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Economic and Financial Drivers of Ocean Economy

Empirical Insights from European Economy

School of Accounting and Finance
Master's thesis in Finance
Master's Programme in Finance

Vaasa 2026

UNIVERSITY OF VAASA

School of Accounting and Finance

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Title of the Thesis: Economic and Financial Drivers of Ocean Economy : Empirical Insights from European Economy

Degree: Master of Science in Economics and Business Administration

Programme: Finance

Supervisor: Niranjan Sapkota

Year: 2026 **Sivumäärä:** 65

ABSTRACT:

This thesis takes a look at the key elements that contribute to the ocean economy in nations that are affiliated with the European Union. Particular attention is paid to taxation, coastal demographics, and commodity pricing, financial development, and inflation. This study makes use of empirical data derived via System Generalised Method of Moments (SGMM) estimations and robustness testing in order to determine the factors that have the most important influence on economic activity that is related with the ocean. Statistics show that the expansion of the coastal population and the increase in taxation both contribute positively to the economy of the ocean, despite the fact that inflation has a negative impact on maritime economies. On the other hand, there is no conclusive association between the economic performance of the ocean and the pricing of goods, the growth of the financial sector, or the exchange rates of currencies. On the basis of these data, one can get the conclusion that in order to boost the economic growth of the ocean, the government ought to give priority to the implementation of appropriate tax systems, the establishment of sustainable coastal districts, and the regulation of inflation. Through the provision of actual data on the economic factors that influence ocean-based businesses, the study contributes to the enhancement of the current body of knowledge. The purpose of this initiative was to exert an effect on the regulations that govern the construction of healthy maritime ecosystems inside the European Union.

KEYWORDS: Ocean Economy, Taxation, Coastal Population, Inflation, Financial Development, Exchange Rate, EU Nations, SGMM Estimation.

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1 Introduction

Local and global civilizations have significant interests in the ocean because it is an essential natural resource and a source of economic opportunity. Despite the fact that they cover more than 70 percent of the earth's surface, the seas are home to 97 percent of the planet's water and are a remarkable repository for a wide variety of organisms. The home of eighty percent of all forms of life. According to the European Commission (2022), it is one of the largest in the world.

A key contributor to the development of jobs and the expansion of the economy, the ocean is also a source of carbon reserves, and it is responsible for producing half of the oxygen that humans breathe.

It is important to note that the OECD (2016) study highlights the oftentimes ambiguous terminology that is applied to the "ocean" economy on page 21: "The term 'ocean' is typically used in Ireland and the United States, whereas the term 'marine' is widely used in Australia, Canada, France, New Zealand, and the United Kingdom." Spain, Norway, and the European Union are three countries that regularly use the term "Maritime." Additionally, whether vocabulary is taken from Japanese, Korean, or Mandarin, it is translated into English in a manner that is distinct from how it is translated into English. Throughout the centuries, the oceans have been a significant contributor to the economic development of human beings. Oil and gas, minerals, and marine foods are some of the natural resources that are harvested from the oceans. These resources are then utilised in the production of pharmaceuticals and chemicals, as well as in other forms of scientific research. In addition to being a significant contributor to both international and domestic trade, ocean freight is a significant source of transportation for heavy goods. According to Nicholls et al. 2020, people are spending their leisure time when on vacations travelling across the border.

The volume of international marine trade, which includes activities such as fishing, offshore wind, marine and shore tourism, and aquatic biotechnology, was anticipated to increase by USD 1.5 trillion in 2010, which is equivalent to 2.5% of the whole volume

of international trade (Sumaila et al., 2021). The recent report “Global Trade Update (June 2025) by UNCTAD” pointed out that in 2023 global ocean trade reached $2.2 trillion, from which $900 billion was for the import and export of tangible products and $1.3 billion for services in the ocean economy. The portion of ocean trade is covering 7% of total global trade. It is also noted that the ocean economy growth between 1995 and 2000 was 2.5 times. Across the globe around 600 million of the world's population are dependent on activities directly interlinked to ocean economy activities. It was also discovered that there was a rapid growth before the COVID-19 epidemic. It was estimated that this value would increase to more than three trillion dollars in the year 2030, which is similar to the GDP of France in the year 2020. Another recent study conducted by European Union, 2022 reveals that ocean economy in European Union is significantly increased in 2022 in comparison to 2021. The ocean economy in European Union employed roughly 4.82 million personal across the sector generating a turnover of approximatly Euro 890 billion. The significant sign of all this report assure us that the European Union fully recovered from the COVID-19 pendemic. Since then, it has been rapidly growing. Therefore, it is important to study ocean economy to have deeper insights into economic systems of European economies.

As an illustration, according to the European Commission (Ecorys, 2012), "the maritime economy is comprised of all the economic activities that are related to the oceans, seas, and coasts, both sectoral and cross-sectoral." The closest direct and indirect supporting activities that are necessary for the functioning of various economic sectors are included in this. Various activities can be located anywhere, including in nations that are landlocked.

"The ocean economy are the economic activities that take place in the ocean, receive outputs from the ocean, and provide goods and services to the ocean," Park proposes after conducting a meta study about existing different worldwide definitions and perceptions of the ocean economy. This definition is almost identical to the one that was proposed by Park. To put it another way, the ocean economy can be described as the economic activities that take place in the ocean, either directly or indirectly, use the

outputs of the ocean, and put the commodities and services into the activities of the ocean (Park, 2014).

Table 1. Some favored definitions of the ocean economy and the blue economy.

Term	Definition	Source
The ocean economy	*"Ocean economy can be defined as the sum of the economic activities of ocean-based industries, and the assets, goods and services of marine ecosystems."*	OECD,2016; P-22
The ocean economy	"*The concept of the Ocean Economy derives from the ocean (or Great Lakes) being a direct or indirect input to the economic activity*."	Colgan, 2007; P-5
The ocean economy	*"The ocean economy can be defined as the economic activities that directly or indirectly take place in the ocean and use outputs from the ocean, while incorporating goods and services into the ocean's economic activities."*	Judith T. Kildow Kwang Seo Park, 2014
The blue economy	"*The blue economy is sustainable use of ocean resources for economic growth, improved livelihoods and jobs, and ocean ecosystem health. "*	The World Bank, 2017
The blue economy	"*A knowledge-based economy, looking to the sea not just for extraction of material goods, but for data and information to address societal challenges and inspire their solutions.*"	Dr. Richard Spinrad
The blue economy	"*The blue economy is associated with marine commercial activities in the seas carried out in an economically efficient way, promoting social inclusion and preserving healthy marine and coastal ecosystems. In other words, it maintains the seas' environmental condition while brings social and economic advantages for both the present and the future*."	Nguyen Thi Hong Nham Le Thanh Ha
The blue economy	"*The blue economy refers to the sustainable utilization of ocean and coastal resources for economic growth, improved livelihoods, and job creation while preserving the health of marine ecosystems.*"	Elegbede et al. ,2023

Source: (Colgan, 2007; Elegbede et al., 2023; Nham and Ha, 2023; NOAA, 2023; Park and Kildow, 2014; OECD, 2016; The World Bank, 2017).

According to Whisnant and Reyes (2015: 6), the blue economy is defined as "the collection of commercial activities, products, services, and investments that are dependent on and have an impact on coastal and marine resources." These activities are environmentally and socially sustainable.

However Lee et al., explains that "the term blue economy has been used in different ways throughout history, and similar terms such as "ocean economy" or "marine economy" are used without clear definitions (Lee et al., 2020)."

Within the framework of the United Nations Sustainable Development Goals (UNSDG), Goal 14 focusses on the preservation of oceans, seas, and marine resources while also ensuring their sustainable utilization. Oceans that are in good health are essential to the existence of humans as well as the well-being of all species on Earth. Approximately 75% of the surface of the world is covered by oceans, which also contain 97% of the earth's water and make up 99% of the living space on the planet in terms of volume. They provide a variety of products, including food, pharmaceuticals, biofuels, and other items, making them an essential source of natural resources. When it comes to the removal of pollutants and the breakdown of waste, oceans play a crucial role, while the coastal ecosystems of these bodies of water defend against storm damage. Furthermore, they act as the greatest carbon sink on Earth, resulting in the absorption of massive quantities of carbon dioxide.

Lee et al. establish a connection between the blue economy and the United Nations Sustainable Development Goals (SDGs), and they come to the conclusion that the objectives that are connected to the blue economy are as follows: underwater life (14), land ecosystems (15), peace, justice, and stable institutions (16), and alliances to achieve the objectives (17) (Lee et al., 2020).

In general, the purpose of all of these definitions that are circulating around ocean and coastal resources is to enable a sustainable utilization of these resources for the pur-

pose of achieving sustainable economic growth, conserving the marine economic environment, and ensuring a prosperous future for our future generations.

Methods of study such as literature analysis, analysis of existing data, and the inference method were utilised in the research that was conducted for this thesis. The information was gathered from a variety of sources, such as the World Bank, the OECD, and the United Nations Conference on Trade and Development (UNCTAD).

1.1 Background and motivation

One of the most important contributors to the expansion and development of the European Union's gross domestic product is the ocean economy, which includes industries such as shipping, sea port services, shipping, on- and off-shore oil and gas exploration, renewable energy, and biotechnology. The activities that are associated to the ocean lead to the creation of millions of employments, which play an important part in the economic growth and stability of coastal nations.

It was pointed that was published by the European Commission that the ocean economy of the EU27 directly employed approximately 4.5 million people who were working in activities related to the ocean. This economy contributed more than €665 billion in revenue and €184 billion in gross value added (GVA), and it plays a significant role in the economy of the EU when we specifically talk about seaside areas (EU blue economy report, 2022). In addition, the report highlighted the fact that the blue economy is crucial to the environmental and climate-related goals of the European Union. Some of the capabilities that are now being developed include the decarbonization of maritime transportation, the promotion of offshore renewable energy technology, and the assistance of recycling management strategies such as ship recycling and the creation of fishing gear that is favorable to the environment.

It is conceivable for ocean-related companies to experience sustainable growth, which will be of assistance in creating policies on the basis of knowledge of the financial and

economic drivers. The identification of suitable sectors and places for renewable energy (such as offshore wind farms), aquaculture, and marine biotechnology is necessary in order to attract the lucrative investment opportunities that are available in the blue economy.

There has been a continued presence of the ocean in the economic activities of all civilizations since the beginning of human history. The ocean has served as a food reservoir, a means of transportation, and a commercial trading route. At present, the phrase "Blue Economy" (BE) has evolved into a notion that is closely connected to maritime assets and enterprises that have formed in the oceans. According to Cristiani (2017), the ongoing development of this technology and the growing requirements of a circular economy (CE) point to the existence of obstacles in both newly developed and already established treatments and materials.

In light of the fact that the oceans' resources are limited and their physical conditions have been endangered as a result of human actions, the objective of ocean economy is to promote economic stability, improve the quality of human development index, and foster social interaction without compromising the environmental sustainability of the oceans, their resources, or their coastal areas (European Commission, 2020).

1.2 Purpose of the study

The objective of this thesis is to identify and investigate a variety of economic and financial elements that have an impact on the expansion, development, and long-term viability of the ocean economy.

The primary purpose of the study is to identify and comprehend the primary economic drivers that contribute to the expansion of the ocean economy. These drivers include ocean-related taxes as a ratio of GDP, coastal population, commodity prices, financial development, inflation, and exchange rate. Other industries, such as shipping, fishing, offshore wind energy, marine biotechnology, and tourism, are also included in this

sector. Additionally, this includes conducting an analysis of the role that private investments, public funds, and creative finance options play in the process.

The objective of this thesis is to investigate the impact that ocean-based enterprises have on gross domestic product, employment, and trade.

1.3 Research gap

The results of this study will greatly enhance our knowledge of the ocean economy and the complex interactions it has with many socioeconomic factors. These results will provide the academic community with a great deal of assistance that will be sent to it. The findings of this study will draw the attention to the factors driving economic activity in the shipping and logistics industry. Consequently, that will give fresh ideas on the dynamics of marine economy. Studying data gathered over 22 years from 27 countries belonging to the European Union's membership can help one to get this understanding. Filling in knowledge gaps and creating a framework for following study would help this academic endeavour to generally extend the present body of knowledge on the ocean economy. A report published in 2023 by the International Monetary Fund forecasted the overall outlook of the world economy and explained that the global growth will slow each year compared to previous years. It is also expected that the global inflation will decline. Steadily over the years due to tighter monetary policy implemented by statutory authorities with the help of lower international commodity prices due to post-pandemic crises and the war in Ukraine. Silva et al. (2024) highlighted the importance of precise economic growth forecasts for decision and policy development for international economic growth. These forecasts are essential for more stable economic estimations, assumptions and future forecasts. Such kinds of forecasts and estimations are crucial and worthwhile for investors and businesses to minimise the risk over investments, estimate uncertainties in markets and capitalise on growth opportunities. Establishing criteria for more research will help to achieve this. Every single stakeholder engaged in the maritime sector inside the European Un-

ion will find the results of this study to be of significant advantage. Many different kinds of business players comprise this group. Included among these stakeholders are companies, politicians, and other groups. Lawmakers have to first fully understand the several factors affecting the quantity of goods flowing through marine channels if they are to properly write laws promoting sustainable development and growth in the blue economy. Legislators need this to be able to draft accurate laws. Some of the kinds of factors that fit this description are taxes connected with the ocean, the dynamics of the population living along the beach, the cost of commodities, the growth of financial markets, inflation, and the rates at which currencies are converted. Furthermore, companies engaged in shipping and logistics can apply the results of this study to guide their investments, operations, and strategic planning, hence increasing their competitiveness and profitability. The results of this study will be of tremendous help to lawmakers and companies hoping to capitalise on the possibilities provided by the ocean economy in order to produce long-term economic development and prosperity inside the European Union. This study was carried out to look at the above-mentioned goals.

1.4 Research hypothesis and questions

This hypothesis is justified because prior research/theory suggests that ocean related taxes influences the overall ocean economy. Therefore, it is expected that ocean related taxes have a strong positive effect on overall ocean economy.

H1: Ocean related taxes affect the ocean economy.

Research Question: What is relationship of ocean related taxes with ocean economy?

H2: Coastal population affected the ocean economy.

This hypothesis is justified through logical reasoning and observation, as costal population has a powerful impact on ocean economy, making it likely that costal population have a solid effect on the ocean economy.

Research Question: How population in coastal areas affect the ocean economy?

The next hypothesis is justified because prior research/theory suggests that commodity prices which is oil prices, influences the overall ocean economy. Therefore, it is expected that commodity prices which is oil prices, have a negative effect on overall ocean economy.

H3: The commodity prices exert influence on ocean economy.

Research Question: What is impact of commodity prices (oil prices) on ocean economy?

This hypothesis is justified because the financial development has a weaker impact on ocean economy, making it likely that financial development have a nominal effect on the ocean economy.

H4: Level of financial development across EU economies affects the ocean economy.

Research Question: Whether and how the financial development level affects ocean economy?

This hypothesis is justified through logical reasoning and observation, as inflation has a negative impact on ocean economy, making it likely that inflation has a effect on the ocean economy.

H5: There is a relationship between inflation level and the ocean economy of EU nations.

Research Question: How inflation level of EU nations affect ocean economy?

1.6 Structure of the thesis

The structure of the thesis consists of six chapters. Chapter 1 is an introduction to the thesis; this chapter tries to paint a picture of the background and purpose of the thesis. The introduction chapter will end with a presentation of the research questions. The second chapter goes through the theoretical framework of ocean economy presenting an overview of the financial and economic drivers of ocean economy, followed by the third chapter that focuses exclusively on literature review. The fourth chapter focuses data, sample and the methodology. Chapter five presents the results of the work presented and discussed. Finally, chapter six concludes the study.

2 Theoretical framework

There is no possible way to overestimate the significance of the oceans' current contribution to the economy of the entire planet. It is so significant that it cannot be discounted. The ocean-based industries and activities are responsible for the creation of hundreds of millions of employment; it is estimated that these businesses and activities contribute around $2.5 trillion to the global economy on an annual basis. The following is an analysis that is more general in nature. According to calculations made by Hoegh Guldberg (2015) and the Intergovernmental Panel on Climate Change (IPCC) in 2019, the economy that is built on the ocean is currently the sixth largest in the world. The conclusions reached by the International Panel on Climate Change lend credence to this assertion.

A significant number of individuals are of the opinion that the oceans represent the "last frontier" for the technological and economic advancement of their life. Approximately 69% of the surface area of the earth is comprised of ecosystems that are found in the open ocean and on the continental shelf. These ecosystems cover a substantial 35.9 million hectares. There is a significant land area here. The physiological significance of these ecosystems arises from the fact that they are responsible for 44.5 percent of the primary production called (photosynthesis) that takes place all over the world (Costanza et al. 1998; Field et al., 1998). This is despite the fact that their output per hectare is very inadequate. This indicates that they are extremely important for the ecosystems that exist on the globe. Because of this, they establish themselves as an essential component of the biological universe. According to Costanza et al. (1997), these ecosystems ought to be considered economically significant because of the contribution they provide to the well-being of humans. The contribution of terrestrial ecosystem services, which is around $12.23 trillion, is roughly equivalent to the ecosystem services that are produced by these ecosystems, which amount to $12.4 trillion. Consequently, this can be explained by the fact that these ecosystems generate ecosystem services that are functionally equal to the contribution made by terrestrial ecosystems.

2.1 Ocean Related Taxes

Ocean taxes can be numerous types of taxes, fees, royalties or levies imposed on activities or entities related to the ocean and marine resources. These taxes can serve multiple purposes, including environmental protection, ecological management of marine resources, funding for coastal and marine protection and conservation efforts, and regulation of maritime activities. The relationship between ocean based taxes and GDP is a major area of research. Ocean related taxes contain to be the major economic contributions of ocean-based industries and environmental policies.

According to a report by the Bureau of Economic Analysis (2018) research, the ocean economy contributed roughly around 1.8% of the U.S. national GDP, amounting to $372.8 billion in 2018. These numbers include sectors such as tourism, national defense, and offshore drilling activities, highlighting the significance of ocean-related industries in the larger economy (Nicolls et al., 2020).

In 2022, 2.0% of EU GDP and 4.8% of total EU government revenue from taxes and social contributions collected, amounting to €317.2 billion in environmental tax revenue account (Eurostat). Eurostat defined an environmental tax as “an environmental tax is a tax whose tax base is a physical unit (or a proxy of it) of something that has a proven, specific negative impact on the environment and which is defined in the European system of accounts (ESA 2010) as a tax”. It is also confirmed by that the share of the tax collection from environmental taxes accounted for 77% of the total in 2022, well ahead of 19% tariffs on transport 19% and 4% on pollution and resources (Eurostat, 2022).

Executing precise taxes on ocean energy production or consumption will potentially influence the implementation and development of marine renewable energy technologies. Sen and Vollebergh (2018) discovered that, for a cluster of OECD nations, higher energy tariffs are associated with significant decline in carbon emissions. Similar findings apply to larger samples including China, where He et al. (2019a) established that environmental taxes reduce pollutant emissions. Hashmi and Alam (2019) investigated

comparable cases and found that, an increase in environmental tax revenue per capita contribute to slight reduction in CO2 emissions in OECD countries. Applying quantile regression, Borozan (2019) shows that energy tax increases energy consumption in lower energy consuming EU countries but at higher quantiles, energy tax insignificantly reduces energy consumption. Similarly, for a group of 15 European countries, Aydin and Esen (2018) also found that environmental taxes have associated not just to emission reduction but also to promote enhanced technological transformation.

Tax revenues collected from ocean-related energy origins can be used for further research and development in ocean economy or used to support coastal neighborhoods and marine conservation efforts.

Further research especially focus on ocean energy taxation will be valuable for policy-makers and stakeholders in the ocean economy sector.

2.2 Coastal population and ocean economy

According to findings of Neumann et al. (2015), around forty percent of the coastal population lives within one hundred km of a coastline. When seen from a geographical perspective, coastal regions exhibit some of the highest population densities on the entire planet. The opportunities for economic development that are associated with industrial activity, tourism, fishing, and maritime trade are the primary variables that are influencing the growth of human settlements in coastal areas. On the other hand, rising urbanization in these regions is associated with severe environmental and socio-economic concerns such as pollution, the loss of habitat, and greater vulnerability to the effects of climate change (Small & Nicholls, 2003).

A greater number of people living in close proximity to the coast helps to foster the growth of industry, increases the number of workers available, and increases the demand for goods and services, all of which contribute to the advancement of the economy. Coastal cities are essential to the economy of both the nation and the world, ac-

cording to Nicholls et al. (2007). This is because coastal cities are integrated into marine trade networks, which makes them extremely important. Companies that are vital to the economy, such as port logistics, fishing, aquaculture, and tourism, are located in coastal locations. These companies generate opportunities for employment and enhance the potential of the economy.

According to McGranahan et al. (2007), urban coastal areas have a tendency to attract investments in infrastructure and enterprises, which ultimately results in an increase in the population density along the beach. It was discovered that there is a positive relationship between its costal population and the gross domestic product (GDP) per capita. Because they offer vast labor markets and a diverse range of business activities, coastal cities serve as engines of economic expansion in a number of different countries.

2.3 Commodity prices and ocean economy

The development of the ocean economy, which includes industries such as maritime transportation, fisheries, offshore energy, aquaculture, shipbuilding, and coastal tourism, is greatly impacted by the fluctuations in the prices of commodities such as oil, gas, seafood, and raw materials by a large amount. The expenses of production, revenues from exports, employment opportunities in maritime-related businesses, and the movement of investment money are all impacted by these prices in a variety of other ways. Because of the close connection that exists between the economy of the ocean and the global commodity markets, fluctuations in the prices of commodities have the potential to have a significant impact on the economic growth and stability of ocean-based economies as well as coastal geographical areas. The most important commodity prices that can affect ocean related economy is international oil prices.

Within the maritime transportation industry, this particular link is one of the most obvious correlations that can be made between the costs of items and the economics of the ocean in general. UNCTAD (2023) estimates that the maritime sector is responsible

for more than 80 percent of the total amount of trade that occurs around the world. Because they are shaped by the demand for commodities and the oil prices of such items, the number of goods that are transported by water is significantly impacted by both of these factors. It has been suggested by Notteboom and Cariou (2011), that an increase in the worldwide price of crude oil could result in an increase in the quantity of commodities that corporations sell on a global scale or the amount of money that these companies produce.

It is possible that the need for shipping and freight rates will be driven by the rising prices of bulk commodities such as coal, iron ore, and grain, which are three of the most important things that are transported by sea. The marine economy would benefit from this in terms of growth. On the other hand, collapsing commodity markets, such as the drop in the price of oil in 2014, result in less money being invested in offshore drilling and as a result, there is less shipping activity. This, in turn, has a negative impact on the profitability of port corporations and shipbuilding businesses (Kilian, 2016).

Especially in countries that border the North Sea, the Gulf of Mexico, and the South China Sea, the offshore oil and gas business is one of the most important pillars that support the economy of the ocean. Both the investment decisions that are being made and the operational profitability of offshore exploration are directly impacted by the prices of commodities, particularly crude oil. According to the International Energy Agency (IEA), rising oil prices typically result in increased exploration, increased employment opportunities, and increased infrastructure growth.

When the price of oil falls below a certain level that is considered profitable, exploration and production efforts are either put on hold or completely halted. In the article that he wrote in 2012, Smith asserts that the fluctuation of oil prices is a significant source of uncertainty, which in turn hinders long-term investments in maritime energy infrastructure and innovation. Consequently, fluctuations in the price of oil could result in instability in regions that are highly dependent on resources located offshore.

In a similar way, the price of commodities has an impact on the essential components of the maritime economy, which include aquaculture and fisheries. When it comes to

profitability, factors such as fish feed pricing, fuel prices for fishing vessels, and conditions in the export market all play relevant roles. The loss of profit margins that small-scale fishermen experience as a result of rising input costs has the potential to impact not only their output but also their employment opportunities (World Bank, 2020).

The global demand for seafood and the price of seafood are two factors that have the potential to influence the ability of fish supply to be sustained over the course of time. A rise in the price of fish could result in an increase in the number of catches, which could eventually exceed the limits that are sustainable. The authors Sumaila et al. (2007), assert that this raises concerns over excessive fishing as well as the damage it does to the environment. In addition, rising commodity prices mean that aquaculture businesses will have to bear increased costs for distribution, maintenance, and feed, which may have an impact on the economic production of the industry in the United States.

The unpredictable nature of commodity prices is identified as one of the most significant challenges associated with the pricing of commodities. This variation has a surprising impact on the marine economy in ways that were not anticipated. According to Hamilton (2009), small island developing countries (SIDS) that are dependent on maritime resources and tourism may experience a scenario of economic instability if they see changes in price. These regions are vulnerable to shocks on both the demand and supply sides, which could consequently result in a considerable decrease in the amount of money generated from foreign exchange as well as the number of employment opportunities that are available.

Ocean economies will be able to investigate the possibility of significantly reducing their sensitivity to variations in commodity prices if they incorporate a diverse range of income streams into the blue economy. Each and every one of these economic streams, such as fisheries, marine tourism, and renewable energy sources, ought to be represented. Through the implementation of catch limits that are strictly regulated and the provision of financial incentives that encourage responsible behavior, sustainable fishing practices are encouraged (FAO, 2022).

It will be possible to lessen reliance on markets for fossil fuels if investments are made in alternative energy choices such as offshore wind turbines.

Enhancing the accuracy of market information systems and forecasting tools will allow for more accurate estimates to be provided and will also allow for more effective control of cost fluctuations. There is a significant influence that the prices of commodities have on the direction that the marine economy takes. Their impact has repercussions for a variety of elements, including but not limited to the overall economic stability, fishing, offshore energy, transportation, trade, and trade. There is a possibility that high prices would drive expansion and investment; yet, shifts and reductions will put the industry in a precarious situation. The development of sustainable regulatory systems, investments in diversification, and economic resilience planning are all necessary steps that must be taken in order to guarantee that the marine economy will continue to be robust in spite of fluctuations in the prices of global commodities.

2.4 Financial development and ocean economy

One of the most important factors that contribute to long-term economic expansion is the progressive development of the financial sector, particularly with regard to the effectiveness, scope, accessibility, and consistency of financial institutions and markets. In the framework of the ocean economy, which encompasses industries such as maritime transport, fishing, shipbuilding, coastal tourism, and offshore energy, the accumulation of funds, the management of risks, the development of new financing techniques, and the investment in infrastructure are all made feasible through the process of financial development (Levine, 2005). With its extensive coastline and economic activity that is mostly concentrated on the water, the European Union (EU) is an ideal location for doing research on the ways in which the growth of the financial sector impacts businesses that are located along the coast and in the maritime environment.

Investments in ocean infrastructure and innovation are made easier when there is access to financial institutions that are managed effectively. Banks, insurance companies, and capital markets are some examples of these types of organizations. Tidal energy and offshore wind farms are two examples of projects that demand a significant initial investment and have a lengthy payback time. Other examples include projects that use marine renewable energy. As stated by the organization for Economic Co-operation and Development (OECD), in countries that are considered to be financially advanced, the utilization of long-term loans and capital market instruments results in a reduction in the cost of capital and an improvement in investor confidence.

According to Beck, Demirguc-Kunt, and Levine (2000), financial development is advantageous for economic growth because it reduces the risks associated with economic expansion, it stimulates the efficient distribution of capital, and it raises the amount of savings that are made. Countries that have well-developed financial sectors, such as Germany, the Netherlands, and France, are in a better position within the framework of the European Union to fund and scale blue economy initiatives such as port modernization, green shipping technology, and sustainable fisheries. This is in comparison to countries that have less developed financial sectors.

Furthermore, in addition to facilitating access to credit, venture capital, and microfinance, financial systems also encourage entrepreneurial activity in the maritime and coastal industries. Initial capital and creative financing are essential for the establishment of new firms, especially those operating in the maritime technology sector. Smart fishing gear, marine robotics, and underwater drones are some examples of these types of technologies. It has been suggested by Caldecott et al. (2018), that environmentally friendly technologies, ocean monitoring tools, and circular economy models for marine plastics and rubbish can all contribute to the acceleration of the transition to a sustainable blue economy.

The BlueInvest platform of the European Union (EU) is a specific financial platform that establishes connections between investors and blue economy startups as well as small and medium-sized enterprises (SMEs). The platform serves as an example of how

ocean industries can address funding deficiencies. Countries that are wealthy and have powerful regulatory frameworks and more complicated financial ecosystems will find these kinds of efforts to be of considerable benefits.

Further factors that contribute to the resilience of coastal communities is the increase of financial resources, which makes it possible for people and small companies to obtain insurance, loans, and savings saves. Coastal economies that are based on fishing, aquaculture, and tourism are frequently susceptible to climate-related threats such as storms, increasing sea levels, and declining fish populations, amongst other factors. By providing safety nets, working capital, and investments in risk-mitigation infrastructure, financial inclusion has the potential to alleviate poverty and strengthen communities, as stated by De la Torre, Ize, and Schmukler (2011). In every one of these ways, financial inclusion contributes to the accomplishment of these objectives.

For instance, in nations that have more established financial markets, it is more typical to discover insurance solutions that are specifically tailored for fishermen. Insurance that is indexed to the weather and cover equipment are included in these products. On the other hand, member states of the European Union that have less developed financial sectors may have a difficult time providing assistance comparable to that of other countries, which would result in discrepancies in the economic opportunities and the ability to exert influence.

Despite the fact that it could be advantageous, the expansion of financial resources does not necessarily offer advantages to every facet of the maritime industry. According to Volz et al. (2020) research, banks in some EU countries would place a higher priority on short-term profits than they would on long-term environmental sustainability. This would lead to investments in marine ecosystem services and conservation being underfunded. Furthermore, informal maritime companies and small-scale fishermen lack official documents or collateral, which makes it more difficult for them to secure financing (World Bank, 2017). This circumstance makes it more difficult for them to obtain funding.

Especially for blue economy activities that require transnational cooperation, such as deep-sea exploration or the conservation of marine species, the legal variation that exists across EU member states may make it even more difficult for funding to move across borders.

It is recommended that the individual take the following actions in order to enhance the role of financial development in supporting the maritime economy:

Through the use of digital banking and targeted microfinance efforts, the financial inclusion of coastal communities and small and medium-sized businesses (SMEs) should be improved.

The United Nations Development Programme (UNDP) recommends the use of green finance approaches, such as blue bonds, in order to bolster sustainable ocean investments.

In order to promote investments in maritime infrastructure that spans international boundaries, it will be helpful to harmonies the regulatory regimes of all of the countries that are members of the European Union.

Institutional investors are drawn to public-private partnerships (PPPs), which also contribute to the reduction of risk associated with large-scale marine projects.

There is a direct correlation between the degree to which member states of the European Union have successfully reinforced their financial systems and the trajectory of the maritime industry. Countries that have reinforced their financial institutions are able to construct a blue economy that is more resilient and sustainable. This is accomplished by improving their access to money, stimulating innovation, and implementing steps to strengthen the resilience of their communities. Efforts that are focused are required in order to close the gap in financial inclusion, encourage sustainable financing, and connect financial institutions with long-term ocean stewardship objectives. Under these circumstances, the maritime economy will be able to realize its full potential over the entirety of the European Union.

2.5 Inflation and ocean economy

Inflation, which is commonly understood to be the steady increase in the overall price level of goods and services within an economy, has an impact on virtually every sector of the economy, including the maritime sector. In the countries that make up the European Union (EU), which are locations in which the ocean economy plays a significant role through industries such as fisheries, maritime transport, coastal tourism, marine biotechnology, and offshore energy, inflation can have an effect on both the operational expenses and the consumer demand. It is of the utmost importance that this relationship exists at this very moment, especially considering that the European Union is still in the process of building its blue economy strategy, which places an emphasis on economic resilience and sustainability.

There is a relationship between inflation and an increase in the price of inputs such as petrol, maintenance, equipment, labor, and raw materials. With regard to the maritime and coastal sectors, each and every one of these is an absolute must. Fishing boats, cargo ships, and cruise liners all see considerable increases in their operational expenses as a result of rising fuel prices, which are caused by inflationary pressures among other factors. There is a possibility that fuel might account for as much as sixty percent of the variable cost of a vessel (Stopford, 2006). As a result, inflation poses a direct threat to the profitability and competitiveness of the shipping industry and related ocean economy. Because of this cost-push inflation situation, businesses might be forced to either reduce their production, delay their investment in more advanced technologies (like environmentally friendly shipping), or pass costs on to their customers. This would result in marine goods and services becoming more expensive and less accessible to consumers.

The coastal tourism industry which is part of ocean economy, which plays a significant role in the economic well-being of the ocean in southern European Union countries such as Spain, Italy, and Greece, is also susceptible to the effects of inflation. Inflation

has a tendency to reduce the amount of disposable income that consumers have, which in turn reduces the demand for leisure activities that are not essential. Dogru, Mody, & Suess, (2019), discovered some of these activities include going on cruises, attending beach vacations, and participating in marine recreation. It is possible that this will lead to decreased profitability for businesses located along the coast, as well as job losses in regions that are highly dependent on tourism.

There is also a connection between inflation and the number of tourists from other countries, particularly when the value of the local currency decreases and travel becomes more expensive. According to Eurostat (2022), this pattern has been apparent during the post-COVID inflationary surge that occurred between 2021 and 2022. During this historical period, the level of tourism activity in various coastal economies of the European Union fluctuated in connection to the volatility of prices.

In the fisheries and aquaculture industries, inflation drives up the cost of inputs such as fish feed, equipment, transportation, and electricity. These inputs are all essential for maintaining operations and cold chain logistics, and they are all significantly increased by inflation. According to the Food and Agriculture organization of the United Nations (2022), small-scale fishermen and aquaculture producers face substantial hurdles as a result of inflation-driven increases in input costs. This is especially true in regions that are sensitive to price fluctuations. In the event that rising production costs are not compensated by an increase in market prices for fish products, increased production costs have the potential to reduce the profitability of the business and put its viability at risk.

Additionally, inflation does have an effect on the competitiveness of enterprises who export goods. There is a possibility that marine product exports could become somewhat more expensive if one EU nation experiences higher inflation in comparison to its trading partners. In light of this, it is possible that buyers from other countries may lose interest, which would contribute to the worsening of trade balances.

Increasing interest rates is one strategy that central banks like the European Central Bank (ECB) might choose to implement in order to combat inflation. This decision may

have an impact on the finance of long-term marine projects that are currently available on the market, as well as investments in maritime infrastructure. While the cost of borrowing money continues to climb, firms and governments may choose to reduce their investment on marine conservation programs, blue energy initiatives, or port modernization, or they may choose to suspend their spending altogether.

This tightening of monetary policy could be detrimental to the expansion of the marine economy, particularly in industries that are dependent on projects that require a significant amount of money. As an illustration, increased interest rates on loans could discourage financing for offshore wind farms, which are essential to the transition of the European Union to green energy.

Inflation may also have an effect on the pay expectations of workers and the dynamics of the labor market in industries that are connected to the water and coastal areas. It is possible that workers in the tourist, transportation, and fishing industries would like to get higher pay in order to preserve their purchasing power, which would then result in an increase in operating costs. It has been established by the International workplace Organisation (2021) that inflationary conditions are typically associated with workplace unrest or greater turnover rates. As a consequence of this, marine firms that are dependent on seasonal or low-wage personnel may experience a loss of stability.

In nations where employment protection rules are very stringent, it is possible that compensation increases can lag behind inflation. It is possible that this will result in a genuine decrease in salaries, a decrease in job satisfaction, and a decrease in productivity, particularly in blue economy industries that are highly dependent on labor. Because of the intricate relationship that exists between inflation and the ocean economy, it is imperative that public policy be implemented. During times of high inflation, one of the suggestions is to provide financial assistance to small marine businesses in order to cover the costs of the necessary inputs, such as petrol or feed.

Efforts are being made to improve the systems that monitor and maintain price stability for essential maritime goods. Marine companies can benefit from the support of

financial hedging methods and insurance programs, which helps to mitigate the impact of inflation on these enterprises. When it comes to projects that are associated with the blue economy, it is necessary to encourage public-private partnerships that are able to withstand inflationary shocks. A greater emphasis should be placed on regional coordination through EU channels in order to guarantee that the effects of inflation will not be unfairly felt by coastal regions or smaller member states.

The ocean economy of EU countries is affected by inflation in a variety of ways, including an increase in the expenses of operations and investments, a decrease in consumer demand, and a decline in export competitiveness. Those industries that are part of the blue economy, which are dependent on consistent prices, cheap lending, and consistent customer behavior, are particularly susceptible to the consequences of inflation. In spite of the fact that it may appear to be a problem with the macro economy, inflation has significant repercussions. Policymakers and corporate leaders need to be vigilant and take preventative measures in order to safeguard the lives of people who are dependent on the ocean and to continue making progress towards the sustainable ocean economy goals of the European Union.

2.6 Exchange rates and ocean economy

Competition, the flow of capital, and international trade are all significantly impacted by exchange rates, which constitute a significant macroeconomic element. To put it another way, exchange rates are the factors that determine how much one currency is worth in comparison to another. Within the context of the ocean economy of the European Union, fluctuations in exchange rates have an impact on industries such as marine trade, fisheries, tourism, offshore energy, and shipbuilding. All of these companies are interconnected on a worldwide scale and are heavily dependent on investments, imports, and exports from other countries (European Commission, 2021).

Due to the fact that the European Union engages in extensive trade with countries such as the United States of America, China, the United Kingdom, and Japan, fluctua-

tions in the exchange rate of the euro in relation to these key trading partners have the potential to significantly alter price dynamics, trade balances, and the viability of industries that are based on marine resources.

In addition to being an essential part of the maritime economy, maritime transport is heavily reliant on the flow of international trade. A devalued euro makes exports from the European Union more competitive by lowering the prices of those products in international markets compared to the value of the euro. In addition to European Union-based businesses, this will be beneficial to shipping companies, port authorities, exporters of marine products and technology, and other businesses. It is possible that a stronger euro would make exports from the European Union less appealing, which would lead to an increase in imports, which would be detrimental to local businesses (Stopford, 2009).

It has been suggested by Krugman and Obstfeld (2018), that fluctuations in exchange rates have the potential to influence trade elasticity, which in turn would have an impact on the quantity and value of market activity. As an illustration, if the value of the euro were to decrease in comparison to the dollar, naval equipment manufactured in Germany or the Netherlands may become more appealing to purchasers in the United States and Asia, which would result in an increase in the amount of money earned from exports.

It is important to note that the fisheries and aquaculture industry lays a significant emphasis on exports, particularly in nations such as Spain, Denmark, and Ireland. Changes in the currency rate have a direct impact on the degree to which seafood exports provide prices that are competitive with those of other products. If the euro continues to decline in value, fish exporters in the European Union will see a rise in their earnings when translated to euros, which will ultimately lead to an increase in their profitability. According to the Food and Agriculture Organization of the United Nations (2022), the global competitiveness in seafood markets, particularly from Asia and South America, contributes to the significance of this dynamic, which is particularly essential.

According to the Organisation for Economic Cooperation and Development (OECD), the depreciation of the euro makes it more expensive to import fish feed, equipment, and fuel, all of which are often purchased in US dollars. This could result in an increase in production costs. It is imperative that governments and manufacturers exercise extreme caution in order to effectively manage the trade-off that exists between the costs of inputs and the revenue generated outside.

In addition, fluctuations in currency rates have an impact on the beach tourism industry, which constitutes a sizeable portion of the blue economy in nations located in the southern region of the European Union. As the value of the euro decreases in comparison to other major currencies, travel to the European Union (EU) becomes more affordable for tourists from other countries. This, in turn, attracts a greater number of tourists, increases the number of hotels that are occupied, and encourages local households to spend more money. Research conducted by Dogru, Mody, and Suess (2019), suggest that favorable exchange rates have a significant influence on the number of tourists from other countries that visit the country.

On the other hand, a stronger euro can discourage tourists from other countries and lower the competitiveness of cruise operators located in the European Union in international tourism markets. Additionally, alterations in the currency have an impact on consumer behavior inside the European Union, which in turn has an impact on domestic tourist trends, particularly in countries that are located on the periphery of the Eurozone and are more sensitive to price variation.

It is also important to note that exchange rates are another factor that influences the flow of money into marine infrastructure projects. These activities include the construction of shipbuilding facilities, the expansion of ports, and offshore wind farms. A significant number of these initiatives are dependent on either foreign direct investment (FDI) or partnerships with businesses from all around the world. According to the report that was published by the United Nations Conference on Trade and Development (2020), a weak or unpredictable euro might either discourage foreign investment

due to the perceived danger that is associated with currency rates or encourage it due to decreased entry costs.

The devaluation of the euro also results in an increase in capital expenditures because components for offshore projects are frequently imported from countries that are not members of the European Union. It is highly probable that this will make ocean economy initiatives less financially viable, unless it is compensated for by increased income estimates or by subsidies from the government.

The use of currency hedging techniques, such as forward contracts, options, and swaps, is becoming increasingly prevalent among enterprises operating in the ocean economy in order to mitigate the risks associated with fluctuations in exchange rates. According to Levine (2005), the ability of organizations to effectively control volatility is enhanced by the growth of their financial resources. On the other hand, smaller businesses operating in the fisheries or coastal tourism industries might not have access to such tools, which makes them more susceptible to being impacted by adverse currency changes.

Therefore, fluctuations in exchange rates could have a disproportionate impact on small and medium-sized businesses (SMEs) that are located in coastal areas. This highlights the necessity of implementing policies that improve financial inclusion and government assistance systems in maritime industries.

The effects of currency rates are not uniformly distributed within the European Union. There is a possibility that countries that are export-oriented, such as Germany or the Netherlands, could benefit from the devaluation of the euro. This is in contrast to countries that are dependent on imports or tourism, such as Greece or Portugal, which may see complicated effects. As a consequence of this, the European Central Bank (ECB) is in charge of controlling the policy of currency rates, which must take into account regional differences in exposure and risk within the maritime economy of the EU.

To increase the level of understanding on the management of currency risk for marine businesses those are small and medium in size.

We are assisting in the development of investment funds for the blue economy that include hedging elements.

We will be monitoring changes in exchange rates, which may have an impact on the competitiveness of blue industries, in collaboration with the European Central Bank.

The exchange rate, which is critical to the expansion of the economy, has a significant influence on the prosperity and consistency of the maritime economy in the countries that make up the European Union. The effects that it has on commerce, tourism, investments, and operating expenses have an impact not only on the potential for short-term growth but also on the potential for long-term growth. If policymakers and business leaders want to increase the resilience and global competitiveness of Europe's blue economy, they must first understand the connection between the two.

3 Literature review

Conducting a literature review and evaluation on the ocean economy aims to explore the current studies, methods, findings, and theoretical frameworks linked to economic and financial activities related to the ocean. The goal of the study is this. Included in this area includes a variety of activities such fishing, travel, transportation, and the use of renewable energy sources. This paper addresses a broad spectrum of topics, some of which are as follows: measurement and categorization techniques; projects for a sustainable ocean economy; the influence of multinational companies; blue growth threats and possible solutions to these challenges; and the consequences of climate change on the ocean economy. This literature review is to provide a summary of the results of studies on the most important economic and financial concerns affecting the economics of the ocean. This study aims to show

Jolly, Stevens, and Jolliffe (2021) claim that the ocean economy is made up of a great diversity of economic activity. These events comprise a great range of economic ones. Among the usual companies that fit this description are biotechnology and oceanic renewable energy, among others. Moreover, this category includes sectors experiencing fast growth including maritime transportation, coastal tourism, the extraction and exploitation of marine life and non-living resources, as well as the bio-economy (Jolly, Stevens, and Jolliffe, 2021). Among such businesses is the bio-economy.

3.1 Previous main studies

A worldwide policy objective that promotes sustainable ocean usage for the benefit of all members of society is said to be in conflict with the unequal distribution of benefits, according to the United Nations (2015).

A number of recent research have concentrated on the development of methods that are capable of evaluating and quantifying the economy of the ocean. On the other hand, O'Donoghue et al. (2022) presented an ESE framework, which stands for eco-

nomic, social, spatial, and environmental. By combining input-output modelling with microsimulation, this approach is intended to investigate the influence that is associated with the maritime industry. Zhao et al. (2013) presented an approach that might be used to evaluate the maritime economy of China. Through the year 2010, the ocean economy contributed $239.09 billion to the overall economy of the nation and provided employment for more than 9 million people.

It is possible that economic activities that are based on the ocean could be beneficial to national economies in terms of employment and financial gain, as well as to local communities and visitors to coastal and marine environments. Additionally, these activities could be financially beneficial to governments through taxation and rent payments, access agreement payments, and opportunities for livelihood and social interaction. According to Hoegh-Guldberg (2015), Lillebø et al. (2017), Cicin-Sain (2015), and OECD (2016), the estimated value of key ocean assets in the United States is over $24 trillion. This is despite the fact that the annual value of services generated from these assets is predicted to be between $1.5 and $6 trillion.

In the paper that he wrote in 2003, Colgan investigated the theoretical underpinnings of a variety of metrics, one of which was gross domestic product. He also included specifics of the data sources and methods that were utilized to investigate the economy of the ocean and coastal areas. It is the purpose of this research to explain the theoretical underpinnings and methodologies that are utilized in the process of analyzing the economy of coastal areas and the ocean. Drawing attention to the necessity of a macroeconomic framework to better ocean economic research and policy studies, Pontecorvo (2019), cited the Nathan Report's effort to estimate the gross value of output from ocean resources. This was done in order to improve the quality of ocean economic research and studies. When all of these studies are considered together, the findings demonstrate that it is becoming increasingly important to employ stringent techniques in order to evaluate the value and impact of the ocean economy.

4 Data and methodologies

4.1 Data, variables and measurement

The ocean economy also known as the blue economy always plays an important role in global economic settings. This includes wide range of activities, comprising but not limited to fishing, ocean transport, tourism, and renewable energy generation. The sector's economic contributions are substantial, with shipping and logistics being essential components that drive its growth. Dependent variable is Ocean Economy also known as blue economy. The proxy for this variable is volume of goods transported via maritime routes, which indicates the economic activity generated by shipping and logistics. Alternatively, it can also be measured using marine protected area. Data of first proxy will be gathered from United Nation UNCTAD data center. The independent variables include ocean related taxes as ratio of GDP, coastal population, commodity prices, financial development, inflation and exchange rate. Data of these variables will be obtained from OECD and UN databases. This thesis studied on the dependent variable, the ocean economy, and its proxies, along with the independent variables that influence it, including data sources and their significance.

4.2 Dependent and independent variable

Ocecon : Ocean Economy (DV)

Taxes: Taxes to GDP ratio (IV)

popul: Natural log of total population (IV)

comod: Commodity prices measured through Oil Rents (IV)

fd: financial development measured through ratio of private sector credit to GDP ratio (IV)

Infl: Inflation measured through consumer price index (IV)

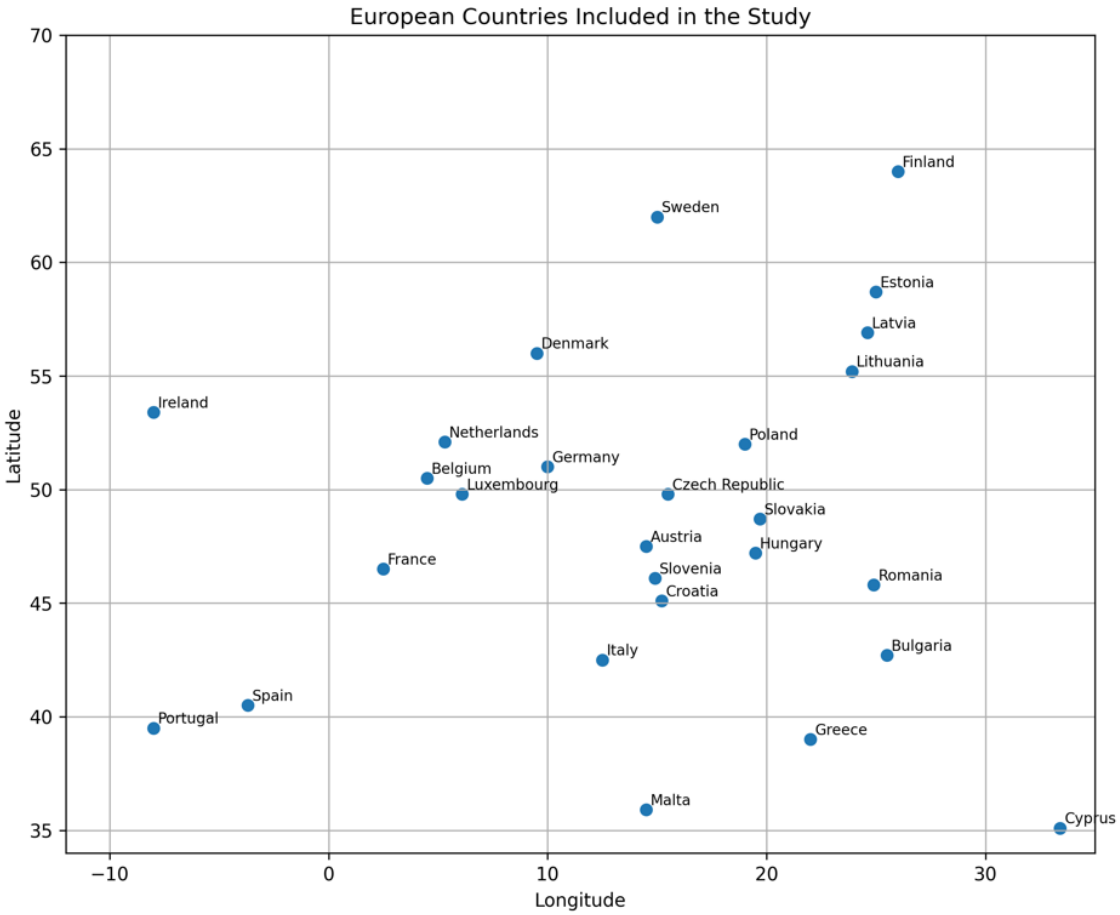
Table 2. summarises the dependent and independent variables.

Serial#	Variable Name	Description	Variable	Variable Code
1	Ocecon	Ocean Economy	Dependent	DV
2	Taxes	Taxes to GDP ratio	Independent	IV
3	popul	Natural log of total population	Independent	IV
4	comod	Commodity prices measured through Oil Rents	Independent	IV
5	fd	financial development measured through ratio of private sector credit to GDP ratio	Independent	IV
6	Infl	Inflation measured through consumer price index	Independent	IV

4.3 Time period and data

The time period of data is 22 years from 2001 to 2022. Whereas data of second proxy was obtained from OECD database. Sample economies are 27 EU countries. The data for this study is consisting over the 27 member countries of the European Union; it is, therefore, the place where diversity and representation are gained. The EU countries have varying coastal areas and exhibit various levels of dependence on the ocean economy, making them an idle sample for this study. The countries included are presented in table 3 below;

Table 3. Countries included in dataset.



4.4 SGMM estimation model

Chen et al. (2025) introduce stochastic generalized method of moments (SGMM) as an algorithm that will be used in this thesis as an estimation method. This technique alternates the Generalized Method of Moments (GMM) which is a broad class of estimators, as the sample size substantially increases and gains over , the accuracy in SGMM performance increases as comparable to traditional GMM, that uses moment conditions implied by economic theory rather than a full likelihood function. The lagged value of the ocean economy is significant, which suggests that SGMM is the appropriate econometric technique to model the relationship of the ocean economy with explanatory variables.

4.5 Descriptive statistics

The article by Sharma et al. (2018) highlights the significance of descriptive statistics as a tool for effectively summarizing and presenting data in a relevant manner. There are two sub-branches that fall under the umbrella of descriptive statistics. These sub-branches are known as "Measures of Central Tendency" and "Measures of Dispersion." For the goal of describing and summarizing fundamental characteristics of a dataset that has been gathered from a sample, such as the central tendency, dispersion, and distribution shape of the dataset, descriptive statistics are utilized. The ultimate objective of descriptive statistics is to convert a high volume of datasets into information that is both relevant and easier to comprehend for those who are responsible for making decisions. The minimum, the maximum, the range, the percentiles, the mean, the median, the mode, the standard deviation, the variance, the skewness, and the kurtosis are all examples of common descriptive statistics (Lee, 2020).

According to Kaur et al. (2018), descriptive statistics are an essential component of the first data analysis process in research and should immediately precede inferential statistical comparisons. In Measures of Central Tendency, we examine the population as well as a sample of the population with the assistance of Mean, which is the average of the date, Median, which is the value that falls in the middle of the date, and Mode, which is the value or values that occur the most frequently. In addition to assisting in the description of correlations between variables in populations or samples (Kaur et al., 2018), it can also show patterns in data (Downie & Starry, 2019). With the assistance of Range, Standard Deviation, Quartile Deviation, Absolute Deviation, and Variance, this section of Measures of Dispersion allows us to do an analysis of both the entire population and a sample of the population. On the other hand, descriptive statistics by themselves do not permit drawing inferences that go beyond the data that has been analyzed or testing the hypothesis (Downie & Starry, 2019).

4.6 Hausman test

It is a typical practice in the field of econometrics to compare two estimators under the assumption that both of them are consistent, but that one of them is more efficient than the other. This is done on the theory that one estimator is more efficient than the other. For the goal of evaluating model misspecification, specifically for the purpose of detecting endogenous regressors, the Hausman test is utilized widely in the field of econometrics (Chmelarova & Hill, 2004). This is done in order to determine whether or not the model is misspecific. The Hausman test is a statistical method that is used to examine whether or not an estimator was consistent and efficient in relation to either an alternative estimator or another estimator. Under the premise of the null hypothesis, it distinguishes between estimators that are efficient and those that are consistent in the majority of circumstances (Ranger & Much, 2020). This is accomplished by comparing estimates from a number of different estimators. In the field of item response theory, the Hausman test can be utilized to assess both the fit of individual items and the fit of the global model. Despite the fact that it has a limited power for detecting violations of conditional independence, it displays good performance when applied to large samples (Ranger & Much, 2020). According to Creel (2003), the Hausman test (Hausman, 1978) is based on the idea that the difference between two consistent estimators is typically equal to zero. This is the premise upon which the test is based. Let's say that one of the estimators, denoted by the symbol θˆ1, is consistent when the correct specification is assumed to be the null. However, when the alternative is taken into consideration, it becomes inconsistent. According to the alternate estimator, which is represented by the symbol θˆ2, it is possible to assert that it is in agreement with both the null hypothesis and the alternative hypothesis. When considering the alternative hypothesis of misspecification, it is expected that the value of $\boldsymbol{K}1$ will not be consistent, whereas the value of $\boldsymbol{K}2$ will continue to be consistent. Within the context of this specific case, the difference vector, denoted as $\Delta = \boldsymbol{K}2 - \boldsymbol{K}1$, will exhibit a probability limit that is not equal to zero. The null hypothesis of accurate specification cation will be rejected as a consequence of this, which will ultimately result in the test statistic. As said by Creel in 2003.

Chmelarova (2007), came to the conclusion that the Hausman (1978) test, which is more convenient, is based on the idea of looking for a statistically significant difference between an efficient estimator under the null hypothesis of no misspecification and a consistent estimator under the alternative hypothesis that misspecification is present. This was the conclusion that Chmelarova (2007) reached. Chmelarova (2012) states that when dealing with heteroskedastic data, it may be necessary to utilize various methods such as robust standard errors or generalized least squares methodology. This is because heteroskedastic data might be difficult to analyze. On the other hand, its application can be challenging to put into practice in certain situations.

5 Results and discussion

Chapter 5 reports data analysis, which includes descriptive statistics, multicollinearity analysis using a correlation matrix, and examination of causal relationships.

5.1 Descriptive statistics

Table 1 summarizes descriptive statistics of variables using 572 observations of data of 26 European economies over time period from 2001 to 2022. The above table contains mean value, standard deviation, minimum values, maximum values, skewness and kurtosis. Each of these variables is an important economic indicator, and knowing these figures is vital in economic studies and policy making.

Table 4: Descriptive statistics

Variables	Mean	Std. Dev.	Min	Max	Skew.	Kurt.
Ocean Economy	9.299	1.967	0.267	12.785	-0.695	4.363
Taxes	0.300	1.154	0.104	16.166	13.633	187.467
Population	15.847	1.587	0.013	18.244	-3.463	35.876
Commodity Prices	0.146	0.308	0.000	1.704	2.812	10.400
Financial Development	0.854	0.547	0.002	8.369	5.44	69.664
Inflation	2.768	3.335	-4.448	34.477	3.373	22.770

Ocean economy is a dependent variable of the study. The mean value of ocean economy is 9.299, whereas the deviation from the mean value is 1.967, indicating moderate variation, which reflects differences in economic performance among observations. The minimum value is 0.267, and the maximum value is 12.785. Skewness of the data for the ocean economy is -0.695, which is negatively skewed, meaning that the average value of the ocean economy is less than the median, so the data distribution is stretched towards the lower values. Kurtosis of the data distribution

is 4.363, which is leptokurtic, higher than the mesokurtic, explaining that the sample distribution has thicker tails and a sharper top than a normal distribution.

Moving further, tax is an independent variable of the study for which the average value is 0.300, whereas the standard deviation is 1.154, indicating moderate variation, which reflects differences in economic performance among observations. The minimum value is 0.104, and the maximum value is 16.166. Skewness of the data for taxes is 13.633, which is positively skewed, meaning that the average value of the taxes is greater than the median, so the data distribution is stretched towards the higher values. Kurtosis of the data distribution is 187.467, which is leptokurtic, higher than the mesokurtic, explaining that the sample distribution has thicker tails and a sharper top than a normal distribution.

The next independent variable is population for which the arithmetic mean value of this sample is 15.847, whereas the standard error is 1.587. The minimum value is 0.013, and the maximum value is 18.244. Skewness of the data for population is -3.463, which is negatively skewed, meaning that the average value of the population is less than the median, so the data distribution is stretched towards the lower values. Kurtosis of the data distribution is 35.876, which is leptokurtic, higher than the mesokurtic, explaining that the sample distribution has thicker tails and a sharper top than a normal distribution.

Furthermore, commodity prices is an independent variable for which the mean value is 0.146, whereas the standard deviation is 0.308. The minimum value is 0.000, and the maximum value is 1.704. Skewness of the data for commodity prices is 2.812, which is positively (right) skewed, meaning that the average value of the commodity prices is greater than the median, so the data distribution is stretched towards the higher values. Kurtosis of the data distribution is 10.400, which is leptokurtic, higher than the mesokurtic, explaining that the sample distribution has thicker tails and a sharper top than a normal distribution.

Moreover, financial development is an independent variable for which the mean value is 0.854, whereas the standard deviation is 0.547. The minimum value is 0.002, and the

maximum value is 8.369. Higher financial development shows enhanced banking, financial market, and banking efficiency access. Moderate financial development is indicated by an average of 0.854, while a lower figure of 0.002 indicates that there are economies with virtually no existence of a financial sector. Levine (1997) found that finance is a growth imperative in economies, facilitating enhanced capital allocation and reduction of asymmetrical information. Skewness of the data for financial development is 5.44, which is positively skewed, meaning that the average value of the financial development is greater than the median, so the data distribution is stretched towards the higher values. Kurtosis of the data distribution is 69.664, which is leptokurtic, higher than the mesokurtic, explaining that the sample distribution has thicker tails and a sharper top than a normal distribution.

Lastly, inflation is an independent variable having average value of 2.768, consistent with low and stable levels of inflation in a majority of economies, whereas the standard deviation is 3.335. The high standard deviation shows a large variability from the average value. The minimum value is -4.448, and the maximum value is 34.477, indicating cases of risk of hyperinflation. For Fischer (1993), moderate inflation can fund growth, whereas excessive inflation discourages investment and actual earnings. Skewness of the data for inflation is 3.373, which is positively skewed, meaning that the average value of the inflation is greater than the median, so the data distribution is stretched towards the higher values. Kurtosis of the data distribution is 22.770, which is leptokurtic, higher than the mesokurtic, explaining that the sample distribution has thicker tails and a sharper top than a normal distribution.

5.2 Correlation matrix

Table 2 reports pairwise correlations. Parentheses contain significance levels, which are also indicated using stars. The independent variables exhibit a significant and strong correlation with the ocean economy, whereas among the two control variables, only inflation is significantly negatively correlated with the ocean economy, while the correlation of the exchange rate with the ocean economy remains insignificant. Among

all independent variables, the correlation level does not exceed the threshold of 0.70 stipulated by Gujrati (2008), indicating that there is no issue of multicollinearity. In first column of table, correlation of each independent variable with the dependent variable is reported. Next columns report the correlation between corresponding independent variables with each other to examine the multicollinearity issue.

Table 5: Pairwise correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)
OCECON	1.000					
TAXES	-0.341***	1.000				
	(0.000)					
POPUL	0.648***	-0.614***	1.000			
	(0.000)	(0.000)				
COMOD	-0.208***	0.298***	-0.256***	1.000		
	(0.000)	(0.000)	(0.000)			
FD	0.028	0.407***	-0.113***	0.139***	1.000	
	(0.526)	(0.000)	(0.009)	(0.002)		
INFL	-0.172***	0.138***	-0.087**	0.367***	-0.148***	1.000
	(0.000)	(0.001)	(0.039)	(0.000)	(0.001)	

Note 1: ***, **, * represent significance level at 1%, 5% and 10%.

Note 2: OCEAN, TAXES, POPUL, COMOD, FD, INFL, EXCH denote ocean economy, taxes, population, commodity prices, financial development, inflation, and exchange rate, respectively.

In the pairwise correlation matrix, the value of -0.341 shows a significant negative correlation of taxes with the ocean economy at the 1% level of significance. The value of 0.648 shows a significant positive correlation of population with the ocean economy at the 1% level of significance. A strong positive correlation suggests that larger populations are connected with higher economic performance. This is indicated by the fact that the correlation is strong. The value of -0.208 shows a significant negative correlation of commodity prices with the ocean economy. Financial development does not show a significant correlation with the ocean economy, whereas the value of -0.172

shows a significant negative correlation of the control variable inflation with the ocean economy at the 1% level of significance.

The correlation matrix reports correlation of population, commodity, financial development, and inflation with taxes. The value of -0.614 shows a significantly negative correlation of population with taxes at the 1% level of significance. The value of 0.298 shows a significant positive correlation coefficient of commodity with taxes at the 1% level of significance. The value of 0.407 shows a significant positive correlation coefficient of financial development with taxes. Lastly, the value of 0.138 shows a significant positive correlation coefficient of the control variable inflation with taxes at the 1% level of significance. Moreover, the value of -0.256 shows a significantly negative correlation of commodity prices with population at the 1% level of significance. The value of -0.113 shows a significant negative correlation coefficient of financial development with population at the 1% level of significance. The value of -0.087 shows a negative correlation coefficient of inflation with population.

Similarly, the value of 0.139 shows a significantly positive correlation of financial development with commodity prices at the 1% level of significance. The value of 0.367 shows a significant positive correlation coefficient of inflation with commodity prices at the 1% level of significance. Finally, the value of -0.148 shows a significantly negative correlation coefficient of inflation with financial development at the 1% level of significance.

5.3 Multi-Colinearity and VIF test

Table 6: VIF Test

Variable	VIF
Ocena economy	1.798
Taxes	2.075
Population	2.544
Commodity	1.281
Financial development	1.342
Inflation	1.261

Multicollinearity among the explanatory variables was verified by applying the Variance Inflation Factor (VIF). The results from the above table shows that all variables have VIF values less than 5 ranging from greater than equal to 1.261 to 2.544 less than equal to, proposing that the multicollinearity was not a serious concern, all predictors are safe to keep in the model and that the estimated coefficients in the System GMM model are stable and reliable. The variable POPUL has the highest VIF (~2.54), but that is still well within the acceptable limits.

5.4 SGMM estimations

Table 6 reports the findings of SGMM for the ocean economy of European nations. The first section of the table represents the variables, coefficients, standard errors, z-values, and significance values. The second section of the table reports the model significance Wald statistics, post-estimation tests, and time fixed effects. The lagged

value of the ocean economy is significant, which suggests that SGMM is the appropriate econometric technique to model the relationship of the ocean economy with explanatory variables. The chi-square value for the joint significance test of time fixed effects is 33.230 with a p-value of 0.022, which suggests that time fixed effects exist. Time fixed effects capture the year-specific effect on the ocean economy that is not captured by independent variables.

In accordance with Kuorikoski et al. (2010) and Roger (1982), an alternative econometric model—Pooled OLS with Driscoll-Kraay standard errors—is employed. This approach corrects for panel-specific dependence, adjusts for serial correlation, accounts for heteroskedasticity, and is efficient for short T, large N panels. The findings for all key variables are consistent with the empirical results obtained from SGMM, confirming that the results are not merely driven by the choice of econometric model or specification changes, but are grounded in theoretical reasoning.

Table 6: SGMM ocean economy results

	Coefficient	SE	Z	P-Value
$OCECON_{t-1}$	0.696***	0.048	14.470	0.000
TAXES	0.139***	0.033	4.190	0.000
POPUL	0.394***	0.033	11.920	0.000
COMOD	-0.123*	0.064	-1.920	0.055
FD	0.519***	0.055	9.290	0.000
INFL	-0.033**	0.015	-2.200	0.028
Constant	-3.813***	0.335	-11.370	0.000
AR (1)	-7.820	Sargan	124.770	
(*p*-value)	(0.000)	(p-value)	(0.041)	
AR (2)	-0.100	Wald	433900.11	
(*p*-value)	(0.921)	(p-value)	(0.000)	
Time Fixed Effect	YES			

Note 1: The superscripts ***, **, and * represent significance levels of 1%, 5%, and 10%, respectively.

Note 2: OCEAN, TAXES, POPUL, COMOD, FD, INFL, EXCH denote ocean economy, taxes, population, commodity prices, financial development, inflation, and exchange rate, respectively.

Econometric equation of model:

$$OCECON_{it} = a_0 + a_1(OCECON_{it-1}) + a_2(TAXES_{it}) + a_3(POPUL_{it}) + a_4(COMOD_{it}) + a_5(FD_{it}) + a_6(INFL_t) + \delta t + \varepsilon_{it1} \quad (1)$$

In equation number 1, OCEAN, TAXES, POPUL, COMOD, FD, INFL, EXCH denote ocean economy, taxes, population, commodity prices, financial development, inflation, and exchange rate, respectively. a_0 *to* a_6 represent the coffiecnet, δt *and* ε_{it1} represent time fixed effect and error term respectively.

Moreover, it is important to note that in Stata's *xtabond2* command for the system generalized method of moments, country fixed effects are already included by design. If country fixed effects are manually added in the model, it results in the dummy variable trap and perfect collinearity.

The above table contains the names of variables, coefficients, standard errors, z-values, and p-values. First of all, the lagged value of the ocean economy has a coefficient of 0.696 at the 1% significance level, and the z-statistic is 14.470. This means that the lagged value of the ocean economy will affect the ocean economy itself. This effect is positive: a higher level of the ocean economy will further boost the ocean economy. Then, taxes have a coefficient of 0.139 at the 1% significance level, with a z-statistic of 4.190, showing that taxes positively affect the ocean economy. Similarly, the positive coefficient of population (0.394) at the 1% significance level, with a z-statistic of 11.920, also shows that the level of population among the European economies positively and favorably affects the ocean economy. However, the negative coefficient of commodity prices -0.123 at the 10% significance level, with a z-statistic of -1.920, shows that there is a relatively weak negative relationship between commodity prices, such as oil prices, and the ocean economy. Then, the positive coefficient of financial development 0.519 at the 1% significance level, with a z-value of 9.290, exhibits a favorable impact of financial development among European economies on the ocean economy. Lastly, for inflation, the negative coefficient value of -0.033 at the 5% significance level, with a z-value of -2.200, shows that inflation adversely affects the ocean economy among European nations.

Moreover, the table carries the values of AR(1), AR(2), and Sargan as post-estimation tests; these test the validity of SGMM. The Wald chi-square value of 433,900.11 at the 1% significance level shows the overall model fitness.

5.5 Robustness of findings

Table 7: Robustness of findings

	Coefficient	Drisc/Kraay SE	T	P-Value
TAXES	0.303***	0.047	6.400	0.000
POPUL	0.888***	0.051	17.210	0.000
COMOD	-0.226**	0.065	-3.460	0.002
FD	1.130***	0.096	11.760	0.000
INFL	-0.024**	0.021	-1.110	0.279
Constant	-5.654***	0.962	-5.870	0.000
F	419.500	R Square	0.4888	
(*p*-value)	(0.000)			

Note 1: The superscripts ***, **, and * represent significance levels of 1%, 5%, and 10%, respectively.

Note 2: OCEAN, TAXES, POPUL, COMOD, FD, INFL, EXCH denote ocean economy, taxes, population, commodity prices, financial development, inflation, and exchange rate, respectively.

The above table contains the names of variables, coefficients, standard errors, t-values, and p-values. First of all, the coefficient of taxes is 0.303 at the 1% significance level, with a t-statistic of 6.400, showing that taxes positively affect the ocean economy. Similarly, the positive coefficient of population 0.888 at the 1% significance level, with a t-statistic of 17.210, also shows that the level of population among the European economies positively and favorably affects the ocean economy. However, the negative coefficient of commodity prices -0.226 at the 5% significance level, with a t-statistic of –3.460, shows that there is a relatively weak negative relationship between commodity prices, such as oil prices, and the ocean economy. Then, the positive coefficient of financial development 1.130 at the 1% significance level, with a t-value of 11.760,

exhibits a favorable impact of financial development among European economies on the ocean economy. Lastly, for inflation, the negative coefficient value of -0.024 at the 10% significance level, with a t-value of -1.110, shows that inflation adversely affects the ocean economy among European nations.

Econometric equation of model for robustness:

$$OCECON_{it} = a_0, + a_1,(TAXES_{it}) + a_2,(POPUL_{it}) + a_3,(COMOD_{it}) + \ a_4,(FD_{it}) + a_5,(INFL_t) + \varepsilon_{it1}, \quad (2)$$

In equation number 2, OCEAN, TAXES, POPUL, COMOD, FD, INFL, EXCH denote ocean economy, taxes, population, commodity prices, financial development, inflation, and exchange rate, respectively. $a_0, to\ a_5,$ represent the coefficient, and ε_{it1} represents error term.

Moreover, the table carries the values of AR(1), AR(2), and Sargan as post-estimation tests; these test the validity of SGMM. The Wald chi-square value of 433,900.11 at the 1% significance level shows the overall model fitness. The negative constant term, which is estimated at the 1% significance level as –5.654 with a t-statistic of –5.870, demonstrates strong statistical significance at the 1% level. The constant coefficient represents the predicted value of the dependent variable when all explanatory variables are equal to zero. The negative and statistically significant constant confirms that the model's intercept is stable across alternative specifications. Therefore, its robustness reinforces the internal consistency of the regression framework, even if the constant lacks direct economic interpretation.

6 Discussion and conclusion

6.1 Discussion

Positive relationship of taxes with the ocean economy is aligned with earlier evidence, as taxes, including ocean-related taxes, not only provide a boost to the economy but also have a favorable effect on the environment, which supports prosperity in ocean-related economic activities (Cisneros-Montemayor et al., 2022; OECD, 2024). According to a report issued by OECD in 2022, local governments are managing ports and collecting taxes, and sometimes rebates, tax credits, and tax reductions under different schemes are crucial for research and development, and innovation for the advancement of the ocean economy. Economic and financial instruments like taxes, fees, and subsidies play a vital role in revenue generation and for controlling purposes as part of governing frameworks and fostering sustainable ocean economies. In an earlier report (OECD, 2020), tax subsidies and exemptions are considered useful to achieve some desirable outputs. It is also noted that many subsidies provided for the development of the ocean economy in the form of tax rebates or exemptions have negative and harmful effects on efforts made for environmental protection and resilience. Furthermore, in a recent study, Cisneros-Montemayor et al. (2022) suggested that a blue tax should be applied on economic and commercial activities to gain more benefits from oceanic areas beyond their traditional geographical boundaries with general global consent through a democratic process.

Similarly, population also positively affects the ocean economy, the reason being that the EU coastal region remained home to 52% of the EU population and contributed 51% of its GDP (PPP) in 2011. Therefore, the population not only boosted the overall economy but also uplifted the ocean economy-based activities carried out by people residing on the coastal lines (Makhnovsky, 2014). Additionally, OECD (2024) revealed that, with major threats, coastal populations are highly exposed to coastal and/or river flooding within the coming 100 years. From EU countries, the Netherlands is the

country for which 55% of its population is exposed to 100-year coastal flooding. The list is not limited to the Netherlands; other countries include Belgium, France, and Finland.

The commodity prices, which primarily represent oil prices, exhibited a negative relationship with the ocean economy. This is also aligned with existing empirical studies, which pinpoint that higher oil prices adversely affect aquaculture production and marine transportation, which ultimately negatively impact the ocean economy (Yiğit, 2024). Moreover, Tarkun (2025) confirms that changes in oil prices have both positive and negative effects on the transportation cost of tankers. Oil price shocks do not affect in the short term but are more sensitive in the long term. He also pointed out that the impact of oil price change shocks on transportation costs during crisis periods is not only short-term but also crucial in the longer term. During times of crisis e.g., the COVID-19 pandemic and the Russian-Ukrainian war, oil price shocks significantly intensified in the sea transport segment.

Moreover, financial development positively affected the ocean economy, as abundant financial resources offered avenues for the growth of ocean-related production (Nham & Ha, 2023), which is well aligned with earlier evidence. Moreover, OECD (2024) pointed out that with major challenges hampering the development of a sustainable ocean economy, at the subnational level, beyond technological challenges, the ocean economy is highly exposed to a lack of financial resources. Furthermore, following Sumaila et al. (2021), financial instruments are either used to finance projects related to the sustainable ocean economy to generate revenues or to develop new financial capital generation instruments to be used in the sustainable ocean economy. These capital generation instruments are typically dependent on the expected rate of return on investment, which almost entirely depends on the risk-return situation in the financial market.

However, as expected and aligned with earlier empirical evidence, the control variable inflation negatively affected the ocean economy, as rising price levels created hindrances in economic activities generated from ocean-related avenues (Engle, 2022). Additionally, OECD (2024) revealed that, with major threats, the ocean economy is highly exposed to inflation, cost-of-living crises, and other economic vulnerabilities.

After analysing the current global economic situation, there is a probability of a repeat of stagflation of the 1970s in 2022 and beyond (Engle, 2022).

6.2 Conclusion

The ocean economy contributes significantly to the expansion of the economies of the countries that make up the European Union by providing assistance to businesses in a variety of industries, such as maritime trade, fishing, coastal tourism, and marine-based industries. The study mainly investigated how the different financial and economic variables are shaping the ocean economy of European nations. Therefore, this study explores how European nations are struggling through difficult times. In these difficult financial times, it was crucial and important to analyze that how the different financial and macroeconomic variables are affecting the ocean economy as ocean economy place a major role in overall prosperity of European economies. The subject of this study is the five primary variables that tax, population, commodity prices (oil prices), financial development, and control variable inflation. The purpose of this study is to investigate the key economic elements that shape the economy of the ocean. The study makes use of System Generalised Method of Moments (SGMM) estimations and robustness testing in order to provide empirical insights into the relationship between the macroeconomic factors that were described before and the economic performance of the ocean.

Based on the results, the independent variable population shows significant positive relationship with ocean economy. A strong positive relationship suggests that larger populations are connected with higher economic performance. The population not only boosted the overall economy but also uplifted the ocean economy based economic activities carried out by population residing near the costal lines, this is indicated by the fact that the relationship is strong.

However, the independent variable commodity prices which is actually oil prices shows significantly negative relationship with ocean economy. Furthermore, in previous studies it is pointed out that higher oil prices adversely affected aquaculture

production and marine transportation which ultimately adversely affected ocean economy. The change in oil prices does not affect in the shorter period of time but more sensitive in longer run. It is also observed that impact of oil prices change shocks on transportation costs during crisis periods is not only short-term but also crucial in the longer period of time. During the time of crisis significantly intensify by the oil prices shocks on the sea transport segment which is ultimately deteriorating the overall economy of the ocean.

Financial development dose not shows a significant relationship with ocean economy, the existence of a marginal relationship between the two variables shows that financial systems contribute to increased economic growth. The ample financial assets offered the avenues for growth of ocean related production besides this; in previous studies it is also observed that ocean economy is highly exposed to lack of financial resources. The reason behind that investors are always looking for higher rate of return on their investment which is typically dependent on risk-return scenario in financial market.

Whereas the control variable of inflation shows significantly negative relationship with ocean economy. A negative relationship indicates that higher inflation is associated to lower economic performance. It is deteriorated to the ocean economy because it reduces the opportunities for investment, raises the expenses of operations, and slows the growth of enterprises in the maritime industry. Inflation negatively affected ocean economy as rising price level created hindrance in economic activities generated from ocean related avenues.

Therefore, this thesis contributed by studying key financial and economic variables of ocean economy which were not observed in previous studies due to lack of work in this important financial and economic segment, key financial and economic indicators were not observed in previous studies. According to the results and conclusion, the results of this study and practical implications are useful for government agencies, local municipalities managing ports, port authorities, financial institutions, non-governmental organizations and marine time institutions of European Union. To summarize, if the ocean economy is to be economically productive over the long term, it is essentially necessary to have a tax structure that is well-regulated, to keep inflation

under control, and to invest in the development of coastal regions that are sustainable. In the event that the member states of the European Union adhere to the implementation of targeted policies and maintain macroeconomic stability, they would be able to enhance their standing in the international maritime trade and achieve sustained economic growth in the blue sector. This study provides guidance to those institutions that how they can devise their policies framework to strengthen the financial development mechanism, how to introduce new tax reforms to optimize the ocean economy for the growth and development of overall European national economy.

6.3 Limitations

First limitation of this thesis is that due to the scope and time constraints only European Union data base have been used. Likewise, the second limitation is that the different important variables could not be study due to keep the thesis simple and avoid the complexities in model. These variables include trade ties and relations, trade deficits, political relationships among European Union, across Europe, relations with other nations and regions, and similar kind of organizations, for example Gulf Cooperation Council (GCC), BRICS (Brazil, Russia, India, China, and South Africa), The African Union, and the Association of Southeast Asian Nations (ASEAN) and not last but least foreign policy. These were some of the important variables that could not be studied. Similarly, the third limitation is that the data was not handily available before year 2002, due to the limited availability of data over a long period of time analysis could not be used.

6.4 Future Directions

In future, the study should be conducted to explore the some important Ocean economies of other regions like Gulf Cooperation Council (GCC), BRICS (Brazil, Russia, India, China, and South Africa), The African Union, and the Association of Southeast

Asian Nations (ASEAN) can also be studied in future because dynamics of these are quite different from European Union. Similarly, certain important areas with respect to the ocean economies that should need to explore in the future include trade ties and relations, trade deficits, foreign policies of the countries under study, political relationships among European Union, across Europe, relations with other nations and regions. These are the variable that needs to be study in future.

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