

AZORES BLUE ECONOMY: measuring the importance of Azorean maritime-related activities for Portugal's economy through the partial hypothetical extraction method

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Extended Abstract

Economic activities related to marine and coastal resources, referred to as the blue economy, hold significant importance in coastal regions such as Portugal. Between 2016 and 2017, according to Portugal's National Institute of Statistics (INE), the contribution of blue economy activities to the national Gross Value Added (GVA) increased from 3.7% to 3.9%. Similarly, during the same period, the share of jobs generated by the maritime economy in total employment rose from 3.9% to 4.1%. Portuguese government projections indicate that blue economy activities could grow to contribute 7% of the GDP by 2030, in an expansion plan that combines the exploration of the maritime economy with environmental and well-being gains.

The extensive Exclusive Economic Zone (EEZ) of Portugal significantly contributes to the growth of blue economy activities. Despite its current size, recent efforts have been made to expand the Portuguese EEZ beyond the 200 nautical miles along the mainland coast and surrounding archipelagos. The involvement of the Mission Structure for the Extension of the Continental Shelf in the Commission on the Limits of the Continental Shelf (CLCS) of the United Nations (UN) is a result of this initiative. A subcommittee within the CLCS was established in 2017 to evaluate the case. Nevertheless, under the current limits, the Portuguese EEZ covers an area of 1.7 million km², of which 955,000 km² are contiguous to the Azores archipelago, equivalent to 55.5% of Portugal's EEZ.

The Azores archipelago, the most recent addition to Macaronesia, has a historical background in transportation and fishing, with a subtropical climate and oligotrophic waters. Located in the transition between a less productive and tropical area (south) and a temperate and more productive area (north), the region faces challenges to economic growth due to its low population (just over 236,000, according to recent INE estimates), scarcity of resources, and geographical isolation. However, the relative increase in the

importance of the blue economy, through the development of activities such as ecotourism and aquaculture, has the potential to establish a new source of growth for the Azorean economy. Nonetheless, the lack of quality data on the maritime economy makes the potential of this transformation uncertain (Carreira and Porteiro, 2015).

Academic interest in the subject has been growing in recent years. Recent studies have quantified the blue economy for various countries, such as China, Ireland, Jamaica, the United States, and Scotland (Morrissey et al., 2011; Zhao et al., 2014; Ram et al., 2019; Graziano et al., 2022), along with exploring its determinants (Bhattacharya and Dash, 2021) and the macroeconomic impacts of climate change on the blue economy (Vrontisi et al., 2022).

Given the economic and cultural significance of activities related to the blue economy for Portugal, particularly for the Autonomous Region of the Azores, and recognizing the growing academic relevance of the topic, this article aims to estimate the size of the maritime economy in the Autonomous Region of the Azores and assess its systemic importance to Portugal. To achieve this, utilizing an inter-regional input-output matrix of Portugal for the year 2017 integrated with the Satellite Sea Account (CSM), we employ the partial hypothetical extraction method of the Azorean blue economy to evaluate its significance in the overall Portuguese economy.

The inter-regional matrix of Portugal used in this study is the outcome of the work by Haddad et al. (2023). This matrix disaggregates inter-sectoral exchanges into seven regions: North; Center; Lisbon Metropolitan Area; Alentejo; Algarve; Autonomous Region of the Azores; and Autonomous Region of Madeira. The data are presented in current values for the year 2017. The subject of this study, the Autonomous Region of the Azores, had the smallest contribution to the Portuguese GDP in 2017; its production accounted for 2.1% of the total observed for the country. However, in relative terms, the region both employed a larger workforce and emitted more CO₂ than the Autonomous Region of Madeira: the Azores were responsible for 2.42% of employment (compared to 2.13% for Madeira) and 1.82% of CO₂ emissions (versus 1.69% for Madeira).

To estimate the blue economy of the Azores, data from the Satellite Sea Account (CSM) of the National Institute of Statistics was utilized. The CSM results from a collaborative

effort between the INE and the Directorate-General for Maritime Policy, addressing the need of European countries to harmonize the accounting of maritime activities. Three levels of observations are defined: i) “characteristic activities”, where part of the operations occurs at sea or whose products originate or have a corresponding final activity at sea or on the coast; ii) “cross-cutting activities”, which support other activities considered in the CSM; and iii) “activities favored by proximity to the sea”, including coastal tourism.

The nine groupings are defined following a value chain logic, namely (total production in billion euros for the year 2017 in parentheses): i) Fishing, aquaculture, processing, and marketing of their products (224.2); ii) Non-living marine resources (0); iii) Ports, transport, and logistics (91.9); iv) Recreation, sports, culture, and tourism (203.9); v) Shipbuilding, maintenance, and repair (1.5); vi) Maritime equipment (0); vii) Infrastructure and maritime works (13.6); viii) Maritime services (20.7); and ix) New uses and resources of the sea (0).

The information provided by the CSM details production levels for the nine defined groupings. The reconciliation between each of these groups and the 65 sectors present in the inter-regional input-output matrix is done based on the activity codes. The Economic Activity Code (CAE) of each activity belonging to each CSM grouping is compared with the codes of the activities composing each of the sectors in the NACE Rev.210 classification manual. Through this comparison, the associated production values are redistributed across the 65 sectors, resulting in the estimated production vectors of the maritime economy for the Azores region.

A prerequisite to the reconciliation between the groupings and sectors of the input-output matrix is the distribution, within the activities composing the groups, of the production values reported in the CSM, as the CSM does not provide production values related to the blue economy at the activity level — only at the group level.

Therefore, this study utilizes the inclusion levels of activities in the groupings to perform this procedure. There are three inclusion levels: “fully” sea-related products, “partially” sea-related products, and “residually” sea-related products. For activities “fully” related to the sea, 100% of the observed production of that activity in the year 2017 is used in

calculating the blue economy of the Azores. The remaining CSM production values are distributed among “partially” and “residually” sea-related activities. A weight of 0.5 is assigned to “partially” sea-related activities and 0.1 to “residually” sea-related activities. The total production of the activity in the region in 2017 is then used to weigh the weights and calculate the share that the activity occupies within the grouping. The shares are obtained by normalizing the weighted weights of each group so that the shares of a group always sum to unity.

Once the shares are calculated, production values can be distributed among activities to reorganize them into the 65 sectors of the input-output matrix. The resulting production vector allows the calculation of the portion of the region's total output generated by non-sea-related activities (θ).

The extraction method, initially proposed by Dietzenbacher et al. (1993), involves the hypothetical removal of a region or sector from the input-output matrix. The aim is to measure the potential reduction in the total production of an economy if that sector or region is excluded. This approach allows the analysis of the significance of a sector/region within the economic structure, considering its removal and the subsequent decrease in economic activity. It is crucial to highlight that the systemic impact is greater when there is greater interdependence of that sector with others.

Instead of extracting an entire sector, this study proposes an adaptation of this method, the partial hypothetical extraction. Here, we extract a portion of all sectors according to the share of production linked to the blue economy of each sector, previously estimated. To do this, the matrix of technical coefficients and the final demand vector are multiplied by the θ vector, and the traditional Leontief model is solved to find the new production vector. Subtracting the initial production vector from the new production vector yields the economic loss in the case of an extraction of the blue economy of the Azores—meaning a measure of the relative importance of sea-related activities in the Azores region.

The initial findings reveal that the blue economy of the Azores impacts 0.25% of Portugal's gross production value, holding significance of nearly 12% in the Azores region. The regions where the Azorean maritime economy has greater relevance in

production are the Lisbon Metropolitan Area and the Autonomous Region of Madeira (0.06%), with less importance for the production of the Algarve and Center regions (0.02%).

The relative importance of the Azorean blue economy is also calculated for employment, value-added, taxes, and CO2 emissions. Overall, it is noteworthy that the significance is higher for job generation than for production, accounting for 0.36% for the entire Portugal and 13.46% for the Azores. However, the weight in CO2 emissions is greater than in production (0.26% for Portugal and 12.1% in the Azores), while it is lower in tax revenue (0.23% for Portugal and 10.28% in the Azores).

The study also estimates the importance of the Azorean blue economy for the 65 economic sectors of the input-output matrix. The sectors in Portugal most dependent on the Azorean blue economy are Fishing and aquaculture (6.9%), Water transport (4.11%), Travel agency, tour operator reservation service, and related activities (2.05%), Retail trade, except for motor vehicles and motorcycles (1.05%), and Warehousing and support activities for Transportation (1%).

In parallel with the Portuguese government's efforts to develop the maritime economy in the country, this work aims to contribute to the study of the theme for the economy of the Azores archipelago. The initial results underscore the importance of the Azorean blue economy for the Portuguese economy, particularly in the region itself, with greater significance for sectors more reliant on resources from the sea. The main limitation of the study was the lack of data on the maritime economy at the activity level, which can be addressed as more detailed data becomes available.