Exploring the Relationship between Maritime Activity and Macroeconomic Indicators: A Regional Analysis

Prof. Dr. Erhan Aslanoğlu , Dr. Kenan Tata , Res. Asst. Yasin Enes Aksu

1. Introduction

Maritime indexes are widely recognized as crucial indicators of economic activity and trade patterns, particularly in regions heavily reliant on international trade, such as Eurasian countries. Extensive literature suggests that maritime indexes are closely intertwined with key macroeconomic indicators, including gross domestic product (GDP), industrial production, and international trade. This connection stems from the fact that shipping activity and trade volumes are often regarded as leading indicators of economic growth, exerting a substantial influence condition, such as shifts in international demand for commodities and manufactured goods. Thus, studying the relationship between maritime activity and macroeconomic indicators can yield valuable insights into the underlying drivers of economic activity and trade patterns, enabling policymakers and investors to better comprehend the economic implications associated with fluctuations in shipping activity. This research aims to investigate the interplay between key macroeconomic indicators—such as consumer price index and industrial production—and maritime indexes, encompassing the Baltic Dry Index, Baltic Dirty Tanker Index, and Container Timecharter Rate Index with regional perspective. By comparing variation among regional dimension, this study endeavors to capture and highlight disparities in the relationships between maritime indexes and macroeconomic indicators. The rest of the paper organized as follows, after this introduction section, section 2 summarizes related literature. Section 3 describes the data and empirical strategy. Section 4 presents the empirical estimation results. Lastly, section 5 offers conclusions.

2. Literature

The idea of free international trade as a precondition for economic growth goes back to Adam Smith, who also discussed the importance of efficient transportation and how transportation costs may affect the price of the units carried. His rationale is based on the idea that the market "invisible hand" can handle the inefficiencies so that the governments need not exert any protections or frictions that may distort the functioning of the market. Specialization of labor and producing accordingly would require an extension of the market for those products and this is possible only with the help of free international trade (Gray, 1985). Ricardo on the other hand provides an example in which countries involved in international trade may benefit even in cases when the means of production put them in a disadvantageous position against other countries. Capital and its redistribution towards industries which provide the greatest marginal benefit is at the primer of specialization, mass production and consequently trade (Dimand, 2000). The comparative advantage reasoning is carried forwards and built in a mathematical model by (Ohlin, 1935). These types of models failed to explain the trade patterns especially among countries with similar factors of productivity. P. Krugman (1995) proposed a model which incorporated geography as a factor in international trade. This inherently raised the question about the transportation systems and the costs induced by carrying goods among countries. These costs are assumed to be reflected in the prices of the goods delivered and that those costs increase in a concave form with the distance the goods must travel.

After the World War II new regimes, institutions and agreements to facilitate and globalize trade took place. Figure 1 depicts the developments in merchandize trade and nominal global GDP growth. The ratio Trade/GDP increased from 10% to almost 25% in the trade boom during early 2000s. In nominal terms the picture is even more pronounced as the indexed chart shows that trade pace almost tripled that of global output.

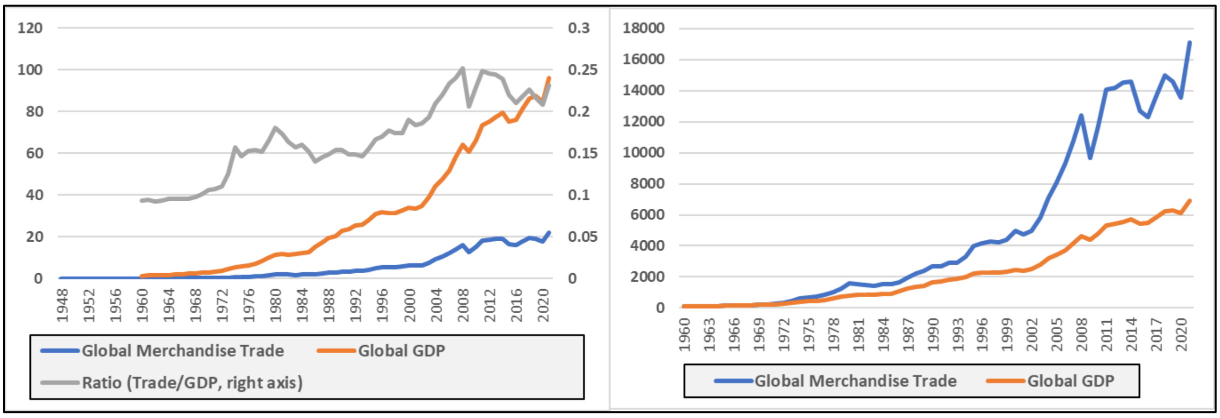

Figure 1. The graph on the left indicates Global GDP and Global Merchandise Trade (both in trillions of current USD) and their ratio. The graph on the right is an indexed graph where both series start at 100.

Source: IMF, UNCTAD, World Bank, St Louis FRED and author's own calculations.

The question of why the trade increased at pace much higher compared to the output still stands. From historic point of view the Bretton Woods agreement consolidated currencies around the gold standard for the Western countries, and is considered one of the most important factor for the trade growth especially among the developed countries (Terborgh, 2003). Also Rose et al (2000) use panel data to test the effects of common currency and the volatility of exchange rates on bilateral trade. They conclude that a common currency drives the trade volume at a higher pace for the countries involved (which can partly explain the establishment of the European Economic Community EEC in 1957), whereas exchange rate volatility has negative impacts on trade. Although, the so-called volatility is evident after the abandonment of Bretton Woods, the increase in trade may be accounted to some extend to the introduction of derivative markets allowing for risk mitigation and insurance. Another notable but also controversial development is the establishment of the General Agreement on Trade and Tariffs (GATT). Notable in the sense that reducing the tariffs and protections is assumed to positively affect bilateral trade and controversial in the sense that there are studies reporting its ineffectiveness in increasing trade. Irwin (1994) compares the global GDP and trade patters after WWI and WWII and concludes that this agreement has no positive effect in the first 10 years after the war other than restricting a further increase in the tariffs. However, it should be noted that with the collapse of the Eastern bloc in the late 1990s fostered globalization and trade liberalization at an even faster pace. The acceleration in trade after 2000 outpaced the growth in GDP by more than two-fold. P. Krugman (1995) argues that the main drivers of the faster pace of trade compared to GDP can be grouped in three categories: political factors which are related to posing or lifting frictions, boundary issues which take into account the geographical proximity and helps explain the relatively intra-trade among close regions of a single country or group of countries and finally the technological progress in transportation and communication. Nevertheless, issues related to rise of low-wage exporters and the ability of producers to exploit value chains across different geographical regions also adds to the pace of trade in the last decades.

The effects of specialization and technology on the transportation are evident in Figure 2. From the slow wooden small ships relying on the winds to the fast large and steam/combustion propelled specialized cargo ships reduced not only the costs, but increased interconnectedness throughout the globe.

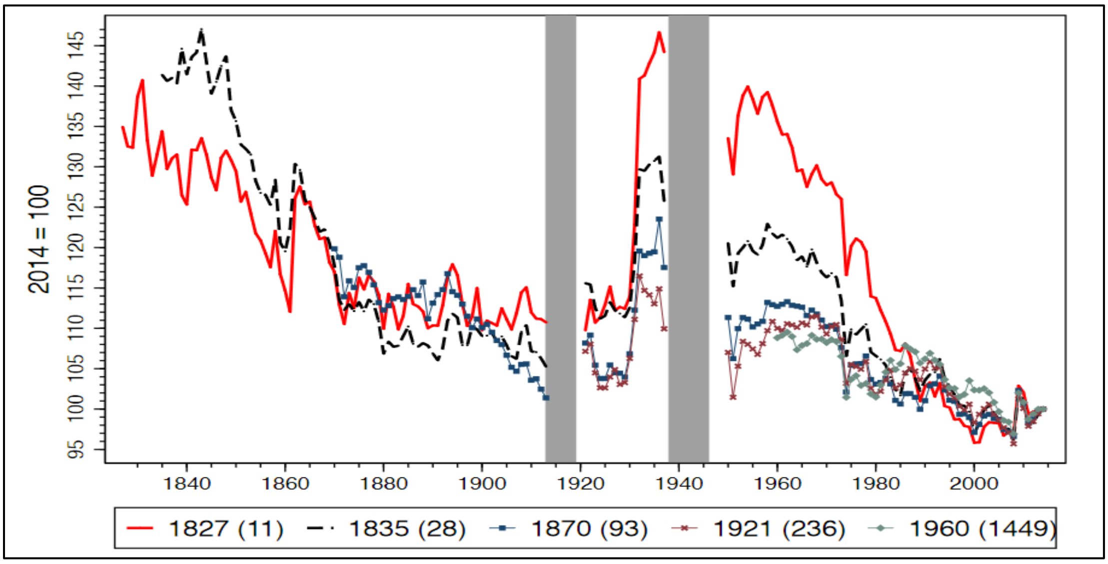

Figure 2. Global Transportation Cost Indices

Source: (Fouquin & Hugot, 2016)

Hummels (2007) argues that the distance and consequently the time and quality of delivery still explains much of the bilateral trade among countries, even after controlling for size, growth or volume. Transportation costs bear an important role as a percentage of the final price of the goods carried. That's why the increasing influence in air transportation is still holding upon goods of higher value, reducing the relative transportation cost and increasing the relative delivery efficiency. Technological changes and the containerization which started in late 70s provided the means of dropping both time and quality of service. The question about pricing though, is out of scope as it involves discussion about liner conferences where collusion and price fixing become an issue.

The current outlook of the types of ships transporting variety of cargo through different routes throughout the globe build a complex network (Figure 3). The container, bulk and tanker ships routes indicate a distinctive pattern of how different geographical regions are concentrated and differentiated with respect to production and consumption.

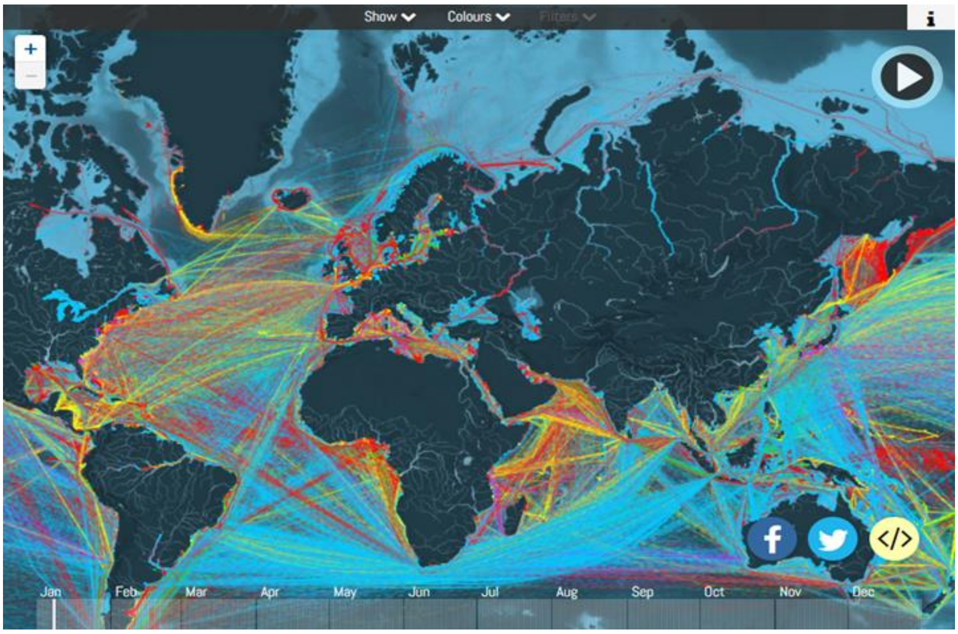

Figure 3. Global Trade Routes with Respect to the Cargo and Ship Type (blue-bulk, yellow-container, red-tanker)

Source: (KILN, 2022)

While the interconnectedness increases, transportation costs still serve as a barrier for the less developed countries that try to integrate their output with the rest of the world (UNCTAD, 2018). Low wage exporter countries mentioned in P. Krugman (1995) struggle with the adequate infrastructure which sets the entry barrier even higher.

The main task of this section is however to assess the driving force that translates into demand for maritime transportation. The main driver behind the demand for maritime services is assumed to be the global GDP, or to be more specific the forces that prevail in the long run within different regions together with the interactions among regions that create the need for transportation. In the long run, the population dynamics and the productivity are at the core of growth. Discrepancies among regions is what creates the need for trade. For example, the aging population of the West, increasing urbanization, environmental problems, protectionism, regional agreements and more so require political will and power to convert these factors into trade for both individual countries and global economy (Hübner, 2016). As mentioned before, the division and specialization of labor and comparative advantage leaves a lot to be explained. The "new trade theory" conned by Krugman considers geography and adds to the already discussed factors of production the ones affecting seaborn trade demand even more directly.

The demand for maritime transport on the other hand measured in both tones and ton-miles and does not bear the price and therefore inflationary effects directly. So, it is more convenient to compare its development with the real growth of the global output. The first graph in Figure 4 summarizes the development of the global GDP and the changes in two different measures of seaborne trade. In the long run all of them exhibit similar behavior on both level and percentage change (at this point no tests of cointegration are done). The collapse of the global GDP due to the Great Recession and the Covid-19 pandemic are mimicked by the trade data, however the response or the post crisis recovery is slightly different. After the recession of 2008-2009 the global trade recovered at a much higher pace compared to the GDP, however, after the pandemic (and still ongoing although at a slower pace) the trade recovery was quite modest compared to the GDP. The supply chain issues, port congestions accompanied by casual lockdowns due to covid case spikes and finally the surging inflation woes increased the transportation costs while leaving the growth of trade way below the growth in the GDP. The average growth of the GDP in the last 20 years is c.3.5%, whereas that of the seaborn trade is c.3.1%. UNCTAD (2021) expects the growth of the seaborn trade to drop to 2.4% for the next 2-3 years before a substantial recovery.

The second part of Figure 4 is a scatter plot depicting the response of trade to changes in global output. Although, causality tests are not performed, and the previous discussion reminds about the endogeneity problems within such reasoning. Nevertheless, the positive relationship is apparent and statistically significant.

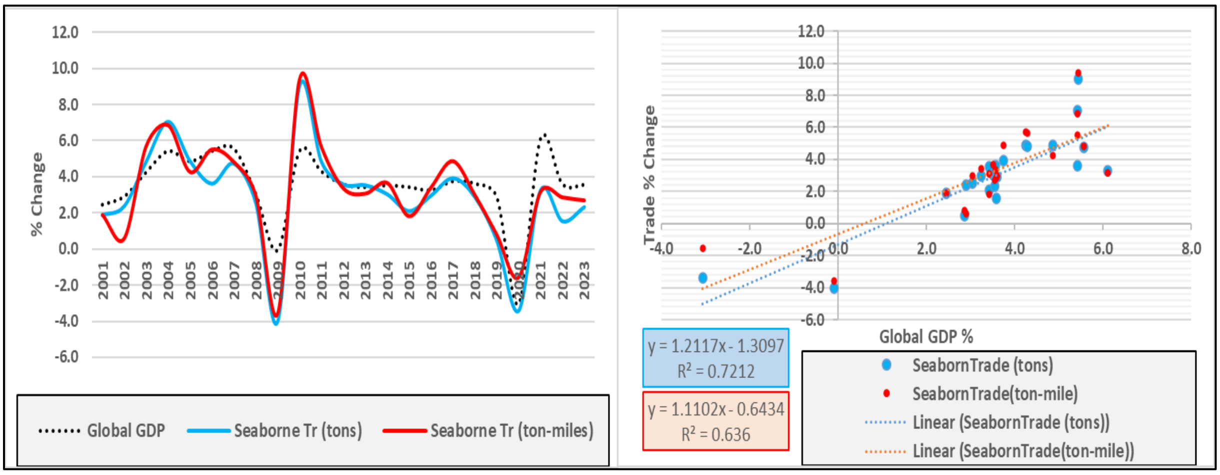

Figure 4. Global GDP and Seaborne Trade. (The graph on the left indicates the annual changes, whereas the graph on the right has the global GDP on the x-axis and the trade changes on the y-axis)

Source: IMF, Clarksons SIN and author's own calculations.

The main components of the seaborn trade are dry cargo (divided into major bulk like iron ore, coal and grains, minor bulk like forestry and steel products and containers), crude oil/oil products, gas in the form of LNG/LPG and chemicals (Figure 5). The composition of the seaborne trade has changed dramatically in the last 20 years. At the beginning of the 2000s the dry bulk and oil were dominating the seaborne cargo markets with a combined amount of more than 80%. As China emerged as the manufacturing exporter of finished goods and a major infrastructure investor container and dry bulk trades picked at the expense of oil and oil products. Container increased from 11% to 18% and dry bulk from 42% to 48%. Another significant increase is observed in the gas trade, from 2.85 to 4.6%. The recent clash between Ukraine and Russia leading to sanctions on Russian energy exports might result in even higher increases the gas trade until the conflict resolves.

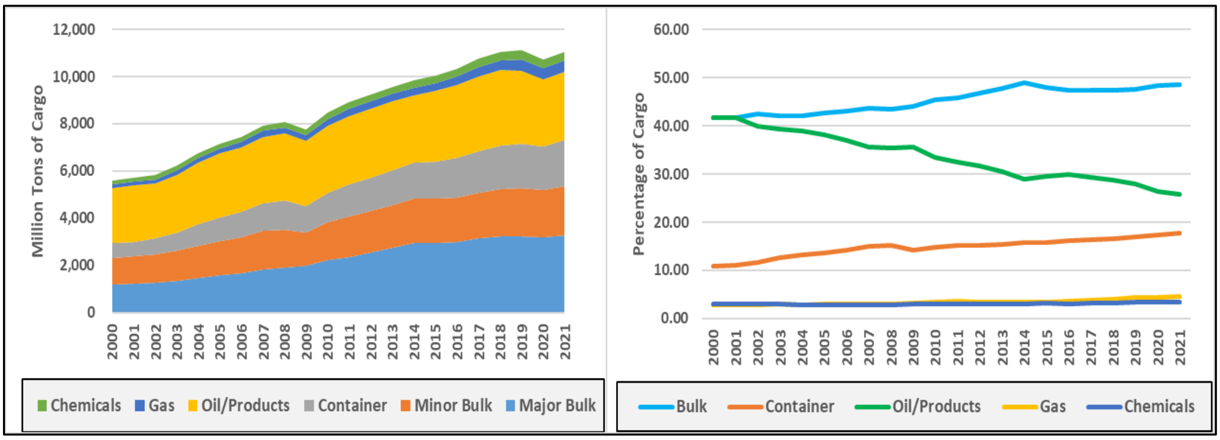

Figure 5. Composition of Seaborn Trade (First graph in million tons, second in %)

Source: Clarksons SIN and author's own calculations

The notion of a market is usually hypothesized as a centralized location where the exchanges take place. However, with the flow of information and the ease of obtaining information this view was objected even as early as in Jevons (1871), where communication is supposed to rule out strict localization. The shipping markets are organized in four main categories. Those are freight markets where the cargoes are being transferred and the prices for those services are determined, shipbuilding where new vessel contracts and orders are realized and new vessels are supplied to the freight markets, second-hand markets where vessels are being bought and sold reflecting the interaction between the freight and newbuilding markets and lastly the scraping or demolition market where the all three previous markets and moreover the commodities markets are interacting with each other (Stopford, 2008). Although earlier attempts to define markets were categorized in a simpler way as carriage and non-carriage markets by Sawa (1958), the former grouping is generally accepted and used by researchers and practitioners. Although the distinction seems quite intuitive, it should be noted that with the development of other fields and finding their usage in the shipping industry, the set is naturally expanding. Until recently, by risk management in the industry mainly insurance and other safety practices were considered as a general field. However, with the introduction of derivative instruments allowing for risk sharing, mitigation, diversification and better planning the field of risk management expanded to the financial offices of the shipping firms (Alizadeh & Nomikos, 2009).

There are also models based on demand supply equilibrium dynamics which serve as a basis for most of statistical models below. Some of these models lacked the tools and the data at the time when they were developed so testing the theory was not always accompanying or conforming those claims. A model specific for its chronological era and considered as groundbreaking is developed by Koopmans (1939), Zannetos (1964), Beenstock and Vergottis (1993) and Kavussanos (1996) in that specific order.

Koopmans (1939) proposed one of the first models where the supply is proportional to the fleet size and the ratio of earnings represented by the freight rates earned to the costs incurred when operating the ship. Also, the laid-up ratio, the ratio of the idle ships in the fleet, is assumed to be affecting the supply side. The demand is measured in terms of ton-miles, which pinpoints the importance not only of the amount of the cargo caried but also the distance traveled. Some critical variables like average speed of ships (which effects resemble those of limiting the supply), scraping and losses are not included. Moreover, although the model is limited to the tanker market, it is important in a sense that it can provide an insight about the short-term shocks and how the supply side reacts accordingly. For example, in the short run the demand is assumed to be inelastic, i.e., the price level or freight in this case is the direct observed response to positive shocks rather that the other variables like fleet size and costs.

After several alterations and inclusions of newly developed techniques in especially economics and finance Zannetos (1964) modelled the demand and supply sides of the tanker market but his approached included also the second-hand and scraping markets. This expansion is important because it is a part of the capital mobility in part in and out of the market and within the market itself. Also, the model is dynamic and includes time as a variable, whereas the Koopmans (1939) model is static. The inclusion of time allowed also for the formation of expectations about the future freight rates by adapting the current observed ones. This insight turned out to be fruitful for the explanation of the cycles observed in the maritime business.

The approach of Beenstock and Vergottis (1993) starts with the micro foundations of ship investment and operation. The profit maximizer agents are assumed to be operating in a perfectly competitive market, and the inputs to their profit functions are the results from the demand-supply equilibrium in the freight markets. So, they are also assumed to be price takers and their decisions are not taken as an input factor to the freight market. The profit is simply a function of the speed, freight rate and costs, both variable and fixed. The demand function resembles the one proposed by Koopmans (1939), including the fleet size and the ratio of freight to costs alike, but departing by allowing for combined carriers (those are ships which are capable of carrying both dry and wet cargo and were popular in the 80s until early 90s) in the fleet and other exogeneous variables that might be affecting the supply for cargo services. Demand is again represented by the seaborne trade volume expressed in ton-miles of cargo caried.

After especially 80s with the development of dynamic risk models and their extensive use in business and economics, Kavussanos (1996) used the volatility model of R. Engle (1982) (ARCH to be more specific) to model dependencies and clustering observed in the second moments of price series. The freight rates are represented by a single index and the model describing the dependencies is the one used by Beenstock and Vergottis (1993). It was already mentioned that the later model allows for the inclusion of exogeneous variables and industrial production is used as an additional explanatory factor. So, the set of explanatory variables includes the industrial production, bunker prices and the fleet size. The model assumed for the timecharter fixtures is based on the expectations of the agents in the freight market. The independent variables are the expected future freight rates and bunker prices. The implicit assumption here is that the agents are rational and utilize all available information. In practice, when the estimations are done, the future lagged values of the expected freight and bunker are used. Both the OLS and ARCH estimations turn out to reveal significant coefficients with the assumed signs. Moreover, the variation through time and the subsequent clusters seem to fit the ARCH specification. The previous models assuming only dependencies of first degree, and looking only for the long-term convergence tun out to be acceptable but not sufficient in the explanation of the observed phenomena in the freight and timecharter rates.

Another notable model is that of Hawdon (1978). He expands the model of Zannetos (1964) in a way that several different cost subcategories are allowed to variate and add to the explanatory power of the variations in the tanker freight rates. However, it is still in a sense old school since the short-term variations and second order dependencies are ignored or not accounted for due to the lack of the necessary techniques.

Shipping indices indicate an equilibrium for the cost of carrying goods for several subindustries ranging from energy and raw materials to finished goods. This equilibrium depends on its own demand and supply dynamics. Primarily commercial fleet growth and utilization on one hand and demand for the services of that fleet on the other. The focus of this study is about the interaction among the drivers of that demand for services and measures provided by completely different sources directed to the real side of the economy. Understanding the connections among economic indicators and maritime activity has invaluable impact on policy making and risk management process of both governmental and private sides of the economy. Some of those indicators have been used for a long time as a measure of expectations and shifts in both demand and supply patterns prevailing in both local and global economy. Most of the research conducted is focused on the predictability of recessions or assessing their probabilities. The literature comprising both sides resides on significant practical and theoretical discoveries. The link between international trade and growth, although not clear cut from directional perspective as discussed above, can be assessed using model that treat both sides as sources of information.

Ng (1992) discusses the impact of a collapse in business confidence triggered by a significant drop in stock market hence business valuations. Among other conclusions a depressed gross output emerging as a long run equilibrium is an important result that may require some prevention measures amid the signal accumulation. Carroll et al. (1994) on the other hand provides an insight about the consumer confidence driven shifts in expenditures, which cannot be explained solely by the prospects about shifts in the future earnings. Matsusaka & Sbordone (1995) establish that consumer confidence explains around 13 to 26 percent of the variation in the output when a vector autoregressive model is applied. Taylor & McNabb (2007) find that both consumer and business confidence indexes have the capability to enhance the GDP forecasts. Despite obtaining relatively robust results for the downturns, the positive output forecasts exhibit mixed results across countries in Europe. Dees & Brinca (2013) report a significant effect of consumer confidence leading the consumption. However, the results are more pronounced when the shock in the confidence level is higher. Such shocks enable the explanation of not only shifts in local consumption patterns but also shifts across country hinting that the mechanism is also significant on an international level. Similarly, Kuzmanovic & Sanfey (2012) find a positive effect of shifts in the consumer confidence on the quarterly GDP through the changes in the retail turnovers.

Bakshi et al. (2011) provides an insight about the predictability power of the Baltic Dry Index of the economic activity in several countries. They employ a univariate GARCH model and use the industrial production as a proxy for the economic activity. The results though limited in terms of model complexity, are significant and support the explanatory power of the 3- and 6-month smoothed BDI index over short horizons. Similarly, Zuccollo (2013) reports a leading effect of BDI in the range of 3-5 years for the South African economy, however on a much shorter time scale with the stock market. Odom (2010) analyses the effects of the Baltic dry and container indices separately as they are supposed to indicate shifts in the activities of different parts in the general demand, say manufacturing and consumption. Multivariate volatility models used by Erdogan et al. (2013) extend the understanding of the mutual impacts by taking into account not only the volatility spillovers but also their impact on the changing covariance structure. The short-term effects are even more evident when considering the financial markets, which offer a higher frequency allowing for structures that dissipate on monthly level.

3. Data and Methodology

Our main motivation is analyzing the relationship between maritime and economic activity within the framework of an endogenous model. Thus, our main hypotheses are as follows.

- H1: Maritime data, especially high frequency pricing equilibrium across different segments of maritime activity possess information about the real side of the economies.
- H2: Information flow is bilateral, short-term shifts in demand creates this reciprocity.
- H3: Effects vary with respect to the maritime subsector and the nature of the economy.

In our empirical analyses we construct our sample at the monthly basis for the 1991M1-2023M5 period[1]. Since we have employed monthly data, we used seasonal adjusted series and our data span and sources: We obtain Maritime Indexes (Container Timecharter Index, Baltic Exchange Dry Index, Baltic Dirty Tanker Index) data from Clarksons. Additionally, economic activity data (Consumer Price Index, constant 2005=100; Industrial Production, constant 2005 $))obtained from Global Economic Monitor Database of World Bank.

In order to explore the dynamic inter-relationship between maritime and economic activity, we employ vector autoregression (VAR) methodology. Within this context our baseline model with p lags as follows,

[1] For East Asia and Pacific region dataset covers 1997M2-2023M5 period due to data availability.

$$y_t = \sum_{q=1}^{p} A_q y_{t-q} + \mu_t \tag{1}$$

$$y_t : \begin{pmatrix} F_t \\ X_t \end{pmatrix} \tag{2}$$

where y_{it} represents the vector of variables including, maritime indexes (F) at time t which we control Containership Timecharter Index (CTRI), Baltic Exchange Dry Index (BADI), Baltic Dirty Tanker Index (BDTI) and X_{it} which stands for economic activity that we control with two separate variables: (i) industrial production, (ii) consumer price indexes. Finally, μ_{it} is a vector of orthogonalized shocks and have the following characteristics: $E(\mu_{it}) = 0, E(\mu'_{it}\mu_{it}) = \Sigma$ and $E(\mu'_{it}\mu_{is})$ for all $t > s$. In this context, we estimate equation 1. for each region separately. Next section, we present the Granger Causality Test results and Impulse-Response functions to determine the direction of relationship between Maritime Indexes and economic activity.

4. Empirical Results

The Granger Test Results presented at table 1. assess the temporal causality between maritime indexes (Container Timecharter Rate Index, Baltic Exchange Dry Index, Baltic Dirty Tanker Index) and economic activity, controlled by consumer price index and industrial production. In the first half of the table, where consumer price index and industrial production serve as independent variables. According to results, in the Middle East and North Africa, Baltic Dirty Tanker Index exhibits a significant Granger causality with consumer price index, indicating a potential predictive relationship. Meanwhile, in various regions, such as Latin America and the Caribbean, Sub-Saharan Africa, South Asia and East Asia and Pacific shows significant Granger causality with maritime indexes, suggesting that changes in Baltic Dirty Tanker Index may precede shifts in industrial production. Additionally, in almost all regions except East Asia and Pacific past values of Baltic Exchange Dry Index is useful to predict changes in industrial production.

In the second half of the table, with maritime indexes as independent variables, intriguing causal relationships are observed. For example, in Middle East and North Africa, consumer price index Granger causes changes in Container Timecharter Rate Index, implying a potential predictive role of economic indicators in container trade. Additionally, Industrial Production in all regions except Middle East and North Africa shows Granger causality with Container Timecharter Rate Index and Baltic Exchange Dry Index suggesting that variations in the industrial production may precede changes in container market and dry bulk shipping market in these regions. Moreover, in East Asia and Pacific both consumer price index and industrial production Granger causes Baltic Dirty Tanker Index. Additionally, we observe that industrial production is useful to predict changes in Baltic Dirty Tanker Index in Sub-Saharan Africa, Europe and Central Asia.

Table 1. Granger Causality Results

Independent Variables	**Region**	***Dependent Variables*** **Container Timecharter Rate Index**	**Baltic Exchange Dry Index**	**Baltic Dirty Tanker Index**
Consumer Price Index	Latin America and Caribbean	0.088	1.744	2.800
	Sub-Saharan Africa	1.704	2.570	1.233
	Middle East and North Africa	4.261	4.508	9.138**
	Europe and Central Asia	2.828	2.182	0.257
	South Asia	3.526	3.857	9.297
	East Asia and Pacific	9.130	4.361	1.528
Industrial Production	Latin America and Caribbean	2.220	24.870***	10.316***
	Sub-Saharan Africa	3.069	18.345***	8.534**
	Middle East and North Africa	4.294	12.615***	3.797
	Europe and Central Asia	5.538	20.420***	2.811
	South Asia	2.135	16.731***	26.863***
	East Asia and Pacific	4.670	6.464	5.668*

Independent Variables	**Region**	***Dependent Variables*** **Consumer Price Index**	**Industrial Production**
Container Timecharter Rate Index	Latin America and Caribbean	0.030	15.986***
	Sub-Saharan Africa	3.970	10.231**
	Middle East and North Africa	9.645**	0.005
	Europe and Central Asia	1.043	16.195***
	South Asia	2.628	22.147***
	East Asia and Pacific	7.978	11.043*
Baltic Exchange Dry Index	Latin America and Caribbean	1.526	19.334***
	Sub-Saharan Africa	1.861	32.387***
	Middle East and North Africa	9.945*	4.146
	Europe and Central Asia	3.551	13.873***
	South Asia	3.675	32.243***
	East Asia and Pacific	3.929	10.812**
Baltic Dirty Tanker Index	Latin America and Caribbean	1.024	3.555
	Sub-Saharan Africa	1.141	5.641*
	Middle East and North Africa	0.168	1.245
	Europe and Central Asia	3.137	8.255**
	South Asia	9.534	4.253
	East Asia and Pacific	13.532***	8.324**

*,**,*** stand for statistical significance at 90%, 95% and 99% confidence levels respectively.

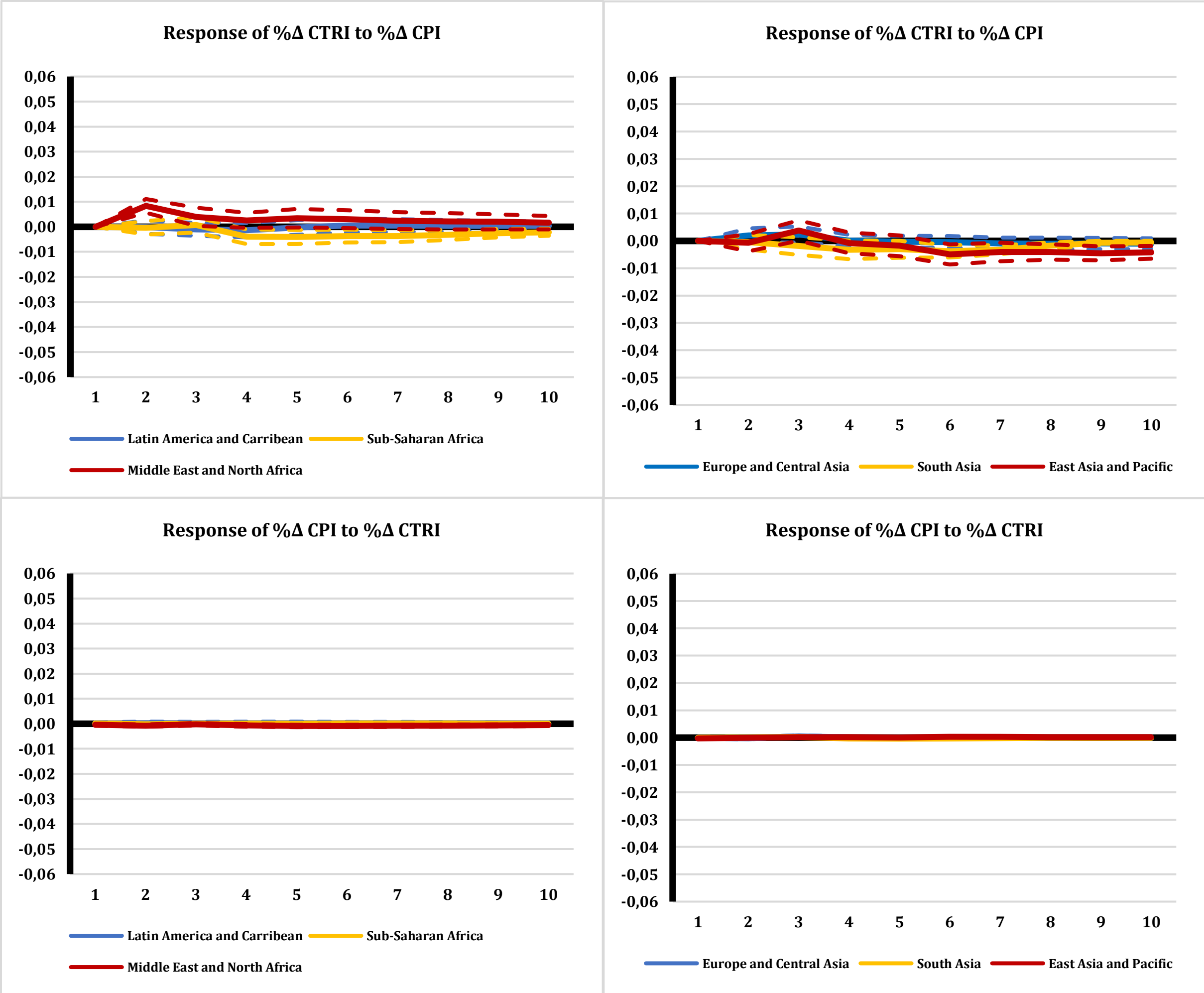

Figure 6. Impulse Response Functions of Container Timecharter Rate Index - Consumer Price Index

Figure 6. shows impulse response functions obtained from our baseline models. According to the results, one standard deviation shock to percentage change of consumer price index leads to significant increases in Container Timecharter Rate Index only for Middle East and North Africa Region. However, this effect fades after two periods. On the contrary, one standard deviation shock to percentage change of Container Timecharter Rate Index is statistically insignificant in all regions.

Figure 7. illustrate the dynamic relationships between the % change in industrial production and the % change in the Container Timecharter Rate Index across various regions. Notably, a positive impact of change in industrial production on the change in Container Timecharter Rate Index is observed consistently across all regions, except for the Middle East and North Africa. This suggests that an increase in industrial production tends to positively influence the Container Timecharter Rate Index in Latin America and the Caribbean, Sub-Saharan Africa, Europe and Central Asia, South Asia, and East Asia and the Pacific. However, in the Middle

East and North Africa, this positive impact is notably absent. Furthermore, the positive effects identified in most regions exhibit a temporal nature, as they tend to fade after four periods, with the exception of East Asia and the Pacific, where the shock effect persists for seven periods. Additionally, the impact of change in the Container Timecharter Rate Index on change in industrial production is statistically insignificant for all regions, except in the Middle East and North Africa. However, it is crucial to note that this effect is relatively small and only achieves statistical significance at the third lag.

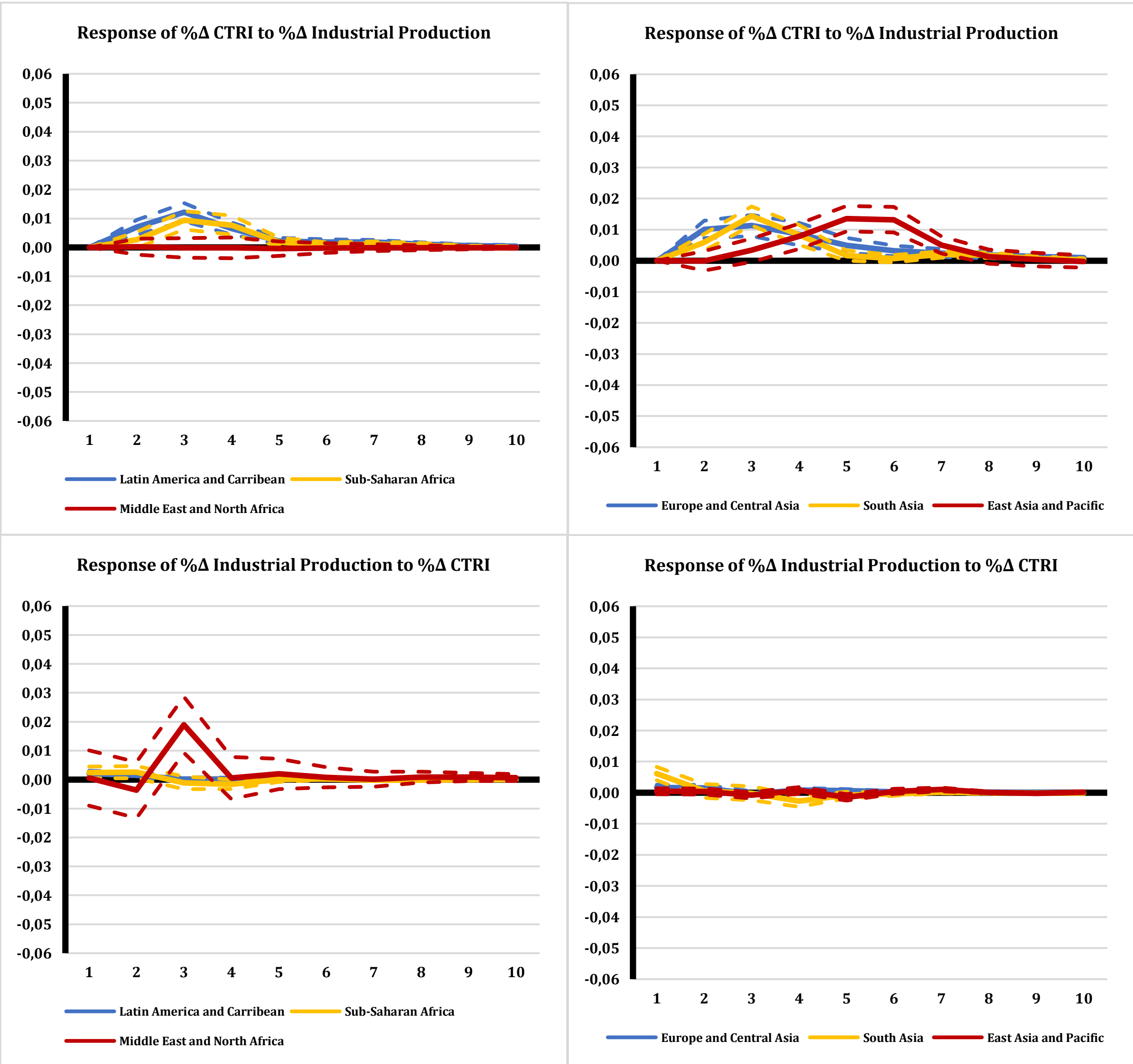

Figure 7. Impulse Response Functions of Container Timecharter Rate Index - Industrial Production

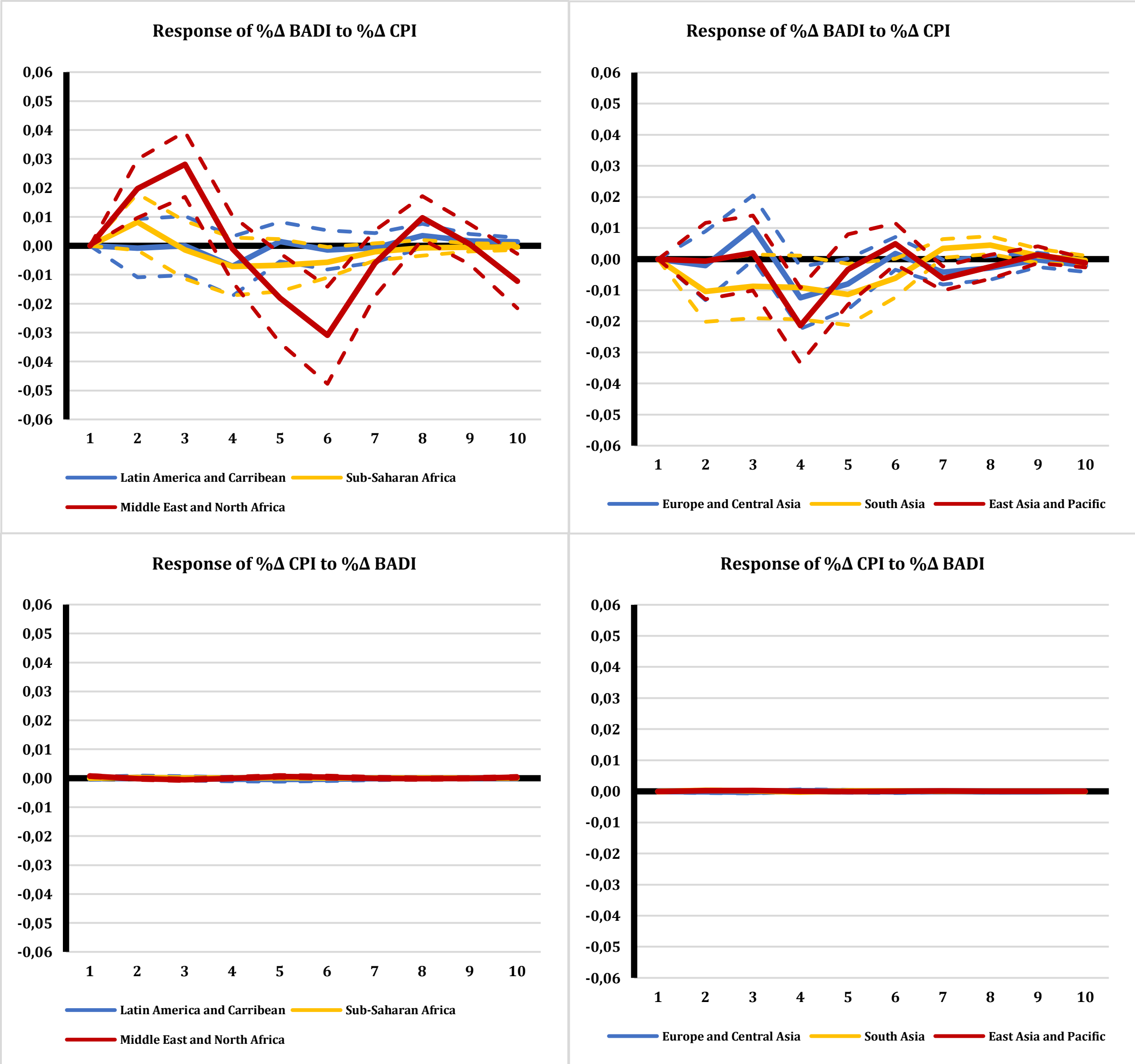

Figure 8. Impulse Response Functions of Baltic Exchange Dry Index - Consumer Price Index

Figure 8. presents the impulse response functions of Baltic Exchange Dry Index and Consumer Price Index. Singularly, a positive impact of the change in consumer price index on the change in the Baltic Exchange Dry Index is discernible solely in the Middle East and North Africa. This implies that, in this region, fluctuations in consumer prices exert a positive influence on the dynamics of the Baltic Exchange Dry Index. However, the temporal nature of this impact is noteworthy, as the positive effect diminishes after three periods. Moreover, when examining the reciprocal relationship, the impact of the % change in the Baltic Exchange Dry Index on the % change in consumer price index is found to be statistically insignificant across all regions. This suggests that, unlike the observed influence of consumer price index on the Baltic Exchange Dry Index in the Middle East and North Africa, changes in the dry bulk shipping

market have no statistically significant impact on consumer price movements in the specified regions.

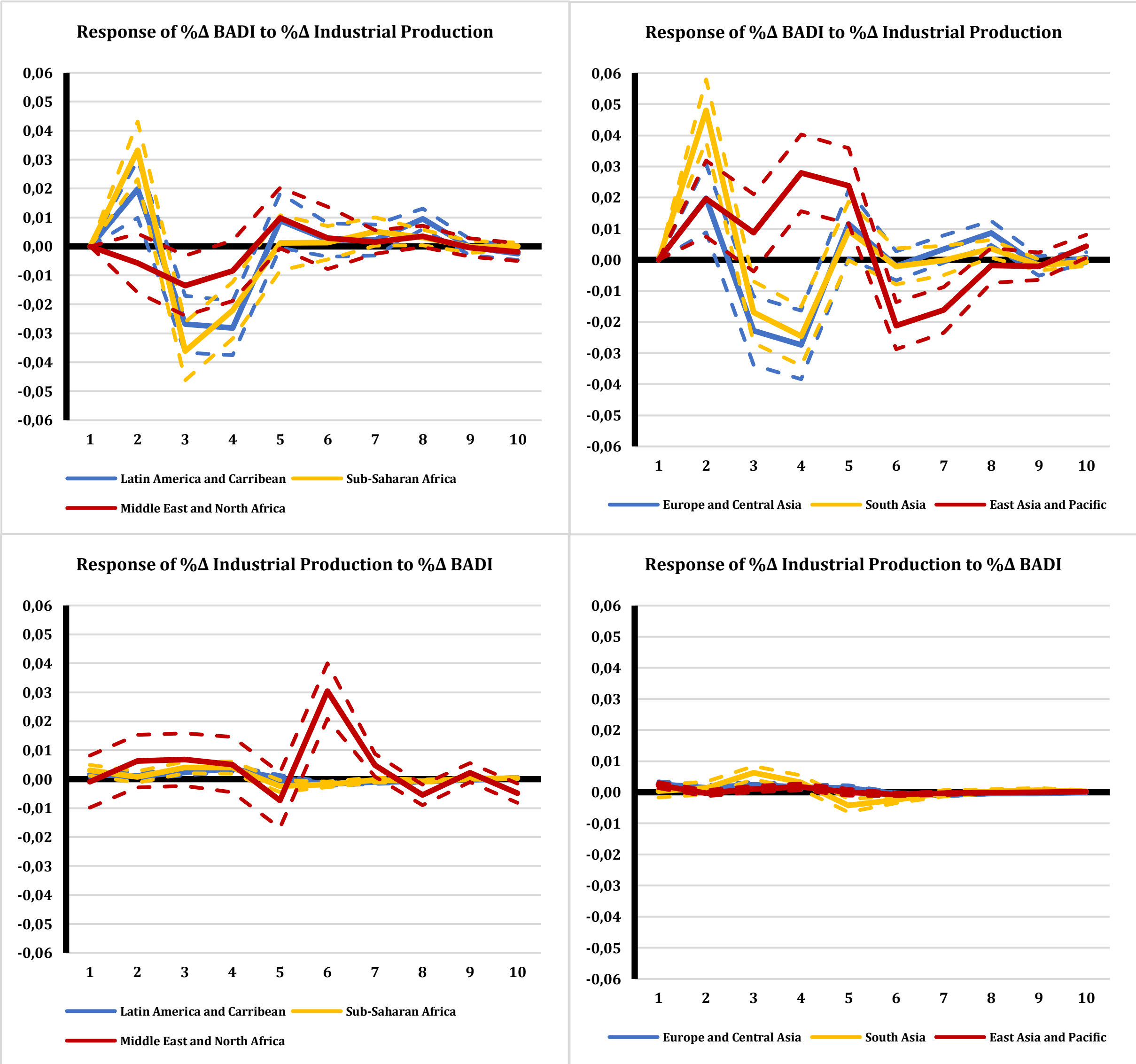

Figure 9. Impulse Response Functions of Baltic Exchange Dry Index - Industrial Production

The impulse response functions of the change in industrial production and the change in the Baltic Exchange Dry Index reveal intriguing dynamics across various regions. Notably, a positive impact of the change in industrial production on the change in the Baltic Exchange Dry Index is evident for all regions, except the Middle East and North Africa, where a negative impact is observed. This implies that, generally, an increase in industrial production positively influences the Baltic Exchange Dry Index; however, this relationship is inverted in the Middle East and North Africa.

Moreover, the temporal aspect of these impacts is noteworthy, as the positive effect of industrial production on the Baltic Exchange Dry Index fades after five months across all regions. This suggests a relatively short-lived influence of industrial production on the dry bulk shipping market dynamics. In examining the reverse relationship, the impact of the change in the Baltic Exchange Dry Index on the change in industrial production is found to be statistically insignificant for all regions, with one exception in the Middle East and North Africa. In this region, a positive impact is discernible at the sixth lag, suggesting a delayed and relatively minor influence of the Baltic Exchange Dry Index on industrial production.

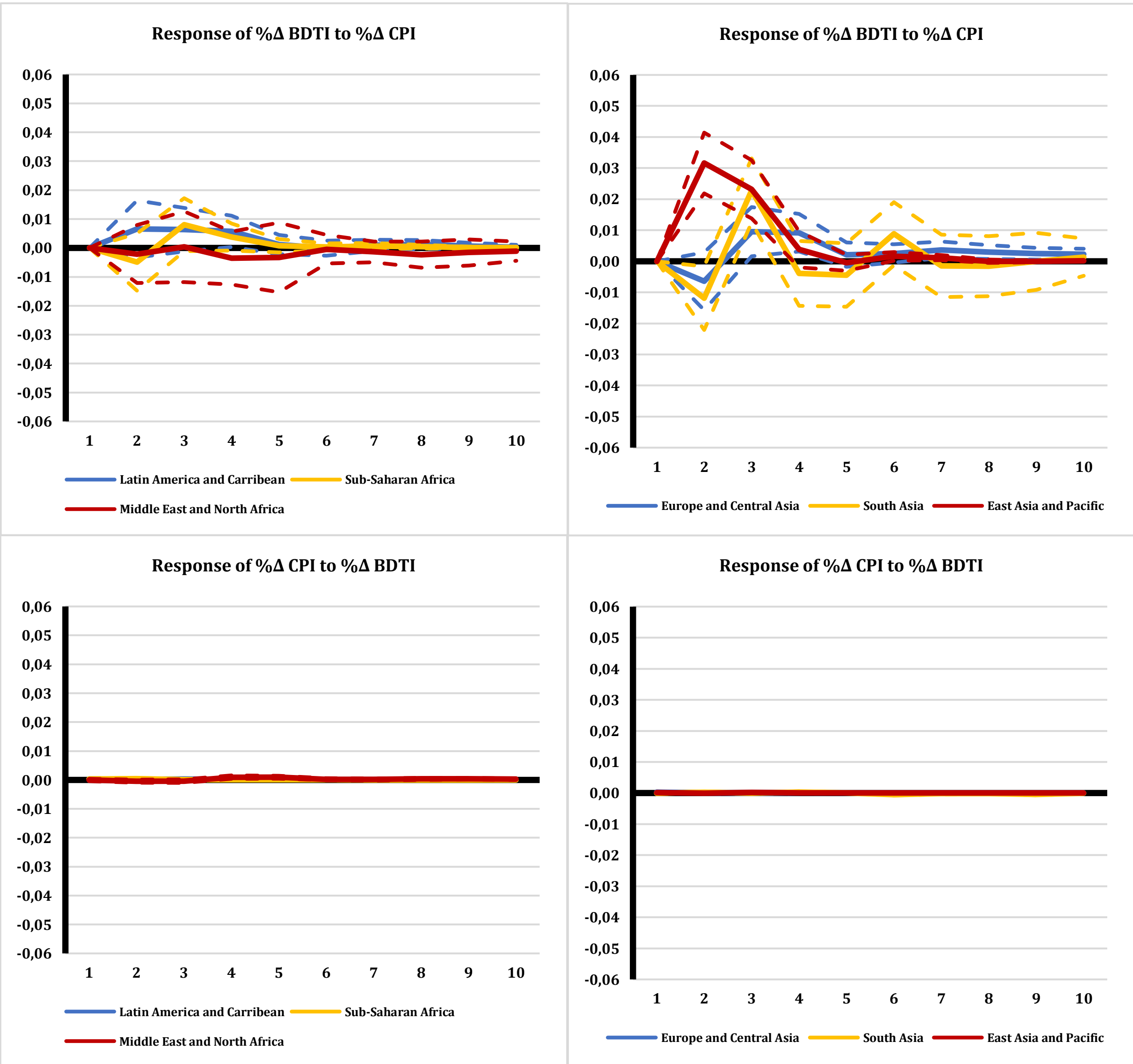

Figure 10. Impulse Response Functions of Baltic Dirty Tanker Index - Consumer Price Index

Figure 10. presents the impulse-response functions of Baltic Dirty Tanker Index and sonsumer price index. Firstly, the impact of the change in consumer price index on the change in the Baltic

Dirty Tanker Index is found to be statistically insignificant for all regions, except South Asia and East Asia and the Pacific. In these two regions, a statistically significant positive impact is observed, indicating that fluctuations in consumer prices exert an influence on the dynamics of the Baltic Dirty Tanker Index specifically in these areas. Furthermore, the temporal aspect of these impacts is notable, as the positive effects observed in South Asia and East Asia and the Pacific fade after four periods. This suggests a relatively short-lived influence of consumer price index fluctuations on the Baltic Dirty Tanker Index in these regions. In examining the reverse relationship, the impact of the % change in the Baltic Dirty Tanker Index on the % change in consumer price index is found to be statistically insignificant for all regions. This implies that changes in the Baltic Dirty Tanker Index do not have a statistically significant impact on consumer price movements across the specified regions.

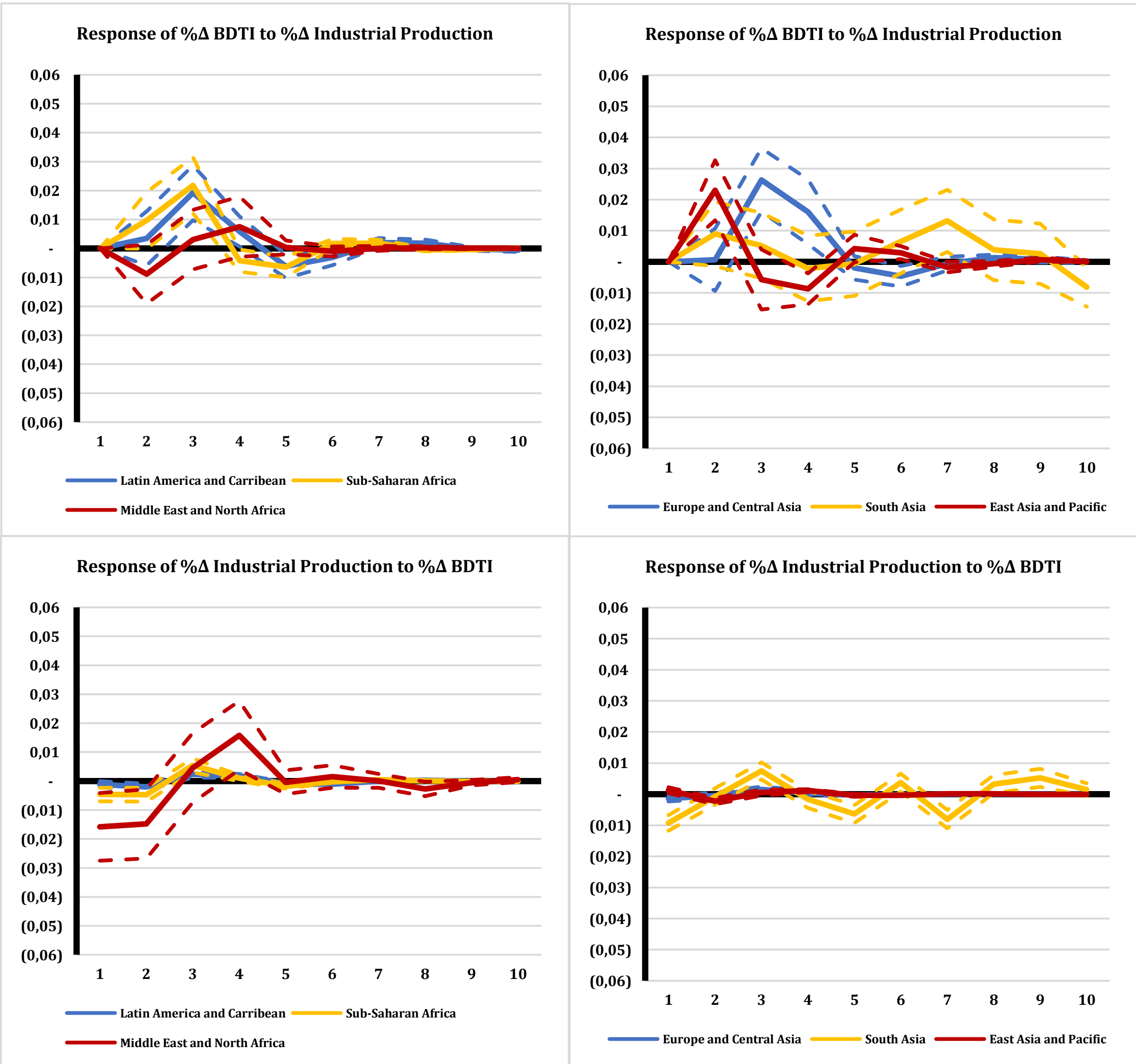

Figure 11. Impulse Response Functions of Baltic Dirty Tanker Index - Industrial Production

Figure 11. demonstrates the impulse response functions that examining the relationship between the change in industrial production and the change in the Baltic Dirty Tanker Index. Firstly, a positive impact of the change in industrial production on the change in the Baltic Dirty Tanker Index is evident for all regions, except the Middle East and North Africa, where this relationship is unexpectedly absent. This suggests that, generally, an increase in industrial production positively influences the Baltic Dirty Tanker Index, but this pattern is not observed in the Middle East and North Africa. Additionally, the temporal aspect of these impacts reveals that the positive effects of industrial production on the Baltic Dirty Tanker Index tend to fade after five periods across all regions. This implies a time-limited influence of industrial production on the dynamics of the Baltic Dirty Tanker Index. In analyzing the reverse relationship, the impact of the change in the Baltic Dirty Tanker Index on the change in industrial production is statistically insignificant for all regions, except in the Middle East and North Africa. However, this impact is lagged and observed only in the fourth period. This suggests a delayed and relatively minor influence of the Baltic Dirty Tanker Index on industrial production in the Middle East and North Africa.

5. Conclusion

This study aims to examine the interrelationship between maritime activity and macroeconomic indicators, focusing on the Baltic Dry Index, the Baltic Dirty Tanker Index and the Container Time Charter Rate Index in a regionally comparative manner. Our motivation stems from the fact that maritime indices are considered important indicators of economic activity and trade patterns, especially in regions heavily dependent on international trade. First, our results support H1, showing that maritime data, especially the high-frequency pricing equilibrium between different segments of maritime activity, indeed contain valuable information about the actual structure of economies. The two-sided nature of information flows, as posited in H2, is confirmed by our empirical analysis, which shows that there are short-term shifts in mutual demand between shipping indices and economic indicators.

Importantly, our regional analysis revealed subtle relationships, confirming H3. For instance, the Baltic Dirty Tanker Index exhibited statistically significant Granger causality with the consumer price index in the Middle East and North Africa, indicating a predictive relationship. Moreover, changes in shipping indices, particularly the Baltic Dry Index, were found to precede changes in industrial production in several regions, emphasizing the sector-specific nature of these relationships.

Impulse response functions further illuminate these dynamics, highlighting the region-specific effects of economic indicators on maritime indexes and conversely. In particular, the temporal nature of these effects is observed, highlighting the transitory but influential nature of the identified relationships.

Overall, our findings provide valuable insights for policymakers and investors seeking a deeper understanding of the economic consequences associated with fluctuations in maritime activity. Recognizing the regional nuances in these relationships is vital for informed decision-making in an ever-evolving global economic environment. As maritime activity remains a vital driver of economic growth, this study provides a foundation for future research and strategic assessments of the complex interplay between maritime dynamics and macroeconomic indicators.

Bibliography

Alizadeh, A. H., & Nomikos, N. K. (2009). Introduction to Shipping Markets. In A. H. Alizadeh & N. K. Nomikos (Eds.), *Shipping Derivatives and Risk Management* (pp. 24–64). Palgrave Macmillan UK. https://doi.org/10.1057/9780230235809_2

Bakshi, G. S., Panayotov, G., & Skoulakis, G. (2011). The Baltic Dry Index as a Predictor of Global Stock Returns, Commodity Returns, and Global Economic Activity. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.1787757

Beenstock, M., & Vergottis, A. (1993). *Econometric modelling of world shipping*. Springer Science & Business Media.

Carroll, C. D., Fuhrer, J. C., & Wilcox, D. W. (1994). Does Consumer Sentiment Forecast Household Spending? If So, Why? *The American Economic Review*, *84*(5), 1397–1408. JSTOR.

Dees, S., & Brinca, P. S. (2013). Consumer confidence as a predictor of consumption spending: Evidence for the United States and the Euro area. *International Economics*, *134*, 1–14.

Dimand, R. W. (2000). Ricardo and International Trade Theory. *History of Economic Ideas*, *8*(3), 7–24. JSTOR.

Engle, R. F. (1982). Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of United Kingdom Inflation. *Econometrica*, *50*(4), 987–1007. JSTOR. https://doi.org/10.2307/1912773

Erdogan, O., Tata, K., Karahasan, B. C., & Sengoz, M. H. (2013). Dynamics of the co-movement between stock and maritime markets. *International Review of Economics & Finance*, *25*, 282–290. https://doi.org/10.1016/j.iref.2012.07.007

Fouquin, M., & Hugot, J. (2016). *Back to the future: International trade costs and the two globalizations*. CEPII, Centre d'etudes prospectives et d'informations internationales.

Gray, H. P. (1985). The Argument for Free Trade and its Underlying Assumptions. In H. P. Gray (Ed.), *Free Trade or Protection? A Pragmatic Analysis* (pp. 8–21). Palgrave Macmillan UK. https://doi.org/10.1007/978-1-349-06983-5_2

Hawdon, D. (1978). Tanker freight rates in the short and long run. *Applied Economics*, *10*(3), 203–218. https://doi.org/10.1080/758527274

Hübner, J.-H. (2016). Shipping Markets and Their Economic Drivers. In M. G. Kavussanos & I. D. Visvikis (Eds.), *The International Handbook of Shipping Finance, Theory and Practice*. Palgrave Macmillan. https://doi.org/10.1057/978-1-137-46546-7_1

Hummels, D. (2007). Transportation Costs and International Trade in the Second Era of Globalization. *Journal of Economic Perspectives*, *21*(3), 131–154.

Irwin, D. A. (1994). The GATT's Contribution to Economic Recovery in Post-War Western Europe. *National Bureau of Economic Research Working Paper Series*, *No. 4944*. https://doi.org/10.3386/w4944

Jevons, W. (1871). *The Theory of Political Economy*. Macmillan.

Kavussanos, M. G. (1996). Comparisons of volatility in the dry-cargo ship sector: Spot versus time charters, and smaller versus larger vessels. *Journal of Transport Economics and Policy*, 67–82.

KILN. (2022). *Ship Map*. https://www.shipmap.org/

Koopmans, T. C. (1939). *Tanker freight rates and tank ship building*. Bohn.

Krugman, P. (1995). Growing World Trade: Causes and Consequences. *Brookings Papers on Economic Activity*, *26*(1, 25th Anniversary Issue), 327–377.

Kuzmanovic, M., & Sanfey, P. (2012). *Can consumer confidence data predict real variables? Evidence from Croatia* (Issue 151). European Bank for Reconstruction and Development, Office of the Chief Economist. https://ideas.repec.org/p/ebd/wpaper/151.html

Matsusaka, J. G., & Sbordone, A. M. (1995). Consumer Confidence adn Economic Fluctuations. *Economic Inquiry*, *33*(2), 296–318. https://doi.org/10.1111/j.1465-7295.1995.tb01864.x

Ng, Y.-K. (1992). Business Confidence and Depression Prevention: A Mesoeconomic Perspective. *American Economic Review*, *82*(2), 365–371.

Odom, P. (2010). Shipping indexes signal global economic trends. *Annual Report, Globalization and Monetary Policy Institute*, 28–35.

Ohlin, B. (1935). *Interregional and International Trade*. Harvard University Press.

Rose, A. K., Lockwood, B., & Quah, D. (2000). One Money, One Market: The Effect of Common Currencies on Trade. *Economic Policy*, *15*(30), 9–45. JSTOR.

Sawa, S. (1958). THE ORGANISATION OF THE SHIPPING MARKET. *Kyoto University Economic Review*, *28*(1 (64)), 1–13. JSTOR.

Stopford, M. (2008). *Maritime Economics 3e*. Routledge. https://doi.org/10.4324/9780203891742

Taylor, K., & McNabb, R. (2007). Business Cycles and the Role of Confidence: Evidence for Europe*. *Oxford Bulletin of Economics and Statistics*, *69*(2), 185–208. https://doi.org/10.1111/j.1468-0084.2007.00472.x

Terborgh, A. G. (2003). *The post-war rise of world trade: Does the Bretton Woods System deserve credit?* London School of Economics and Political Science, Department of Economic History. https://EconPapers.repec.org/RePEc:ehl:wpaper:22351

UNCTAD. (2018). *50 years of Review of Maritime Transport, 1968–2018: Reflecting on the past, exploring the future* (Transport and Trade Facilitation Series, 1–No 11). United Nations.

UNCTAD. (2021). *Review of Maritime Transport* (p. 177).

Zannetos, Z. S. (1964). *The theory of oil tankship rates: An economic analysis of tankship operations*.

Zuccollo, D. R. (2013). *The Baltic Dry Index: A leading economic indicator and its use in a South African context*. University of the Witwatersrand, Faculty of Commerce, Law and Management ….