision-makers on the economic importance of marinas. They allow investment funds to be concentrated on areas with the most significant impact on the local economy.*

Originality/Value: *The authors of this article were the first in the country to address the economic importance of marinas using the input-output method.*

Keywords: *Yacht marinas, boating, input-output model, Leontief model, local economy.*

JEL codes: *Z32, C67, D57, R15,* ***R58.***
Paper Type: *Research article.*

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1. Introduction

There are a dozen or so small seaports on the Polish coast of the Baltic Sea. These are multifunctional economic structures in which fishing, transhipment, passenger and sailing activities are carried out. Recently, there has been a decline in fishing activity. To compensate for the lost revenue, port operators have started investing in alternative activity areas.

However, the choice of direction was dictated more by the availability of funds than by economic analysis. One of the intensively developed areas of activity enjoying increasing popularity was sailing (Heflich, 2011; Jugović *et al.*, 2012; Łapko, 2015). The expansion of the sailing infrastructure that has taken place over the past several years is unprecedented in the post-war history of small seaports (Nowaczyk, 2019). However, decision-makers are increasingly asking themselves questions about the economic effects of the investments made (Danielis *et al.*, 2013; Dooms *et al.*, 2015).

Hence, the main objective of this article is to determine the economic importance of marinas located in the largest of the small seaports, i.e., in Kołobrzeg, Darłowo, Ustka, Łeba and Hel. To achieve the objective required using the input-output method, which allows for a comprehensive evaluation of the economic object, distinguishing direct, indirect and induced effects. The authors of this article have shown the initial importance of yacht marinas, determined the strength of their economic impact and explained the relationship between economic effects.

There is a lack of studies in the national literature showing the economic aspect of yacht marinas. But also, in the foreign literature, the issue addressed is poorly studied (Report, 2015; CE, 2016; Gerke *et al.*, 2018). Most input-output studies focus on large seaports and transhipment activities (Coto-Millán *et al.*, 2010; Danielis, 2011; Merk *et al.*, 2013; Bottasso *et al.*, 2014; Santos *et al.*, 2018).

The few researchers who used the input-output method to determine the economic importance of yacht marinas were Fernández Guerrero, Martí Selva and Puertas Medina. In their article 'Economic impact of Western Mediterranean leisure ports', they showed the effects of yacht marinas on port cities and regions. The similarity of the issues raised was the rationale for using the above article in a comparative analysis.

The most challenging task in the input-output method is regionalising the national input-output table. The use of different techniques by the authors distorts the final results. In the present article, the regionalisation of the national table is done based on Flegg's location factor, which gives the most accurate results (Flegg *et al.*, 1995; Flegg *et al.*, 1997; 2000). In summary, the novelty of this article is:

- to quantify the importance of domestic marinas using the input-output method,
- to take into account the relationships that exist between the economic impacts of marinas,
- the regionalisation of the national input-output table utilising the Flegg location coefficient.

This article consists of three parts and a conclusion. The first part presents the research methodology and the sources of information used. The second part presents the results of the research in six tables. The last section discusses the research results and provides a comparative analysis. The summary presents a synthesis of the research conducted and directions for further research into the economic importance of marinas.

2. Methodology

The input-output method, often referred to as the Leontief Model (Miller *et al.*, 2009; Eurostat, 2008; Danielis, 2011), was used to determine the economic importance of marinas. It is one of the methods typically used to assess marinas comprehensively. The method distinguishes between direct, indirect and induced effects. The first effect is related to the activities of those directly involved in the operation of marinas. The indirect effect covers the economic sectors that are a source of supply for those directly involved in providing tourism services.

The source of the last effect, which is frequently referred to in the literature as the Type 2 income multiplier, is the consumption expenditure of households directly and indirectly linked to the activities of yacht marinas (Danielis, 2011; Sangajło, 2022). The above effects are discussed considering: output, added value and employment volume.

The extent of the marinas' impact was referred to as the level of sub-regions (NUTS 3). For the ports of Kołobrzeg and Darłowo, this is the Koszalin sub-region. For the ports of Ustka and Łeba, it is the Słupsk sub-region; for Hel, it is the Gdańsk sub-region. These ports represent each section of the Polish Baltic Sea coast, and most seagoing yachts are stationed there. A comparative analysis was carried out in this paper, comparing the results of a study of national marinas with those of the Valencia Region of Spain (10 sites) and marinas in Italy (3 sites) (Fernández Guerrero *et al.*, 2008).

The starting point for determining direct, indirect and induced effects is the formula defined by the inverse of the Leontief matrix expressed by the formula:

$$X_i=(I-Aij)^{-1}Y_i \quad (1)$$

where:

X_i — output of the *i*-th branch
I — unit matrix
$A_{ij} = \frac{xij}{Xi}$ — technical coefficients of intermediate consumption, where xij - flow from the *i*-th to the *j*-th branch
Y_i — demand for products and services of the *i*-th sector

Based on formula (1), we can calculate the total volume of output resulting from an increase in demand for the products and services of a particular branch of the economy.

To determine the direct effect, we use a formula expressed by the formula:

$$X_{dir} = (I + Aij)Y_i \tag{2}$$

where:
X_{dir} — the output volume following an increase in demand for the products and services of those directly involved in economic activity.

In contrast, a formula of the form is used to determine the indirect effect:

$$X_{indi} = (Aij^2 + Aij^3 + \ldots Aij^n)Y_i \tag{3}$$

where:
X_{indi} — the indirect effect, i.e. the volume of output following the increase in demand for the products and services of the sourcing entities directly involved in the economic activity.

The indirect effect can also be obtained by subtracting from the Leontief inverse matrix (1) the formula used to determine the direct effect (2), i.e.:

$$X_{indi} = (Aij^2 + Aij^3 + \ldots Aij^n)Y_i = (I - Aij)^{-1}Y_i - (I + Aij)Y_i \tag{4}$$

The induced effect is determined from the basic input-output model formula (1) by adding another row and column to the matrix. The elements in the row represent net income (wages and salaries) per unit of output. The column elements, on the other hand, represent household consumer expenditure. The induced effect represents the difference between the sum of the direct, indirect and induced effects and the sum of the direct and indirect effects:

$$X_{indu} = X_{dir+indi+indu} - X_{dir+indi} = (I - \bar{A}ij)^{-1}Y_i - (I - Aij)^{-1}Y_i \tag{5}$$

where:
X_{indu} — the induced effect following an increase in household income

$\overline{A}$ — matrix of technical coefficients extended by income and consumer spending.

The determination of employment and added value required the creation of an additional diagonal matrix, the elements of which were the coefficients – employment and added value per unit of global value, respectively.
In the case of added value and employment, total, direct, indirect and induced effects are calculated using the formulas:

Total effect:

$$V_{dir+indi} = \hat{v}(I - Aij)^{-1}Y_i \quad (6)$$

$$L_{dir+indi} = \hat{I}(I - Aij)^{-1}Y_i \quad (7)$$

where:
$L_{dir+indi}$ — total employment, following an increase in demand
$\hat{v}$ — diagonal matrix of value-added coefficients
$\hat{I}$ — diagonal matrix of employment coefficients

Direct effect:

$$V_{dir} = \hat{v}(I + Aij)Y_i \quad (8)$$

$$L_{dir} = \hat{I}(I + Aij)Y_i \quad (9)$$

where:
V_{dir} — direct added value following an increase in demand.
L_{dir} — direct employment following an increase in demand.

Indirect effect

$$V_{indi} = \hat{v}(I - Aij)^{-1}Y_i - \hat{v}(I + Aij)Y_i \quad (10)$$

$$L_{indi} = \hat{I}(I - Aij)^{-1}Y_i - \hat{I}(I + Aij)Y_i \quad (11)$$

where:
V_{indi} — indirect added value following an increase in demand
L_{indi} — indirect employment resulting from increased demand

Induced effect:

$$V_{indu} = V_{dir+indi+indu} - V_{dir+indi} = \hat{v}(I - \overline{A}ij)^{-1}Y_i - \hat{v}(I - Aij)^{-1}Y_i \quad (12)$$

$$L_{indu} = L_{dir+indi+indu} - L_{dir+indi} = \hat{I}(I - \overline{A}ij)^{-1}Y_i - \hat{I}(I - Aij)^{-1}Y_i \quad (13)$$

where:
V_{indu} — induced added value following income growth
L_{indu} — induced employment as a result of increased income
$\overline{A}$ — matrix of technical coefficients extended by income and consumer spending.

The use of the Leontief model is based on data contained in input-output tables published in Poland at 5-year intervals (the latest available version presents data for 2015) (CSO, 2015). The CSO in Poland publishes input-output tables nationally, which implies their adaptation to a regional or sub-regional dimension. Regionalisation allows for the determination of the self-sufficiency of the reference area and is the most challenging task related to the use of the Leontief model.

Before regionalisation, the input-output table was aggregated from 98 to 19 divisions corresponding to the PKD 2007 section (PKD, 2022). The availability of statistical data at the sub-regional level dictated the procedure of narrowing the table. In addition, too much disaggregation affects the complexity of the model, making it difficult to interpret the results.

The regionalisation of the national table was based on Flegg's location coefficient expressed by the formula (Flegg *et al.*, 1995; 1997; Flegg 2010).

$$FLQ_{ij} \equiv CILQ_{ij} \text{ x } [\log_2(1+\frac{TRE}{TNE})]^{\delta} \quad (14)$$

where:
FLQ_{ij} — Flegg's location factor
TRE — employment in the region's economy (in all sectors)
TNE — employment in the domestic economy (all sectors)

$$CILQ_{ij} = \frac{SLQ_i}{SLQ_j} = \frac{REi/NEi}{REj/NEj}$$

where:
RE_i — regional employment in the sales sector
NE_i — domestic employment in the sales sector
RE_j — regional employment in the buying sector
NE_j — domestic employment in the buying sector
δ — the delta parameter, the value of which is between ($0 < \delta < 1$).

Location coefficients are the most commonly used in the regionalisation of a national table, and among them, the Flegg coefficient has the highest accuracy in determining the self-sufficiency of regions. The value of the critical parameter δ in the formula was taken from Flegg and Tohmo's research for Finnish regions. As a result, the regression function for calculating the value of the δ parameter was estimated as follows (Flegg *et al.*, 2000):

$$\ln \delta = -1{,}8379 + 0{,}33195 \ln R \quad (15)$$

By substituting the value added for the 'R' parameter, the value of the δ parameter for the Koszalin sub-region was estimated to be 0.1461, for the Słupsk sub-region

0.1383 and the Gdańsk sub-region 0.1632. The final step was to create a final demand vector. Data on expenditures were obtained from the surveyed seaports and then assigned to PKD sections. In turn, data on added value, employment, wages and household expenditure were obtained from regional statistics (Central Statistical Office – Local Data Bank (CSO-BDL), 2015).

3. Results

The surveyed marinas show considerable variation in terms of output, added value and employment (Tables 1-5). The most significant stream of financial flows occurs in the marinas in Łeba, Kołobrzeg and Hel, much smaller in Darłowo and Ustka. The main reasons for the differences are the size of the marinas (number of berths for yachts) and their accompanying infrastructure (accommodation, catering and social facilities, facilities for wintering yachts), which translates into the volume of sailing traffic and thus the value of financial flows and employment.

The sum of the effects (direct, indirect and induced) is lower than the initial value and, depending on the marina, ranges from 59% to 77% for output, from 41% to 61% for added value and from 38.60% to 116.13% for employment.

Regardless of the factor analysed in all marinas, the direct effect has the most significant economic impact. Of much less importance is the induced effect. In the case of output, it ranges from 21.99% to 33.12% of the value of the direct effect. For added value, the corresponding figures range from 21.30% to 23.00%, and for employment, from 24.48% to 27.99%. The indirect effect, on the other hand, is the least powerful. It represents between 3.99% and 7.57% of the value of the direct effect in the case of output, between 3.54% and 8.78% in the case of added value and between 4.90% and 10.49% in the case of employment.

Table 1. *Impact effects of the Kolobrzeg marina*

Economic category	Type of effect				Total
	Initial	Direct	Indirect	Induced	
Global output	659 582	289 108	11 534	90 754	391 396
Added value	413 842	135 938	4 815	29 267	170 020
Employment	8	4.08	0.20	1.07	5.35

Source: *Own studies based on data from the Port of Kołobrzeg Authority*.

Table 2. *Impact effects of the Darlowo marina*

Economic category	Type of effect				Total
	Initial	Direct	Indirect	Induced	
Global output	122 095	53 516	2 135	16 800	72 451
Added value	76 606	25 163	891	5 418	31 472
Employment	2	0.75	0.04	0.20	0.99

Source: *Own studies based on data from the Port of Darłowo Authority*.

Table 3. *Impact effects of the Ustka marina*

Economic category	Type of effect				Total
	Initial	Direct	Indirect	Induced	
Global output	47 776	21 623	1 195	7 164	29 982
Added value	29 976	10 043	461	2 310	12 814
Employment	1	0.30	0.02	0.09	0.41

Source: *Own studies based on data from the Port of Ustka Authority.*

Table 4. *Impact effects of the Łeba marina*

Economic category	Type of effect				Total
	Initial	Direct	Indirect	Induced	
Global output	870 125	485 421	26 831	160 817	673 069
Added value	470 536	225 448	10 345	51 871	287 664
Employment	8	6.86	0.51	1.92	9.29

Source: *Own studies based on data from the Port of Łeba Authority.*

Table 5. *Impact effects of the Hel marina*

Economic category	Type of effect				Total
	Initial	Direct	Indirect	Induced	
Global output	283 079	135 803	10 278	29 866	175 947
Added value	177 611	45 139	3 963	9 612	58 714
Employment	5	1.43	0.15	0.35	1.93

Source: *Own studies based on data from the Port of Hel Authority.*

The data in Table 6, on the other hand, is a synthetic compilation from the five surveyed marinas. The value of output (the sum of direct, indirect and induced effects) is €1,342,847, which represents 67.73% of the initial value.

For added value, the corresponding figures are 560,685 euros and 47.98%, and for employment, 17.97 and 66.56%. Among the effects, the most significant is the direct effect, with a value of €985,472 for output, €441,731 for added value and 13.42 for jobs. Of much lesser importance is the induced effect, with 30.99%, 22.29% and 27.05% of the value of the direct effect, respectively.

For the indirect effect, the corresponding values are 5.27%, 4.63% and 6.86%.

Table 6. *Impact effects of the surveyed marinas*

Economic category	Type of effect				Total
	Initial	Direct	Indirect	Induced	
Global output	1 982 657	985 472	51 974	305 401	1 342 847
Added value	1 168 571	441 731	20 476	98 478	560 685
Employment	27	13.42	0.92	3.63	17.97

Source: *Own studies based on data from marina operators.*

4. Discussion

The value of the stream of financial flows and the volume of employment in the input-output model depends on the reference area, the economy's structure, and the specifics of the sector under study. The sum of effects (direct, indirect, induced) of Polish marinas (Table 7) concerning the initial value varies from 47.98% (in the case of added value) after 66.56% (in the case of employment) to 67.73% (in the case of output).

These values are much smaller than the equivalent values adopted for the comparisons of the Valencia Region's marinas (Table 8.), which were referred to the area of port cities. The port cities are smaller organisms than the Polish sub-regions, so considering the reference area itself, the scope of influence of the studied yacht marinas should be more significant.

The difference may be due to how the input-output table is regionalised (the authors do not specify the technique used) and the level of self-sufficiency of port cities, which may be higher than in Polish subregions.

Table 7. *Impact effects of surveyed marinas in Poland*

Economic category	Type of effect				Total
	Initial	Direct	Indirect	Inducted	
Global output	1 982 657	985 472	51 974	305 401	1 342 847
Added value	1 168 571	441 731	20 476	98 478	560 685
Employment	27	13.42	0.92	3.63	17.97

Source: *Own studies based on data from marina operators.*

Table 8. *Impact effects of Valencia Region marinas*

Economic category	Type of effect				Total
	Initial	Direct	Indirect	Inducted	
Global output	1 865 000	1 151 000	76 000	532 000	1 859 000
Added value	898 000	616 000	39 000	347 000	1 002 000
Employment	30	15	1	10	26

Source: *Own studies based on Fernández Guerrero et al. 2008.*

Table 9. *Impact effects of marinas in Italy*

Economic category	Type of effect			Total
	Direct	Indirect	Inducted	
Global output	1 303 000	210 000	978 000	2 491 000
Added value	796 000	114 000	512 000	1 422 000
Employment	23	2	9	34

Source: *Own studies based on Fernández Guerrero et al. 2008.*

The direct effect is the most powerful, followed by the induced effect, and the indirect effect is the least important, and this is true for both the Polish and the marinas used for comparison. The dominance of the direct effect can be explained by the vast network of connections created by sailing tourism.

On the other hand, it no longer requires such an extensive network of inter-sectoral links, including entities that are supply sources for direct service providers. The importance of the indirect effect of Polish marinas is comparable to that of the Valencia Region marinas but less than that of Italian marinas. The latter form a more elaborate network of inter-sectoral links.

In contrast, the importance of the induced effect depends on the amount of household income and the amount of investment in the expansion of marinas. The amount of household income depends on the labour intensity of the economy, the level of wages and the propensity to consume.

On the other hand, the size of investment outlays depends on the availability of funding sources. The value of the induced effect of Polish marinas is much lower than that of Spanish and Italian marinas. It is underestimated by the lower level of development of the Polish economy and the fact that investment outlays are not included in the model due to the excellent quality of the sailing infrastructure, which has been modernised recently.

5. Conclusions

This paper identifies the importance of five marinas on the Polish Baltic coast in terms of output, added value and employment. The input-output method allowed three economic effects to be distinguished, i.e., direct, indirect and induced. The scope of economic impact was limited to coastal sub-regions (NUTS 3).

The surveyed marinas show considerable variation in terms of output, added value and employment. The differences are due to the size of the marinas, and thus the number of berths for yachts, and the presence of associated infrastructure.
The strength of the economic impact of the studied yacht marinas (direct, indirect and induced effects) is less than the initial impetus. In the case of output, it is 67.73% of the initial value; in the case of added value, 47.98% and in the case of employment, 66.56%.

The greatest strength of the economic impact is associated with the direct effect, followed by the induced effect, and the smallest with the indirect effect. The value of the indirect effect is 5.27% of the direct effect for output, 4.63% for added value and 6.86% for employment. The induced effect is much more critical, at 30.99%, 22.29% and 27.05%, respectively.

The strength of the economic impact of Polish marinas is lower than that of the Valencia Region marinas adopted for comparison, which may be due to the regionalisation technique of the input-output table and the higher self-sufficiency of port cities in Spain. The dominance of the direct effect – in the marinas surveyed and those adopted for comparison – may be due to the extensive network of linkages that nautical tourism creates.

However, it does not require an extensive network of inter-sectoral links – hence the much weaker strength of the indirect effect. On the other hand, the lower significance of the induced effect of Polish marinas may be due to the lower level of development of the Polish economy and the failure to include investment expenditures in the model. In recent times there has been a thorough modernisation of the yachting infrastructure, which to a large extent, meets the needs of yachters.

The issue of the economic importance of marinas requires further research. The territorial scope of the research should be extended to include inland sailing facilities. An attempt should be made to narrow the scope of the study to smaller territorial units, i.e. communes and port cities, which would require the acquisition of more detailed statistical data.

Polish seaports are multifunctional economic structures. Although sailing is a prospective activity area, it is not the only one. Hence, it would be necessary to determine the importance of other port functions (transhipment, passenger, fishing) and compare the results with the sailing activity.

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