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Economic impact of ocean fish populations in the global fishery

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Abstract Our goal in this paper is to estimate the total output in an economy that is currently dependent (at least partially) on current fisheries output. We therefore applied the Leontief technological coefficients at current production and then estimate total output supported throughout the economy at the current level of production. Estimates of gross revenue from capture fisheries suggest that the direct value of output for this sector is US $80–85 billion annually (Sumaila et al., Journal of Bioeconomics 9(1):39–51, 2007; Willmann et al., The Sunken Billions, World Bank, FAO, Washington DC, Rome, 2009). However, as a primary or a potential economic base industry, there are a vast number of secondary economic activities—from boat building to international transport—that are supported by world fisheries, yet these related activities are rarely considered when evaluating the economic impact of fisheries. This study applies an input–output methodology to estimate the total direct, indirect, and induced impact of marine capture fisheries on the world economy. While results suggest that there is a great deal of variation in fishing output multipliers between regions and countries, when we apply the output multipliers to the capture fisheries sector at the global level, we find that significant indirect and induced effects place the impact of this sector to world output nearly three times larger than the value of landings at first sale, at between US $225 and 240 billion per year.

Keywords Fisheries · Input–output · World economy · Economic impact

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1 Introduction

An economy, much like an ecosystem, is composed of many economic actors, each with different abilities performing different, and many times, complementary roles. Each economic actor consumes certain goods while at the same time producing others. Furthermore, just as one can organize the organisms in marine ecosystems by phylum, class and lower taxa, we can decompose an economy into groups that allow us to investigate these parts so to gain meaningful insights into the wider economy and how agents function within it.

Once one divides the economy into several parts, we can begin to understand something about how these sectors operate, the agents who contribute to that industry and its eventual outputs. Fishing is one such industry that we may try to understand in this manner and forms the focus of this paper. A great deal of the inputs for the fishing sector come from natural resources, however, the industry also relies upon products from manufacturing (boats and netting), as well as many others like agriculture and management services. Clearly, changes to the fishing sector will affect many other sectors whose output is used as an input in the fishing sector, which should make many people outside of the fishing industry interested in fisheries inputs.

A second item that may interest us when investigating the fishing sector is the final destination for the outputs of this industry. It is clear that the vast majority of outputs from the fishing sector will find their way to the dinner table, but the path taken by output of the fishing sector before it reaches this destination can be very important. Some fish are sold directly to the consumer while others may be sold to an intermediary who combines the fish with other inputs to produce something that is then purchased by consumers as a different product. Since we are interested in both the inputs and outputs of the marine fishing sector, we can gain much more from considering these items simultaneously rather than separately. Input–output analysis allows us the unique ability to do just this and, as is shown later, we use the results of this analysis to determine the full economic impact of marine capture fisheries in the global economy.

The objective of this paper is modest—to apply the Leontief technological coefficients at current production and then estimate total output supported throughout the economy at the current level of production. While we recognize that the non-linearity of fisheries production could cause problems when doing predictions at various levels of production, we do not think that this is an issue when analyzing the impact of current production. It should be noted that we do not study the situation of zero fisheries production in this paper. The question we address is 'What is the total current impact of the fisheries sector at current production?'

A short background to input–output analysis as it relates to the fisheries sector is briefly discussed before describing the data and methods used in this study. Next, we summarize the results of an input–output analysis of the marine capture fisheries sector for the world's coastal nations. This is followed by some comments that aim to put these national results into a global context. At this stage, results are used in combination with landed value as reported by the *Sea Around Us Project*[1] to calculate the total economic impact of fisheries to world output. Some concluding remarks close the paper with an outline for future fisheries studies using an input–output methodology.

2 Background

As a primary industry, fishing is the beginning of a productive value chain for many nations. Generally, primary industries are activities focusing on extracting or processing natural resources such as energy, minerals, and in this case food, for use elsewhere in the economy. This definition of primary industry allows for little value to be created through the direct extraction of natural resources. In fact, for many nations, the fishing industry contributes a relatively small amount to gross domestic product or value added with the majority reporting contributions less than 1% of GDP.

However, despite its disposition in relation to other sectors, the fishing industry remains an important one for policy makers; especially in developing and resource rich regions. When fisheries output is combined with other sectors dependent on ocean resources its total impact on the economy can be much greater (Pontecorvo et al. 1980). Furthermore, although the fishing sector's share of national output for many developing nations ranges between 0.5 and 2.5%, the industry may support much greater output through 'trickle-up' linkages in the economy (Béné et al. 2007).

The economic multiplier is used in fisheries research to emphasize that the industry has many linkages throughout the economy. Such multipliers are a factor by which we can multiply the value of final demand for an economic activity's output to obtain its total contribution to economic output including activities directly and indirectly dependent on it. Therefore, the importance of this industry to the economy may be understated when considering only the direct values obtained through the usual method of national accounts. The amount normally cited when considering the total production of the fisheries sector (referred to as 'Landed Value'—Sumaila et al. 2007; Willmann et al. 2009) is the value of fish when they change hands for the first time after leaving the boat. This is the direct economic value of fisheries sector output and is considered as the starting point for total economic impact in input–output analysis.

It is only in rare occasions that the value chain for fish ends immediately after landing such as in the case of subsistence fishing, where fish is usually caught for own consumption. Rather, fish are sold to markets where they are again re-sold to consumers or an intermediary will purchase larger quantities for processing; these products will later make their way to the dinner table. Each time a fish changes hands, it is combined with other goods, be it tin for canning or the management services of someone involved in retail distribution. At each link in this value chain, a portion of the value of output from each sector can be traced back to capture fisheries, with this share decreasing the further down the chain it goes. In this way, we can follow a fish through the chain of production to reveal that a great deal of economic activity is supported by capture fisheries. Such economic impacts are referred to as the 'downstream effects' of

[1] http://www.seaaroundus.org/.

fisheries and can occur in many sectors ranging from agriculture and forestry through to manufacturing and financial services.

Recognizing that indirect economic effects can be very important, researchers have adopted approaches to account for these effects in some of the fisheries literature. A considerable amount of this previous work using economic impact methodology has been done for the USA (e.g. Seung and Waters 2006). Several methods used in such studies to analyze the economic impacts of fishing including input–output modeling, social accounting matrix (SAM) modeling, econometric input–output (EC-IO) modeling, fisheries economic assessment models (FEAM), and computable general equilibrium (CGE) models. Each of these techniques has its merits and demerits, which have been discussed in the literature at length (Loveridge 2004; Radtke et al. 2004).

Of these models, the input–output technique is well used in the study of fisheries, likely due to the relative ease of computation and accessibility of results (Leung and Pooley 2001; Hoagland et al. 2005; Bhat and Bhatta 2006). Results from an input–output study can be used to predict the outcome of a marginal change in demand for a particular good. These results from an input–output study can also be easily interpreted and used in a practical manner. For example, results from a study concerning the Hawaiian longline fleet reveals that a reduction in the value of the fleet's output of \$43.88 million would translate to a total negative economic impact of \$72.58 million; more than 65% greater than the direct impact to the longline sector alone (Leung and Pooley 2001).

3 Methodology and data

3.1 Overview of methods

The method developed by Nobel Laureate, Wassily Leontief, known as input–output analysis, is a tried and tested approach to analyzing the structure of the economy. Beginning as early as the late 1940s, Leontief used his method in a number of applications, including the well-known analyses of the potential economic impact of disarmament for the United States of America and tests of the Heckscher-Ohlin theory now known as the 'Leontief Paradox' (Leontief 1953; Leontief et al. 1965). The definitive source on input–output methodology, his book on the subject is a collection of his earlier works and serves as an excellent foundation for using input–output analysis (Leontief 1966). There are, however, several additional sources for readers who are interested in the methodology as applied to fisheries (Heen 1989; Leung and Pooley 2001; Jin et al. 2003; Hoagland et al. 2005; Roy et al. 2009).

Input–output analysis uses inter-industry transaction data to compute a technical coefficient matrix, $\mathbf{A}$, which is composed of entries $\mathbf{a}_{i,j}$ summarizing the output from industry i required to produce a unit of output for industry j. We compute this technical coefficient matrix for every maritime country of the world, expressing the economy of each country as a system of linear equations summarized by the equation:

$$\mathbf{Ax} + \mathbf{d} = \mathbf{x} \tag{1}$$

where $\mathbf{A}$ is the matrix of technical coefficients describing input requirements for each sector, $\mathbf{x}$ is a vector of sector inputs, and $\mathbf{d}$ is a vector of final demand. The above equation then simply states that the sum of intermediate demand ($\mathbf{Ax}$) and final demand ($\mathbf{d}$) is equal to supply ($\mathbf{x}$). It is then a simple problem of linear algebra to solve for the vector of inputs ($\mathbf{x}$) required to satisfy a given final demand vector ($\mathbf{d}$) using $\mathbf{I}$ as the identity matrix. This solution is expressed as:

$$\mathbf{x} = [\mathbf{I} - \mathbf{A}]^{-1}\,\mathbf{d} \tag{2}$$

We note that the vector $\mathbf{x}$ represents total output supported by the demand vector $\mathbf{d}$. It is important to keep this measure of economic activity separate from other measures such as value-added, which subtracts the value of inputs from the value of output. It is worth noting that it is not appropriate to make comparisons between estimates using input–output analysis and measures of value-added such as GDP.

3.2 Type I & II output multipliers

Given the solution in Eq. 2 above, we calculate the change in output with respect to final demand. To do this, we take a partial derivative of Eq. 2 with respect to final demand ($\mathbf{d}$):

$$\frac{\delta \mathbf{x}}{\delta \mathbf{d}} = [\mathbf{I} - \mathbf{A}]^{-1} \tag{3}$$

Equation 3 describes a new relationship that proves to be very useful in macro-economic analysis. The right hand side of this equation, $[\mathbf{I} - \mathbf{A}]^{-1}$, is also denoted as $\mathbf{L}$ since it is commonly called the Leontief inverse or multiplier matrix. This square matrix is of interest because each entry (denoted $\mathbf{l}_{i,j}$) describes the marginal inputs required from sector i when the output of sector j increases by one unit.

We calculate industry multipliers by computing the column sum of the Leontief inverse matrix $\mathbf{L}$ as:

$$\mathbf{M} = \sum_{i=1}^{N} \mathbf{l}_{i,j}$$

where $\mathbf{M}$ is a row vector of Type I industry output multipliers. Each entry, $\mathbf{M}_j$, in this row vector is an output multiplier that allows us to compute the direct and indirect output required to support a unit of output for industry j. For example, in a sector with a multiplier of 1.5, we would estimate that \$100 in final demand from this sector supports \$150 of activity throughout the economy.

As we have shown, for a given economy with n industries, one calculates the Leontief inverse using a $n \times n$ technical coefficients matrix as described above. Multipliers calculated in this way account for the direct and indirect output supported by a given industry. In addition to these multipliers, often called Type I, a second set of multipliers, called Type II may also be calculated. The advantage to using Type II multipliers is that they account for indirect as well as induced effects that occur. For example, when additional demand for a given sector increases, household incomes induce demand for additional output. With Type I multipliers, household consumption is part of the final demand sector, and therefore assumed to be exogenous; with Type II multipliers, we treat household consumption as endogenous by adding it as an additional intermediate sector in the technical coefficients matrix **A**. When computing Type II output multipliers, a technical coefficients matrix with endogenous households will be $n+1$ by $n+1$ in dimension. Summing the multiplier matrix **L** over n output sectors will produce Type II output multipliers that include the induced effect of endogenizing households without confusing output and income, which would occur if we added the last row of the multiplier matrix—also known as the income effect.

It should be mentioned that input–output analysis is not without criticism (Christ 1955). It is well noted that input–output analysis relies on the stability of technical coefficients, which may not hold when used in forecasting situations that are greatly different than described by the respective input–output table used. Furthermore, input–output analysis is fairly data intensive—a factor that can be problematic when studying regions with scattered high quality data sources. These caveats aside, we believe that input–output analysis is well-suited to the research questions of this study.

3.3 Income multipliers

In addition to output multipliers that estimate the impact on output resulting from an exogenous change to final demand, one can use the Leontief inverse matrix to compute employment, value-added and income multipliers. Current limitations in data prevent us from calculating employment multipliers at this time. Furthermore, since this paper seeks to focus on fisheries impact on output as opposed to value-added we do not estimate multipliers of this type. However, we investigate the influence of fisheries sector household income by estimating income multipliers. Such multipliers reflect total household income throughout the economy supported by output in the fisheries sector through indirect and induced effects. These multipliers can be obtained for each sector using the equation:

$$\mathbf{Z} = \mathbf{y}\,[\mathbf{I} - \mathbf{A}]^{-1} \tag{4}$$

where $\mathbf{y} = \frac{\mathbf{Y}}{\mathbf{Q}}$ is the income per unit of output of each sector. The vector of income multipliers $\mathbf{Z}$ summarizes the marginal change in income that will occur when output in a given sector changes by one unit and $\mathbf{Z}_j$ is the income multiplier for the jth sector.

3.4 Using economic output multipliers

Once input–output multipliers, whether Type I, Type II, or income, are computed, we have a great deal of information in need of context. We can make use of input–output multipliers by considering them alone as the marginal change in output of the fishing sector when final demand for its output changes. However, in this study, we seek to estimate total economic activity supported by fishing in the broader economy using the current output of the fishing sector. This is done in a simple and concise manner, which can be expressed using matrix notation as:

$$\mathbf{x} = \mathbf{L} * \mathbf{d} \tag{5}$$

where data in the vector $\mathbf{d}$ in Eq. 5 represents final demand or final consumption. Since using landed value, which is total industry output, in the place of final demand may over-state the impact of fisheries, we adjust Eq. 5 to net out the possibility of double-counting intermediate demand (de Mesnard 2002). Using net multipliers, which correct for possible double-counting, we compute the economic impact of industries as:

$$\mathbf{x}' = [\mathbf{I} - \mathbf{A}]^{-1}\, \mathbf{A}\mathbf{x} \tag{6}$$

where $\mathbf{x}'$ is the total economic impact estimated using the net multiplier methodology and $\mathbf{x}$ is a vector of industry output. Recalling that $\mathbf{M}$ is a vector of industry Type II output multipliers, the calculation of total economic impact of the fisheries sector using net multipliers as specified in Eq.6 simplifies to:

$$\mathbf{x}'_{fish} = \left(\mathbf{M}_{fish} - 1\right) \mathbf{x}_{fish} \tag{7}$$

where $\mathbf{x}_{fish}$ is landed-value for the fisheries sector in the year 2003. This is done for each country for which landed value is available using national input–output multipliers and regional multipliers when national tables are not available. In a nutshell, the net multiplier is equal to the Leontief multiplier minus one.

It is worth noting that the idea of net-multipliers are a relatively new development in input–output analysis. There has been debate concerning the specification and application of net-multipliers that is currently unresolved (de Mesnard 2002, 2006; Oosterhaven and Stelder 2002; Dietzenbacher 2005; Oosterhaven 2006). However, we are confident that applying net-multipliers as specified in Eq. 6 above is a suitable transformation for compensating for potential over-estimation of multiplier effects when using industry output rather than final demand.

4 Data source

Input–output tables have been constructed for several countries as far back as the late 1940s. The process of collecting 'supply' and 'use' data (usually published by national statistical agencies) and transforming them into symmetrical input–output tables, where flows of goods can be followed in a symmetrical industry by industry format, can take a significant amount of time, which can cause a lag between when input–output data are available and the present. For example, in the case of Leontief's study of American disarmament, the study was published in 1951 but the most recent input–output table used in the analysis was for 1947.

Since input–output tables were first collected, lag time between present day and available input–output data has declined somewhat. However, a significant lag between present day and available data remains. For example, several developed nations have submitted input–output tables to the Organization for Economic Cooperation and Development (OECD) covering years up to 2006. Unfortunately, acquiring recent data for many developing countries can be difficult at times and nearly impossible in some cases. Furthermore, there is no standard by which input–output tables are compiled and may vary considerably in sectoral aggregation. Some nations produce tables identifying more than 100 sectors, while others report fewer than ten. Such differences in sector aggregation can complicate comparison between national input–output data.

It is clear that there are significant issues to collecting input–output data that is comprehensive and standardized at the global level. In order to deal with these issues, the Global Ocean Economics Project (GOEP) uses a large dataset of economic flows from the Global Trade Analysis Project (GTAP) at Purdue University. This database was originally designed for use in computable general equilibrium (CGE) models using a collection of standardized input–output tables as its core. The database currently includes economic flows for 57 sectors and 113 regions of the world.[2]

The GTAP database is a rich collection of data suitable for conducting complex CGE modeling. However, since this type of modeling is beyond the scope of our paper, only the input–output tables, which form the foundation of the GTAP database, are used. In order to extract input–output tables, we first take two steps to prepare the database. First, we modify the default GTAP aggregation scheme that creates ten sectors out of the 57 available. In our modified aggregation scheme, fishing is identified separately from the other extractive activities while the other sectors remain as in the default specification.[3] Second, we use the CRUSOE[4] tool to identify GTAP data for each of the 113 regions of the world separately.

With sectors defined, the input–output tables used in computations are extracted from the database and an estimate of the output multiplier matrix, $[\mathbf{I} - \mathbf{A}]^{-1}$, is found for each coastal country specified independently. Turning to coastal nations where input–output tables are not available, we use the regional table estimates from GTAP to estimate economic multipliers in these regions. We estimate the economic impact in the economy from output in the fisheries sector through indirect and induced effects using Type II output multipliers; income multipliers are derived using Eq. 4 above.

5 Results

5.1 Total contribution of capture fisheries to world output

Total output of global fisheries is presented by geographic region in Table 1 with the total economic impact including indirect and induced effects in the third column. In the last column of Table 1 we present the average fisheries output multiplier weighted

[2] Much more information about the structure of GTAP can be found at the Project's website: http://www.gtap.agecon.purdue.edu/.

[3] The sensitivity of computation to the level of aggregation was conducted using aggregations of 57, 40, and 25 sectors. These results were compared with the 10 sector aggregation and no significant differences were found.

[4] More information about the freely available CRUSOE45 utility by Mark Horridge is available at http://www.monash.edu.au/policy/crusoe.htm.

Table 1 2003 World fisheries output impacts by region

	Landed value (USD billions)	Economic impact (USD billions)	Average multiplier
Africa	2.10	5.46	2.59
Asia	49.89	133.31	2.67
Europe	11.45	35.78	3.12
Latin America	7.20	14.78	2.05
N. America	8.23	28.92	3.52
Oceania	5.22	17.06	3.27
World total	84.10	235.31	2.80

by landed value. Each of these effects are computed for every coastal country and presented by geographic location for brevity; the world total of fisheries economic impact is presented in the last row. The result of economic impact analysis suggests that indirect and induced effects bring the total economic impact of capture fisheries to more than three times the sum of the initial activity. The total economic impact of global fisheries for 2003 is estimated to be between US$ 225 and 240 billion.

At the regional level, Asia is the clear leader in terms of economic impact whether in terms of direct, indirect, or induced impacts. This is mainly due to the influence of China and Japan. The total of direct, indirect, and induced impacts in China totals US$ 48 billion while the equivalent for Japan is US$ 37 billion. Together these two nations represent more than 60% of fisheries related economic activity in Asia and over 35% at the global level.

While it is Asia that leads in terms of regional output supported by fisheries, we find that it is North America that has the greatest marginal effect stemming from changes in fisheries output. With a weighted average multiplier of 3.52, North Americans can expect a fair amount of economic activity to be supported by increased fisheries output caused by improved management systems. However, this is not to say that improving fisheries management is less important in other regions. The global weighted average output multiplier suggests that a dollar of fisheries sector output supports about three dollars of output throughout the global economy from manufacturing to financial services. This global average multiplier of 2.8 is bracketed closely by regional multiplier estimates of between 2.05 and 3.52. The average multiplier value of 2.8 is consistent with recent literature concerning fisheries as an economic base industry in Newfoundland, Canada, which supports the theory that fisheries have an economic influence greater than their direct contribution to output (Roy et al. 2009).

5.2 Total household income supported by world capture fisheries

In addition to economic output, we are often interested in the amount of household income supported by a given sector. Table 2 reports total income supported by the capture fisheries sector for 2003 and is organized by geographic region. Column two of the table presents landed value while the third column presents the total of household income through indirect and induced effects due to output from the fishing

Table 2 2003 World fisheries income impacts by region

	Landed value (USD billions)	Income effect (USD billions)	Average multiplier
Africa	2.10	1.30	0.62
Asia	49.89	35.30	0.71
Europe	11.45	8.70	0.76
Latin America	7.20	4.06	0.56
N. America	8.23	10.06	1.22
Oceania	5.22	3.80	0.73
World total	84.10	63.22	0.75

industry. The last column of the table reports a weighted average of household income multipliers for each region.

As with output, Asia leads the rest of the world in total income supported by the capture fisheries sector. Asia accounts for more than 55% of household income in the world and, again, China and Japan are the big drivers. Household income supported by fisheries totals US$ 11 billion in China and US$ 12 billion in Japan for a combined total of $23 billion—more than 36% of the world total of fisheries-related household income.

Just as North America has high output multipliers, it also ranks highest among regions when we consider household income. In fact, the average household income multiplier for North America is greater than one, suggesting that an increase of fisheries sector output of one dollar results in more than one dollar of household income among workers in fisheries related activities when we account for indirect and induced effects.

6 Conclusion

Input–output analysis is not a new concept in economics and its use traces back to the very beginnings of quantitative economic methods. However, the use of this technique for the marine capture fisheries sector as proposed by this study is the first of its kind. It is apparent from our analysis that when one accounts for the total of direct, indirect and induced economic activity, the full impact of this sector is much greater than the value of catch landed at the port.

We used a global database of economic flows to consider the direct, indirect, and induced effect of changes in demand for the output from marine capture fisheries as well as its effect on household income. The results suggest that although the landed value of global fisheries is large, considering this value as the contribution of marine capture fisheries to world output underestimates the full impact of this sector to the world economy by a factor of about three. Considering direct, indirect and induced effects in the fisheries sector, we found the total economic impact to be about US$ 240 billion per year. Furthermore, the capture fisheries sector is estimated to produce more than US$ 63 billion per annum in household income when direct, indirect and induced effects are considered.

We set out with the goal of answering the simple question: what is the total current impact of the fisheries sector at current production? This is the first estimate of its type at the global fisheries level, and therefore can only serve as a first estimate of the global economic impact of global fisheries. Future methodological approaches and application will serve to improve this estimate with time. Input–output analysis has received scattered attention in past fisheries literature leaving a great deal of work for future practitioners. The input–output approach, in general, has recently enjoyed a surge in popularity as evidenced by the content of the journal *Economic Systems Research*. We have great optimism that breakthroughs in economic modeling will spill over into the fisheries literature and pave the way for much future research using this methodology. Obvious first steps for future work include testing the robustness of this study's results against any number of regional and/or national case studies. There is also a great deal of potential for using output from studies of fisheries management to predict the total economic benefit throughout the economy from reforming current management practices.

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Appendix

See Tables A1 and A6.

Table A1 Detailed input–output results for Africa (USD millions)

Country	Landed value	Economic impact	Income effect
Algeria	36.10	42.89	9.01
Angola	105.75	374.29	76.81
Benin	5.76	8.78	1.83
Cameroon	30.39	89.86	23.22
Cape Verde	3.83	5.84	1.22
Comoros	4.30	12.68	3.08
Congo Dem. Rep.	1.93	6.81	1.40
Congo Rep.	11.50	34.00	8.78
Cote d'Ivoire	34.57	52.67	10.98
Djibouti	0.14	0.42	0.10
Egypt	75.54	182.54	54.96
Eq. Guinea	0.86	2.55	0.66
Eritrea	4.71	13.90	3.38
Gabon	28.47	84.18	21.75
Gambia	30.27	46.12	9.61
Ghana	67.94	103.51	21.58
Guinea	99.43	151.48	31.58

Table A1 continued

Country	Landed value	Economic impact	Income effect
Guinea Bissau	4.80	7.31	1.52
Kenya	5.69	16.80	4.09
Liberia	3.20	4.87	1.02
Libya	24.86	29.53	6.20
Madagascar	103.97	243.40	80.32
Mauritania	67.33	102.57	21.39
Mauritius	6.18	10.00	3.09
Mayotte	2.82	8.33	2.03
Morocco	200.80	564.21	183.34
Mozambique	32.43	59.44	24.16
Namibia	359.68	1,734.98	314.67
Nigeria	195.60	55.52	10.73
Reunion	1.11	3.27	0.79
Sao Tome & Principe	1.92	5.69	1.47
Senegal	151.77	335.36	127.69
Seychelles	22.72	67.06	16.32
Sierra Leone	58.15	88.60	18.47
Somalia	29.88	88.17	21.45
St Helena	0.17	0.26	0.05
Sudan	4.88	14.40	3.50
Tanzania	20.81	56.69	22.93
South Africa	216.40	677.58	143.89
Togo	3.78	5.75	1.20
Tunisia	43.77	63.78	12.05
Region total	2,104.22	5,456.10	1,302.31

Table A2 Detailed input–output results for Asia (USD millions)

Country	Landed value	Economic impact	Income effect
Bahrain	31.33	32.08	7.87
Bangladesh	242.03	719.74	212.88
Brunei Darussalam	1.65	3.56	1.02
Cambodia	97.84	169.60	52.66
China	14,258.62	47,583.72	11,270.93
Cyprus	1.84	1.12	0.35
East Timor	0.27	0.57	0.16
Gaza Strip	2.28	2.33	0.57
Georgia	1.48	3.02	0.78
Hong Kong (China)	138.39	358.67	63.08
India	2,637.98	3,598.91	1,409.87
Indonesia	1,952.79	3,250.58	1,023.50

Table A2 continued

Country	Landed value	Economic impact	Income effect
Iran	674.02	1,306.09	94.67
Iraq	2.58	2.65	0.65
Israel	3.06	3.14	0.77
Japan	13,486.52	37,146.66	11,621.04
Jordan	0.18	0.19	0.05
Korea Dem. People's Rep.	166.37	506.45	118.47
Korea Rep.	2,054.66	5,969.61	1,264.17
Kuwait	7.18	7.35	1.81
Lebanon	4.37	4.47	1.10
Macau (China)	1.72	5.25	1.23
Malaysia	1,647.86	4,244.24	1,157.96
Maldives	548.50	1,631.41	421.17
Myanmar	786.27	667.70	255.31
Oman	213.78	218.90	53.73
Pakistan	435.25	940.69	250.65
Philippines	1,920.59	2,286.16	647.05
Qatar	14.99	15.35	3.77
Saudi Arabia	101.44	103.87	25.49
Singapore	3.04	12.19	2.14
Sri Lanka	544.44	551.74	176.44
Syria	4.06	4.16	1.02
Taiwan (China)	2,885.41	9,463.36	2,794.77
Thailand	2,080.11	4,406.58	499.31
Turkey	378.57	601.95	191.48
United Arab Emirates	112.97	115.67	28.39
Viet Nam	1,989.40	6,897.74	1,526.08
Yemen	460.31	471.34	115.69
Region total	49,894.15	133,308.82	35,298.06

Table A3 Detailed input–output results for Europe (USD millions)

Country	Landed value	Economic impact	Income effect
Albania	2.23	3.63	1.21
Belgium	44.82	278.74	70.37
Bulgaria	4.13	75.73	2.84
Croatia	11.71	38.32	9.08
Denmark	382.51	1,422.71	398.07
Estonia	55.53	211.68	28.10
Faeroe Islands	560.53	1,179.64	313.97
Finland	43.64	68.13	18.64
France	1,014.85	4,173.46	1,143.82

Table A3 continued

Country	Landed value	Economic impact	Income effect
Germany	195.46	640.25	175.47
Gibraltar	0.00	0.00	0.00
Greece	287.35	952.30	274.71
Iceland	782.63	1,947.83	395.70
Ireland	373.26	802.97	141.76
Italy	588.43	1,028.71	301.13
Latvia	62.60	269.53	69.71
Lithuania	124.82	473.08	78.40
Malta	0.89	2.26	0.54
Monaco	0.00	0.00	0.00
Netherlands	372.19	1,097.66	252.73
Norway	921.06	3,097.62	797.70
Poland	56.30	240.55	42.10
Portugal	201.58	964.27	307.18
Romania	0.75	2.80	0.65
Russian Federation	2,704.10	6,769.24	1,344.27
Serbia-Montenegro	0.59	1.24	0.33
Slovenia	1.33	8.29	2.17
Spain	1,190.45	4,599.63	1,189.99
Sweden	631.72	1,679.80	428.77
U.K.	698.29	2,972.05	763.71
Ukraine	140.51	781.04	147.19
Region total	11,454.26	35,783.18	8,700.31

Table A4 Detailed input–output results for Latin America & the Caribbean (USD millions)

Country	Landed value	Economic impact	Income effect
Anguilla	0.96	1.16	0.27
Antigua Barb	5.11	6.21	1.45
Argentina	916.45	2,724.82	781.79
Aruba	0.31	0.38	0.09
Bahamas	75.00	91.13	21.35
Barbados	3.12	3.79	0.89
Belize	9.95	34.45	7.77
Br. Virgin Islands	7.28	8.84	2.07
Brazil	1,135.43	2,719.08	922.84
Cayman Islands	0.36	0.44	0.10
Chile	865.37	2,111.69	472.83
Colombia	48.84	153.30	69.72
Costa Rica	49.01	105.88	25.50
Cuba	94.72	115.09	26.96

Table A4 continued

Country	Landed value	Economic impact	Income effect
Dominica	2.87	3.49	0.82
Dominican Rep.	35.40	43.01	10.08
Ecuador	208.32	677.58	140.39
El Salvador	86.22	298.49	67.30
Falkland Islands	61.53	130.54	27.56
French Guiana	20.66	43.83	9.25
Grenada	4.20	5.10	1.19
Guadeloupe	26.76	32.51	7.62
Guatemala	38.45	71.95	20.07
Guyana	164.45	348.87	73.66
Haiti	26.30	31.96	7.49
Honduras	44.55	154.24	34.77
Jamaica	25.43	30.90	7.24
Martinique	7.50	9.11	2.13
Mexico	1,598.15	972.39	188.71
Montserrat	0.15	0.18	0.04
Netherlands Antilles	1.74	2.11	0.49
Nicaragua	62.78	94.43	25.61
Panama	237.18	606.06	215.82
Peru	755.36	2,225.42	616.95
Puerto Rico	5.92	7.19	1.68
St. Kitts & Nevis	0.78	0.95	0.22
St. Lucia	3.17	3.86	0.90
St. Vincent	9.39	11.41	2.67
Suriname	98.31	208.56	44.04
Trinidad & Tobago	20.48	24.89	5.83
Turks & Caicos	10.52	12.78	2.99
Uruguay	125.83	330.90	79.87
U.S. Virgin Islands	3.10	3.77	0.88
Venezuela	301.09	318.16	133.58
	7,198.48	14,780.87	4,063.50

Table A5 Detailed input–output results for North America (USD millions)

Country	Landed value	Economic impact	Income effect
Bermuda	0.80	5.87	1.05
Canada	2,749.32	9,080.68	2,947.82
Greenland	670.82	4,951.27	888.63
St. Pierre & Miquelon	2.25	16.58	2.97
U.S.A.	4,802.84	14,866.47	6,218.58
Region total	8,226.02	28,920.87	10,059.06

Table A6 Detailed input–output results for Oceania (USD millions)

Country	Landed value	Economic impact	Income effect
American Samoa	46.62	155.88	30.17
Australia	902.28	3,329.38	995.96
Cook Islands	20.29	67.85	13.13
Fiji	121.47	406.19	78.63
French Polynesia	78.75	263.34	50.98
Guam	0.81	2.72	0.53
Kiribati	75.34	251.92	48.77
Marshall Islands	355.78	1,189.66	230.29
Micronesia	290.76	972.25	188.20
North Marianas	1.07	3.58	0.69
Nauru	0.35	1.16	0.22
New Caledonia	24.45	81.74	15.82
New Zealand	945.06	2,441.34	615.78
Niue	0.20	0.67	0.13
Norfolk Island	0.00	0.00	0.00
Palau	1.76	5.88	1.14
Papua New Guinea	1,524.57	5,097.92	986.83
Samoa	30.10	100.65	19.48
Solomon Islands	270.02	902.90	174.78
Tokelau	0.20	0.67	0.13
Tonga	13.85	46.31	8.96
Tuvalu	9.19	30.73	5.95
Vanuatu	509.59	1,703.99	329.85
Wallis & Futuna Islands	0.30	1.00	0.19
Region total	5,222.80	17,057.71	3,796.60

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