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Doctor of Philosophy (PhD)

DOMESTIC DRY CARGO SHIPPING MARKET: USING MODELS TO DEVELOP FORECASTS

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ABSTRACT

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Domestic Dry Cargo Shipping Market: Using Models to Develop Forecasts

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This dissertation aims to reveal the demand variables in the domestic dry cargo shipping market, investigate their relations and develop demand forecasting models. The shipping industry performs in industrial markets and the characteristics of demand in industrial markets are complex. When the environmental impact of the shipping industry is added to this complexity, it becomes evident that there is a need for a demand-oriented marketing support system. This support will reduce the imbalances between supply and demand, help to identify needs and provide marketing information to guide industry actors and decision makers. The main motivation of this dissertation is to establish and provide a multi-perspective demand forecast support and an indicative process for the domestic dry cargo shipping market.

The study was carried out in three stages and both qualitative and quantitative methods were used during the research. In the first phase, forecasting models of domestic dry cargo shipping were developed by ARIMA, MLP, LSTM, NARX and Hybrid ARIMA_MLP models and comparisons of these models were made. In the second phase, the variables compiled from shipping and industrial marketing literature were mapped to obtain geographical and market specific variables. The last phase consisted of a field study that provides a model for domestic dry cargo shipping demand.

In the first phase, after the pre-interviews Black Sea Region of Turkey is selected as the application area for the forecasting study. 18-month out-of-sample

forecasts of the domestic dry cargo volume are made. It is found that ARIMA models reached the least forecasting error rate compared to other soft computing and hybrid models.

In the second phase, specific variables of the domestic dry cargo shipping market of Turkey were explored. Current issues, future projections and challenges, policies and strategies that need to be implemented to increase domestic shipping are presented from the perspective of the actors in the market.

In the third phase a field study is conducted to present the influencing variables of the domestic dry cargo shipping demand and the relations between these variables, and finally to construct a model for domestic dry cargo shipping. With these variables, 6 macro factor groups, 8 micro factor groups, and 6 company factor groups were obtained. As a result of the developed model with these determinants, foreign trade, energy consumption, international seaborne trade, profits, cargo effects, ship recycle market, distribution channels, transport service costs and quality, operational safety were found as the determinants of domestic dry cargo shipping demand.

The contributions of the thesis can be considered in three areas as a contribution to the method, marketing literature, and practitioners. This study is the first to provide significant empirical evidence using LSTM and NARX models in shipping forecast literature as far as reviewed by comprehensive literature. Performances of these models and benchmarks are contributed to the literature. Additional variables that are not encountered at the shipping demand and forecast literature and industrial marketing demand and forecast literature are revealed in terms of domestic dry cargo shipping. These findings have enabled a unique contribution toward finding out industry specific variables and dynamics. The study provides guiding and value-creating contributions to policy-makers, main actors and stakeholders through the model for domestic dry cargo shipping demand. Finally, it is proposed that explored determinants can be used in future models to lower accuracy error rates.

Keywords: Domestic Shipping, Industrial Marketing, Dry Cargo Shipping, Demand Forecast, Forecasting Methods.

ÖZET

Doktora Tezi

Yurt içi Denizyolu Kuru Yük Taşımacılığı Pazarı: Model Kullanımı ile Tahmin Geliştirme

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Bu tezin amacı, yurt içi denizyolu pazarında talep değişkenlerini ortaya çıkartmak, ilişkilerini incelemek ve talep tahmin modelleri oluşturmaktır. Denizyolu taşımacılığı endüstriyel pazarlarda faaliyet göstermektedir ve endüstriyel pazarlarda talebin özellikleri karmaşıktır. Bu duruma denizyolu sektörünün çevresinin etkisi de eklendiğinde talep yönlü pazarlama destek sistemine ihtiyaç olduğu ortaya çıkmaktadır. Bu destek arz ve talep arasındaki dengesizlikleri azaltacak, ihtiyaçların belirlenmesine yardımcı olacak ve sektör aktörlerine ve karar vericilere yol gösterecek pazarlama bilgisi sağlayacaktır. Bu tezin temel motivasyonu çok yönlü bir talep tahmini desteğinin ve yurt içi denizyolu taşımacılığı pazarı için yol gösterici bir sürecin tesis edilmesi ve sağlanmasıdır.

Araştırma sırasında nitel ve nicel yöntemler birlikte kullanılmış olup çalışma üç aşamalı olarak yürütülmüştür. İlk aşamada, yurt içi kuru yük taşımacılığının tahmin modelleri ARIMA, MLP, LSTM, NARX ve Hybrid ARIMA_MLP modelleri ile oluşturulmuş ve bu modellerin karşılaştırmaları yapılmıştır. İkinci aşamada, denizyolu taşımacılığı ve endüstriyel pazarlama literatürlerinden derlenen değişkenler, coğrafi ve pazar özel değişkenlerin de elde edilebilmesi amacıyla haritalanmıştır. Son aşama, yurtiçi denizyolu kuru yük taşımacılığı talebi için model temin eden bir saha çalışmasından oluşmaktadır.

İlk aşamada, ön görüşmelerin ardından tahminlerin gerçekleştirilmesi için uygulama alanı olarak Türkiye'nin Karadeniz Bölgesi seçilmiştir. Yurt içi kuru yük hacminin 18 aylık gerçekleşen örneklem dışı tahminleri

gerçekleştirilmiştir. Araştırma sonuçlarına göre, ARIMA modellerinin kullanılan diğer esnek hesaplama ve hibrit modellere göre daha az tahmin hata oranına ulaştığı bulunmuştur.

İkinci aşamada, Türkiye'nin kuru yük taşımacılığı pazarının coğrafi ve pazara özgü değişkenleri araştırılmıştır. Yurtiçi kuru yük taşımacılığı pazarındaki güncel konular, gelecekteki tahminler ve zorluklar, yurtiçi taşımacılığın artırılması için uygulanması gereken politikalar ve stratejiler pazardaki aktörlerin görüşü ile yansıtılmıştır.

Üçüncü aşamada bir alan çalışması yürütülerek yurt içi denizyolu kuru yük taşımacılığı talebini etkileyen değişkenler ile bu değişkenler arasındaki ilişkiler araştırılmış ve yurt içi kuru yük taşımacılığı talebi modeli oluşturulmuştur. Değişkenler ile 6 makro faktör grubu, 8 mikro faktör grubu ve 6 şirket faktör grubu elde edilmiştir. Bu belirleyici faktör grupları ile oluşturulan model sonucunda dış ticaret, enerji tüketimi, uluslararası deniz ticareti, gemi geri dönüşüm pazarı, taşıma hizmeti maliyetleri ve kalite, operasyonel emniyet yurt içi kuru yük taşımacılığının belirleyicileri olarak saptanmıştır.

Tezin katkıları yönteme, pazarlama literatürüne ve uygulayıcılara katkı olarak üçe ayrılabilir. Bu çalışma kapsamlı literatür çalışmasının gösterdiği kadarıyla, denizyolu taşımacılığı tahminleme literatüründe LSTM ve NARX modellerini kullanan önemli ampirik kanıtlar sunan ilk çalışmadır. Bu modellerin performansları ve karşılaştırmaları literatüre katkıda bulunmaktadır. Denizyolu taşımacılığı talep ve tahmin modellerinde ve endüstriyel pazarlama talep ve tahmin modellerinde karşılaşılmayan değişkenler yurt içi denizyolu kuru yük taşımacılığı açısından ortaya konulmuştur. Bu bulgular sektöre özgü değişkenlerin ve dinamiklerin ortaya çıkartılmasında özgün bir katkı sağlamıştır. Yurt içi denizyolu kuru yük taşımacılığı talep modeli aracılığıyla politika yapıcılara, ana aktörlere ve paydaşlara dönük yol gösterici ve değer yaratıcı katkılar sağlanmaktadır. Son olarak, saptanan belirleyicilerin daha düşük doğruluk hata oranlarına sahip gelecekteki modellerde kullanılabileceği önerilmektedir.

Anahtar Kelimeler: Yurt İçi Denizyolu Taşımacılığı, Endüstriyel Pazarlama, Kuru Yük Taşımacılığı, Talep Tahmini, Tahmin Yöntemleri.

DOMESTIC DRY CARGO SHIPPING MARKET: USING MODELS TO DEVELOP FORECASTS

CONTENTS

CHAPTER THREE

FORECASTING METHODS

CHAPTER FOUR
RESEARCH ON MODELLING AND FORECASTING DOMESTIC DRY CARGO SHIPPING

ABBREVIATIONS

AC	Analog Complexing Algorithm
ANN	Artificial Neural Network
ANN_ABC	Artificial Neural Network with Artificial Bee Colony
ANN-LM	Artificial Neural Network with Levenberg-Marquardt Algorithms
ARIMA	Autoregressive Integrated Moving Average
ARIMAX	ARIMA Model with Exogenous Variables
ASEAN	Association of Southeast Asian Nations
B2B	Business to Business
BPNN	Back-Propagation Neural Networks
CETA	Comprehensive and Economic Trade Agreement
C^{cat}CSAGA	Chaotic Cloud Simulated Annealing Genetic Algorithm
CDM	Classical Decomposition Model
CSAPSO	Chaotic Simulated Annealing Particle Swarm Optimization
DA	Decomposition Approach
DMTU	A Dry Metric Ton Unit
ECM	Error-Correction Model
EMD	Empirical Mode Decomposition
FC	Forecast Competition
GARCH	The Generalized Autoregressive Conditional Heteroscedasticity
GDP	Gross Domestic Product
GM	Grey Differential Equation Model
GNP	Gross National Product
GP	Genetic Programming
ISIC	International Standard Industrial Classification of All Economic Activities
KPCA	Kernel Principal Component Analysis
LSSVM	Least Square Support Vector Machine
MA	Moving Average
MARS	Multivariable Adaptive Regression Splines
MMTPA	Metric Tonnes Per Annum

MLR	Multiple Linear Regression
MNR-GA	Multiple Nonlinear Regression with Genetic Algorithm
MSHW	Multiplicative Seasonal Holt-Winters
MTI	Ministry of Transport and Infrastructure of Turkey
NACE	The Statistical Classification of Economic Activities in The European Community
PPR	Projection Pursuit Regression
RFNN	Recurrent Fuzzy Neural Networks
RSVR	Robust V-Support Vector Regression Model
R/T	Revenue Ton
SAPSO	Simulated Annealing Particle Swarm Optimization
SARIMA	Seasonal ARIMA
SARIMANT	Seasonal ARIMA without Transformation and Interventions
SD	Seasonal Decomposition
SECM	Structural Error-Correction Model
SVM	Support Vector Machine
TCBM	Central Bank of the Republic of Turkey
TCS	Turkish Chamber of Shipping
TF-DPSO	Transfer Forecasting Model Guided By Discrete Particle Swarm Optimization Algorithm
TOBB	The Union of Chambers and Commodity Exchanges of Turkey
TRM	Trignometric Regression Model
TUIK	Turkish Statistical Institute
UN	United Nations
VAR	Vector Autoregression
VARMA	Vector ARMA Model
VECM	Vector Error Correction Model
WNN	Wavelet Neural Networks

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INTRODUCTION

Shipping industry is a field of substantial investments. Due to having a capital intensive nature, the shipping industry needs to get benefited from demand forecasting as a marketing decision support tool. The need for developing strategies on investment decisions, routes, fleet planning, human resources and related subjects prove the vital importance of demand forecasting for shipping. However, there are still doubts about the accurate results of forecasting errors. Changes in market environments and lack of information cause differing results. Literature has benefited from various methods and various models based on different variables have been adapted. In this dissertation, the variables which influence shipping demand have been identified, evaluated and analyzed in detail by benchmarking forecasting methods.

Domestic shipping can alleviate traffic congestion, and enhance economic development by maintaining cargo flow efficiently (Medda and Trujillo, 2010). Several researches and projects have been launched to get benefits of modal shift from road to the sea. The main motivation for selecting domestic shipping as a forecasting case lies behind this increasing importance and modal shift movement.

In the first chapter of this dissertation, shipping markets and domestic dry cargo shipping markets have been explained briefly. Forecasting studies encountered during the literature review have been presented with details as focused region, data frequency, modeling and forecasting methods, forecasting exercise and research theme. Potential variables for demand forecasting have been deduced from these studies.

In the second chapter of this dissertation, industrial marketing concept and characteristics, demand in industrial marketing have been presented. The importance of the industrial marketing environment has been emphasized and demand forecasting and forecasting methods in industrial marketing have been reviewed. With the help of a literature review, variables have been deduced to identify demand variables for developing forecast models in industrial markets.

In the third chapter of this dissertation, the forecasting concept and process have been given briefly. Qualitative and quantitative forecasting methods are reviewed and especially time series methods that are used in this dissertation are emphasized. Evaluations of forecasting methods have been presented in this chapter as well.

The fourth chapter of this dissertation consists of findings of the empirical researches that are carried out in three main parts. The first part is a quantitative study aimed to develop forecasting models using time series forecasting methods as ARIMA, MLP, NARX, LSTM and hybrid ARIMA-MLP models. Benchmarking of these forecasts has been also another aim of this part of the dissertation. Domestic dry cargo shipping volume of the Black Sea Ports of Turkey has been selected as a forecasting area.

A qualitative study has been conducted in the second part of the fourth chapter to explore the specific geographic and market variables of domestic dry cargo shipping in Turkey. Semi-structured interviews are conducted with domestic dry cargo shipping actors. This qualitative study both presents a variable map on the domestic dry cargo shipping market of Turkey and gives insights into the current market environment.

Upon the exploration of demand variables of domestic dry cargo shipping, the last part of the fourth chapter presents the finding of a field study conducted in the market. This study investigates the effects of demand variables on the domestic dry cargo shipping and the relationships of these variables. In the end, the domestic dry cargo shipping demand model has been established and explored determinants have been proposed to lower accuracy error rates of future models.

The dissertation ends with the conclusions, academic and practical implications, limitations and suggestions for further researches.

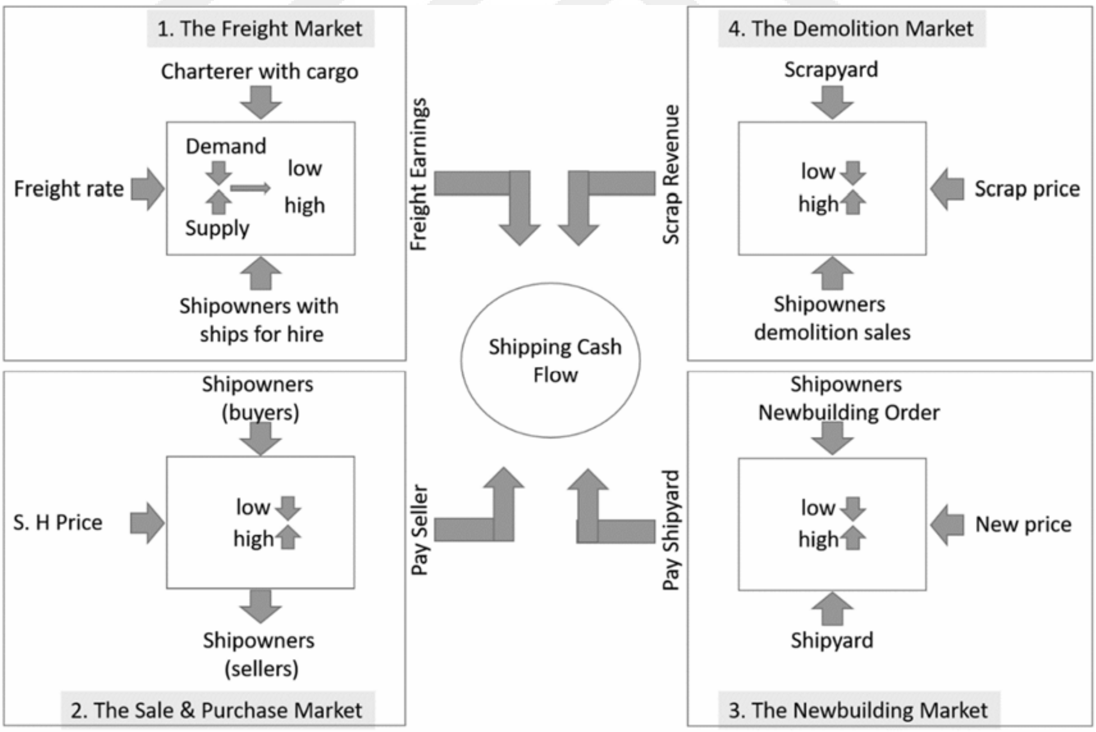
CHAPTER ONE
DOMESTIC SHIPPING AND FORECASTING

1.1. SHIPPING MARKETS AND CHARACTERISTICS

Shipping industry is principally carried out over four related markets; freight, sale and purchase, newbuilding and demolition which is illustrated in Figure 1 (Stopford, 1997: 80). This part of the study aims to provide information about these markets and their characteristics to see how they efficaciously work.

The main actors of the four shipping markets are shipowners, charterers, shipyards, and shipping companies. Each market determines their prices according to the both external and internal developments. Four shipping markets are strongly linked together by cash flows among these market actors. (Stopford, 2009).

Figure 1. Four Shipping Markets



Source: Adapted from Stopford (1997) and Stopford (2009).

1.1.1. Freight Market

The concept of freight is defined in the Merriam-Webster dictionary (2020) as “the charge per unit (as per hundred pounds or per ton) by a carrier for the transportation of cargo generally published in a freight tariff”. Turkish Language Association (TDK, 2020) also defines the concept as “the fee requested by the carrier for the cargo to be carried on the ship”. In another definition, freight is the fee given for the transportation of goods to another place by a ship (Kender and Çetingil, 2007:104).

In maritime transportation, each sub-sector has its market structure. Factors such as ship type, cargo type, entry-exit barriers to the sector, degree of competition, transportation model and distribution of financial responsibilities to the parties affect this structure. The freight rate, which is shaped according to the strength of the competition, is the most important factor in terms of the sustainability of sectoral activities. Therefore, companies in the maritime sector should analyze the structure and market situation of the sector in which they are located and shape their future decisions according to these analyses (Erol and Dursun, 2016: 155).

The world's first freight market, the Baltic Shipping Exchange, opened in London in 1883, but its functions were previously carried out by the Baltic Coffee House in a much less organized form for a long time. In this respect, the freight market with a history dating back to a century ago. There are two different types of transactions in the freight market: the *freight contract* and the *time charter*. The freight contract is the type of contract in which the shipper purchases service from the ship-owner at a fixed price per ton of cargo. The time charter, on the other hand, is the hiring of a ship with a fixed price per day. The time charter is for experienced ship operators who prefer to manage the timeline themselves, while the freight contract is suitable for shippers who prefer to pay an agreed amount and leave the management of the transport to the ship-owner (Stopford, 2009: 180-181).

In maritime transportation, four different types of contracts that distribute costs and responsibilities differently are widely used, as shown in Table 1. The voyage charter is the type of contract which is signed between the ship-owner and the charterer to carry a specific cargo at a specific price per ton. In this type of agreement, all voyage costs are covered by the ship-owner. The time charter is the hiring of a ship with its crew for a price per day, month or year. In this agreement, while capital costs and operating expenses are paid by the ship-owner, the voyage costs are covered by the charterer. In this type of agreement, ship management continues to be carried out by the shipowner. However, the charterer commands the ship's captain where to go and what cargo to load and unload. A bareboat charter is the hiring of a ship without a crew or any operational responsibility. In this type of agreement, the ship-owner is only responsible for the capital costs requiring no ship management expertise (Stopford, 2009: 183).

Table 1. Voyage Charter, Time Charter, And Bareboat Cost Distribution

Voyage Charter	Time charter	Bareboat
Master instructed by: Owner	*Master instructed by:* Owner for ship and charterer for cargo	*Master appointed by:* Charterer
Revenue depends on: Quantity of cargo & rate per unit of cargo	*Revenue depends on*: Hire rate, duration and off-hire time	*Revenue depends on*: Hire rate & duration
Costs paid by owner:	**Costs paid by owner:**	**Costs paid by owner:**
1. *Capital costs*	1. *Capital costs*	1. *Capital costs*
- capital	- capital	- capital
- brokerage	- brokerage	- brokerage
2. *Operating costs*	2. *Operating costs*	**Costs paid by charterer:**
- wages	- wages	1. *Operating costs*
- provisions	- provisions	- wages
- maintenance	- maintenance	- provisions
- repairs	- repairs	- maintenance
- stores & supplies	- stores & supplies	- repairs
- lube oil	- lube oil	- stores & supplies
- water	- water	- lube oil
- insurance	- insurance	- water
- overheads	- overheads	- insurance
3. *Port costs*	**Costs paid by charterer:**	- overheads
- port charges	1. *Port costs*	2. *Port costs*
- stevadoring charges	- port charges	- port charges
- cleaning holds	- stevadoring charges	- stevadoring charges
- cargo claims	- cleaning holds	- cleaning holds
4. *Bunker, etc.*	- cargo claims	- cargo claims
- canal transit	2. *Bunker, etc.*	3. *Bunker, etc.*
- bunker fuel	- canal transit	- canal transit
	- bunker fuel	- bunker fuel

Source: Stopford, 2009: 182.

The dry cargo market is the most diverse in terms of the variety of ships used among the freight markets. Some variants of the dry cargo market can be quite different from the dry cargo market in general. The dry cargo owners who can be shipper or charterer should follow the day-to-day freight markets and the issues necessary for better transportation of cargo. This is done by direct communication with ship-owners or brokers specialized in this field. Besides, they must follow what is going on in the dry cargo market to get the best solution to their transportation needs. The dry cargo market can be divided into as follows: bulker, container, ro-ro, liner, small ships, special (Gorton et al., 1995: 2).

Dry cargoes are transported internationally at deep sea and coastal areas which referred to as short sea. Here these two terms will be investigated.

1.1.1.1. Deep Sea Shipping

Deep sea shipping means "*maritime transport of goods on intercontinental routes, crossing oceans*" (EUROSTAT, 2015). With containerization, deep sea shipping has encountered huge growth over the last 50 years. Due to the scope and scale of the deep sea shipping, more attention has been paid rather than short sea shipping (Gouvernal et al. 2010: 97). Gouvernal et al. (2010: 99) also claimed that dry cargo shipping at the international level is disappearing, but it preserves the importance at the regional level. Deep sea operators are acting on the basis of liberalized trade, while cabotage or local trades have more protectionist market environment (Mukherjee, and Brownrigg, 2013:19). Deep sea shipping focused on the largest ports, while short sea shipping uses terminals.

1.1.1.2. Short Sea Shipping

Short sea shipping means the "*maritime transport of goods over relatively short distances*". In the context of the European Union (EU), short sea shipping consists of EU countries (sometimes also including candidate countries and EFTA countries) and ports situated in geographical Europe, on the Mediterranean and Black Sea (EUROSTAT, 2019).

There are several terms used interchangeably with short sea shipping. "Maritime cabotage", "coastal navigation", "domestic shipping", "coastal shipping/trading", "coasting shipping/trade" and "coastwise" (hereinafter cabotage) are often used interchangeably as well (Casaca and Lyridis, 2018: 212). These terms will be explained in detail in the 1.2.1. Terms and Definitions part of this dissertation.

1.1.2. Shipbuilding Market

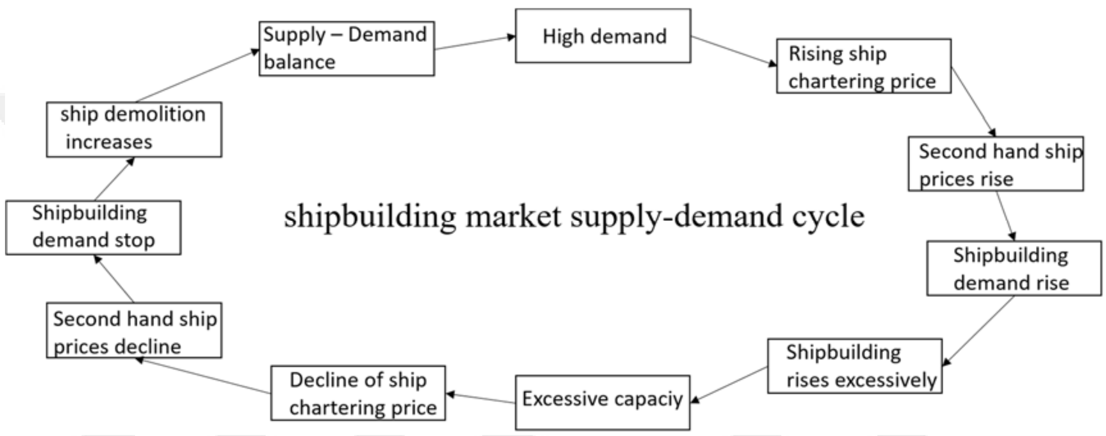
Shipbuilding is the creation of a functional product by combining raw, semi-processed or fully processed materials, machinery and equipment according to a design and rules. The reasons that require the construction of a new commercial ship are summarized as renewal, fleet enlargement, cargo or line change, market change, etc. (Akıncı, 2008: 41).

Shipbuilding demand and supply are evaluated within the commercial shipping market. Increasing ship demand naturally leads to an increase in shipbuilding prices and ship orders. As ship deliveries are made, ship supply increases, so the number of ships in the market increases and freight charges decrease. As a result, ship orders decrease, the economy of old ships decreases, and ship demolition increases. As a result of ship demolition, ship supply and the number of ships decrease which causing the freight charges to increase. This leads to an increase in ship demand, which is the beginning of the cycle. The balance of supply and demand in maritime transportation fluctuates in this way and determines shipbuilding prices and shipbuilding orders. Ships, which are the elements of maritime transportation, are both technical and economically durable structures. As the ships wear out under working conditions and especially under the corrosive effects of sea water, their maintenance and repair costs increase and lose their economic efficiency. Especially at times when the freight rates are favorable, ship-owners scrapped their old ships and renew their fleet, creating demand for new shipbuilding. In addition, new designs that increase operating efficiency by using superior technology with the types of ships that result from the spread of the integrated transportation (intermodal transport) approach and the changes in world trade are the elements that increase the demand for new shipbuilding (Aydın, 2009: 52).

Demand and price formation varies greatly depending on political conditions and fluctuations in the freight market. Figure 2 shows the shipbuilding market supply-demand cycle.

The shipbuilding market is closely associated to the sale and purchase market. However, the character of these two markets is different. Ships are of interest in both markets, but the shipbuilding market aims to uncover ships that do not exist. The characteristics of the ship to be built should be determined first in the new construction process. Shipyards usually direct the buyer to an existing design, as it will go through a faster production process than special orders (Stopford, 2009: 207).

Figure 2. Shipbuilding Market Supply-Demand Cycle



Source: Brauner and Llingworh, 2006; Aydın, 2009: 53.

In shipbuilding market, China, Japan and the Republic of Korea are the top of three countries. In 2018, for example, these countries maintained their leadership in global shipbuilding, representing 90% of shipbuilding activity (40% (China), 25% (Japan) and 25% Republic of Korea, individually). China made up 60% of global bulk vessels 49 percent of container ships, 47 percent of general cargo ships and 45 percent of offshore vessels (UNCTAD, 2019: 30).

If the new buildings are ordered to shipyards during periods of high freight, the time takes for the ship to be built and put into service is about 3-3.5 years. If the demand for maritime transport could be met instantly, freight rates would remain constant, provided that regional tonnage deficiencies, fuel prices, and other cost variables were neglected. Therefore, due to the increasing demand, the fact that the new shipbuilding period is long and the capacity of the shipyards cannot meet the demand in time causes the increase in the freight prices. In cases where the supply of the ship exceeds the demand, the reluctance of the ship owners to disable their excess capacity ships delays the arrival of freights to their normal levels (Tvedt, 2003: 330; Töz, 2014: 57).

1.1.3. Sale and Purchase Market

The sale and purchase market consists of traders, transport companies and speculators in the freight market. In this market, the process begins when the ship-owner enters the market with a ship for sale. The ship can be sold with prompt delivery, mortgage or cash. Sometimes, depending on the benefit of an ongoing time charter agreement, the sale may take place. The ship-owner can take a sales decision for different reasons. The aging of the ship is one of the most common reasons. Besides, the fact that the ship is no longer suitable for the type of trade carried out and the expectation that the ship prices will decrease are effective factors in taking a sales decision. The purchaser may likewise have different purposes. These purposes are generally the need for commercial continuity and the idea that the price index is suitable for ship investments (Stopford, 2009: 198).

In the maritime industry, it is considered that the earnings of investors will be achieved not only by ship management but also by realizing the purchase and sale of the ship at the right time (Kavussanos and Alizadeh, 2002: 325). In some cases, although newly built ships are cheaper, investors who do not want to miss the earning opportunities in the market buy second-hand ships (Töz, 2014: 57).

The sale and purchase process is usually done through shipbrokers. The ship-owner asks the shipbrokers to find a buyer for the ship it is on sale. Generally, the sales process is carried out with many brokerage firms. However, the owner may sometimes want to work with a single shipbroker and does not request any other intermediaries. After the request, the shipbroker starts to search for buyers who can buy the ship. Before the marketing process for sale begins, a file is prepared to contain all the ship's specifications, including the hull, machinery, equipment, class, survey status, and general equipment. At the same time, the shipbroker starts collecting requests from potential buyers and presents the vessels that meet the requests. If an agreement is reached, the sale takes place (Stopford, 2009: 199).

The dynamic structure of the second-hand ship market offers low purchase and high sales opportunities, enabling high profits. The decision of when to invest is a critical question here. In an environment where freight rates drop, ship values also decrease. Although this situation is undesirable for ship owners, it provides an opportunity for the investors to purchase (Tsolakis et al, 2003: 348).

In the second hand market, it is determined that ships of different sizes and segments react differently to changes in the market variables that determine them. For this reason, second-hand market evaluations should be made in a disaggregated way, not collectively. New construction and freight rates are the most important factors in determining second-hand prices in the short and long term (Tsolakis et al, 2003: 347).

For some ship owners, sale and purchase is an important source of income than shipping operations. Stopford stated that "ship owners have two jobs: operating a ship and second hand trading. The former one is a profitable business but it does not provide much profit in a short time. The later one can provide high profit opportunity if it is to be in the right place at the right time." Although most of the ship-owners focus on shipping trade income, some ship-owners are only interested in the sale and purchase market (Park et al., 2018: 1).

1.1.4. Demolition Market

The demolition market, also called recycling, is an important part of the maritime industry, although it is not very active compared to other maritime markets. The procedure operating in this market is similar to the second hand market. As a difference, customers are scrap yards that dismantle ships rather than ship-owners.

The ship-owner offers a ship to the demolition market thinking that the ship is no longer trade (Stopford, 2009: 212). When the ship-owner decides to scrap a ship, there are two options to choose from. The first option is to sell the ship directly to a scrap yard. Another option is to sell the ship to a cash buyer who later resells it to the shipbreaker (Sundelin, 2007: 11). In some cases, purchases can also be made by brokers. They purchase a ship that is put on the demolition market by her owner and sell it to scrap yards.

There are some trends in terms of specialization in scrapping trade. For example, large vessels are often scrapped in the Asian demolition market. The small vessels especially work in Europe is scrapped in Turkey, the largest scrapping center located in the west. The reason for this may be the voyage costs that will arise when traveling from Europe to Asia (Sundelin, 2007: 11).

Ship demolition market is a shipping market commonly dominated by developing countries such as India, Bangladesh, Pakistan, Turkey, etc. due to various factors such as low labor costs, high use of steel for domestic manufacturing, and convenience in legal regulations (UNCTAD, 2019: 35). Previously, after ships were taken out of service, scrapping was generally applied in the countries where they were built. However, after the 1970s, the demolition industry first moved to South Korea and Taiwan shipyards and then to India, Bangladesh, Pakistan and China. Today, most of the ship dismantling takes place in these countries. In Europe, there are generally shipyards that allow the dismantling of small ships. However, there are scrap yards, located in Belgium, Italy, Holland and Turkey, capable of dismantling larger ships (Sundelin, 2007: 10). Table 2 shows the market distribution of the top 5 countries with the highest share of scrapping in the world.

Table 2. Tonnage for Demolition by Major Vessel Type and Country for 2018 (Thousand Gross Tons)

	Bangladesh	**India**	**Pakistan**	**Turkey**	**China**	**World Total**	**%**
Oil tankers	5 989	1 946	2 824	66	14	10 884	**59.5**
Bulk carriers	1 115	465	829	18	53	2 495	**13.6**
General cargo ships	127	149	57	65	5	405	**2.2**
Container ships	620	402	38	54	152	1 284	**7.0**
Gas carriers	347	455	48	3	97	951	**5.2**
Chemical tankers	43	167	28	28	2	268	**1.5**
Offshore vessels	181	581	72	143	30	1 156	**6.3**
Ferries / passenger ships	-	171	-	14	-	185	**1.0**
Other	210	353	47	29	5	673	**3.7**
Total	**8 632**	**4 690**	**3 943**	**418**	**359**	**18 300.9**	**100.0**
Percentage	**47.2**	**25.6**	**21.5**	**2.3**	**2.0**	**100**	

Source: UNCTAD, 2019: 35

As shown in Table 2, most of the tonnage for scrapping belongs to oil tankers, bulk carriers and container ships. However, bulk carriers, which was the leader in the previous year, fell behind the oil tankers in 2018 (UNCTAD, 2019: 35).

Most of the scraps resulting from the dismantling of the ships are offered to local markets for raw material supply and construction. Therefore, the demolition market frequently depends on the demand of the local steel markets (Stopford, 2009: 212). Ship demolition and recycling industry turn ships withdrawn from commercial activities into steel and other recyclable materials. Almost every part of the ship resulting from dismantling is reused. Therefore, the ship demolition industry offers a high contribution to environmental sustainability (Sarraf et al., 2010:1).

1.1.5. Shipping Markets and Classifications

All economic activities have been arranged by ISIC with the aims of adapting a standard classification system and providing international comparability (UN, 2008: ix). Shipping markets are integral parts of the international trading system, and these markets advance international trade by connecting sources of supply and demand for commodities (Alizadeh and Nomikos, 2009: 63). Therefore, these markets are classified under ISIC classification as well. Freight market activities are regarded under the division H. Newbuilding market activities are regarded under the Division C.30.11 Manufacturing (Building of ships and floating structure). Ship sale and purchase market activities are regarded under the Division H. Ship demolition market activities are regarded under Division E 38.30 Water supply; sewerage, waste management and remediation activities. However, there is a special clause with the dismantling of the ship that indicates if a shipyard mostly carries out ship dismantling it should not be combined with ship building class (UN, 2008:7).

ISIC is prepared by the UN is a central classification system to use at the further statistical analysis of economic activities (Cerit, 2013). Similarly, TOBB has been prepared Classification of Professions Guide at Turkey based on the NACE system (TOBB, 2010). Cerit (2013: 7) compiled shipping related industries from the ISIC Rev. 4 classification system as presented in Table 3. Sea and coastal water transport are considered together. Classes that are not directly related to the shipping activities are presented in italics. However, there are some hybrid activities including distribution channels and suppliers of the shipping industry that are not presented at the Table. Within the scope of this dissertation, NACE (EUROSTAT, 2008) will be used to collect data on industrial goods that are the issue of dry cargo shipping. Moreover, TCS professional committees that are classified similarly with ISIC are used in this dissertation.

Table 3. Primary Shipping Activities According to ISIC Rev. 4, NACE Rev 2. Classifications Systems

Division	**Group, Class, Description**	
A	Agriculture, Forestry and Fishing	
B	*Mining and quarrying*	
C	Manufacturing	
D	*Electricity, gas, steam and air conditioning supply*	
E	Water supply; sewerage, waste management and remediation activities	
F	Construction	
G	Wholesale and retail trade; repair of motor vehicles and motorcycles	
H	Transportation and Storage	
	50	Water Transport
	50.1	Sea and coastal passenger water transport
	50.2	Sea and coastal freight water transport
	50.3	Inland passenger water transport
	50.4	Inland freight water transport
	52	Warehousing and support activities for transportation
	52.1	Warehousing and storage
	52.2	Support activities for transportation
	52.22	Service activities incidental to water transportation
	52.24	Cargo Handling
	52.29	Other transportation support activities
I	Accommodation and food service activities	
J	Information and communication	
K	Financial and insurance activities	
L	*Real estate activities*	
M	Professional, scientific and technical activities	
	74.9	Other professional, scientific and technical activities n.e.c.
N	Administrative and support service activities	
	77	Rental and leasing activities
	77.34	Renting and leasing of water transport equipment
O	Public Administration and Defense; Compulsory Social Security	
P	Education	
Q	*Human Health And Social Work Activities*	
R	Arts, Entertainment And Recreation	
S	*Other Service Activities*	
T	*Activities Of Households As Employers; Undifferentiated Goods-And Services-Producing Activities Of Households For Own Use*	
U	Activities of Extraterritorial Organizations and Bodies	

Source: Adapted from Cerit, 2013 and compiled from UN (2008)

1.2. DRY CARGO SHIPPING MARKET: DEFINITIONS, ENVIRONMENT AND DEVELOPMENTS

This part provides a brief introduction to domestic shipping. The first part presents the definitions and terms that are used interchangeably with domestic shipping and proposes the definition of domestic shipping. Then, the domestic dry cargo shipping market environment is illustrated and developments regarding domestic shipping from geographical perspective are given systematically.

1.2.1. Terms and Definitions

As mentioned above, there are several terms used interchangeably with short sea shipping. “Maritime cabotage”, “coastal navigation”, “domestic shipping”, “coastal shipping/trading”, “coasting shipping/trade” and “coastwise” (hereinafter cabotage) are often used interchangeably as well (Casaca and Lyridis, 2018: 212).

Cabotage is the “*French name for the coasting trade. Many people believe that it is derived from cabo due to coasting ships generally sailed from cape to cape.”* However, it is likely to derived from the French word “Cabot” (Dear and Kemp, 2005: 83). Cabotage is the countries’ domestic trade that reserved for ships flying the national flag. Cabotage is still widespread in both developing and developed countries (Mukherjee and Brownrigg: 2013: 79, 99).

A navigable inland waterway is a river, canal, lake or other “*stretch of water, that is not part of the sea, on which vessels with a carrying capacity of not less than 50 tonnes can navigate when normally loaded*” (EUROSTAT, 2013).

UK Department for Transport (2017) defined domestic waterborne freight as freight traffic moved within the UK by water transport.

“Coastal shipping is the maritime transport of goods along the coast over relatively short distances. Coastal shipping excludes freight movement in inland waterways and refers only to a single mode of waterborne transport” (Venkatesh et al. 2017: 362, 363).

Short sea shipping covers coastal shipping and domestic shipping. Short sea shipping includes multimodal/intermodal components (Venkatesh et al. 2017: 363).

Common characteristics of these terms are having small transit times and distances and designed for particular circumstances and voyages (Mukherjee, and Brownrigg, 2013: 23). Consequently, a definition of domestic shipping has been given by considering the above mentioned characteristics and scope of this dissertation. Within the scope of this dissertation domestic shipping can be defined as follows: Domestic shipping is the maritime transport of goods between ports of country weather restricted by cabotage policy or not. This definition is similar to McDowell et al.'s (1999) referring to domestic shipping.

Short sea shipping is essential for countries with long coastlines as China, Norway, Brazil, and the USA, and within confined waters as the Baltic Sea, the Black Sea, the Mediterranean, the Red Sea, and the Persian Gulf and within limited open sea areas (Casaca et al. 2017: 258).

1.2.2. Domestic Dry Cargo Shipping: Market Environment

The macro external environment of domestic dry cargo shipping has a prevailing feature that it is oriented to the global, national or regional markets. The regulatory framework of the shipping industry is generally global and adopted by most of the countries. However, there are some exceptions to the domestic shipping industry (Theotokas, 2018: 26).

- **Economic Environment**

The economic environment includes the demand for maritime transportation services (Theotokas, 2018: 34). This fact can be deduced for domestic shipping as demand to domestic shipping and demand to the commodities are the issue of domestic shipping cover the economic environment. Business cycles, fluctuations, growth rates, cyclicality, ship demand are some of the forces of the economic environment.

- **Political/ Legal Environment**

The legal environment of domestic dry cargo shipping has international, regional and domestic character. IMO that creates a regulatory framework for the maritime industry, Memorandum of Understanding Agreements that maintains the applications of these regulations, and Law of the Sea that is the international legal system are the international and regional forces of the shipping industry (Cerit, 2013:

15). In domestic shipping, the Turkish Commercial Code and Turkish Cabotage law, and other national legislation and regulations are formed the legal environment.

According to Cerit (2013) infrastructural investments, taxing and investment subsidies and shipbuilding subsidies, supports for national flags, employment incentives, educations, and research and development activities are among the political forces of the shipping industry (OECD, 2020) as well as domestic dry cargo shipping industry.

- **Technological Environment**

The technological environment of the shipping industry consists of inventions, techniques and organized knowledge (Theotokas, 2018: 29). Technological change is imposed by forces and pressures from within and without the shipping industry. These forces are "*basic transport technology such as ship form or propulsion systems, cargo or ship handling technology, as well as ship management, information control, and communications technology, and various intermodal and port interface technologies. Technological change in shipping has accelerated*" and it is a dominant factor in shipping development (Frankel, 1991: 43- 45).

- **Social/ Cultural Environment**

The social and cultural environment is heavily dependent on the national and geographical characteristics of the countries. Maritime culture, history, literature all arts-related with seas, ships can be regarded as a social and cultural environment (Cerit, 2013). Maritime traditions and norms that are historically accepted by the shipping industry and the framework of professional values and ethics shape the culture of the maritime communities at international and national levels and brings an important responsibility to the institutes to pass them to the future generations (Cerit, 2003).

- **Natural Environment**

The natural environment is a dynamic system that includes air, water, land and living organisms. This system is composed of four spheres as atmosphere, hydrosphere, geosphere, and biosphere (Lindgren et al. 2016: 30). Similarly, the main environmental features of dry bulk shipping are mentioned by (Comtois and Lacoste, 2012: 173) as distance, topography, hydrology, climate change, and natural hazards.

Shipping operations are inevitably pressures on the natural environment (David and Gollash, 2015: 1).

- **Suppliers**

There is a dual structure in the supply function of the shipping industry as suppliers and actors in industry overlap. Suppliers of the domestic dry cargo shipping are listed in Figure 3.

- **Substitutes**

Main bulk commodities (iron ore, grain, and coal) constitute 29% of the tons of the total international maritime trade. Other dry cargoes (minor bulks) constitute 41.80% of the tons of the total international maritime trade (UNCTAD, 2019: 5). Substitutes of domestic dry bulk shipping can be listed as other transport modes as liner shipping, ro-ro transportation, road and railway transportation.

- **Society and external stakeholders**

Society and external stakeholders of the shipping industry consists of governments and other public institutes, ports, shipyards, other coastal facilities and their communities, non-governmental organizations, and national professional societies (Cerit, 2002; Akdas, 2019). These are considered as a society and external stakeholders for the domestic dry cargo shipping industry as well.

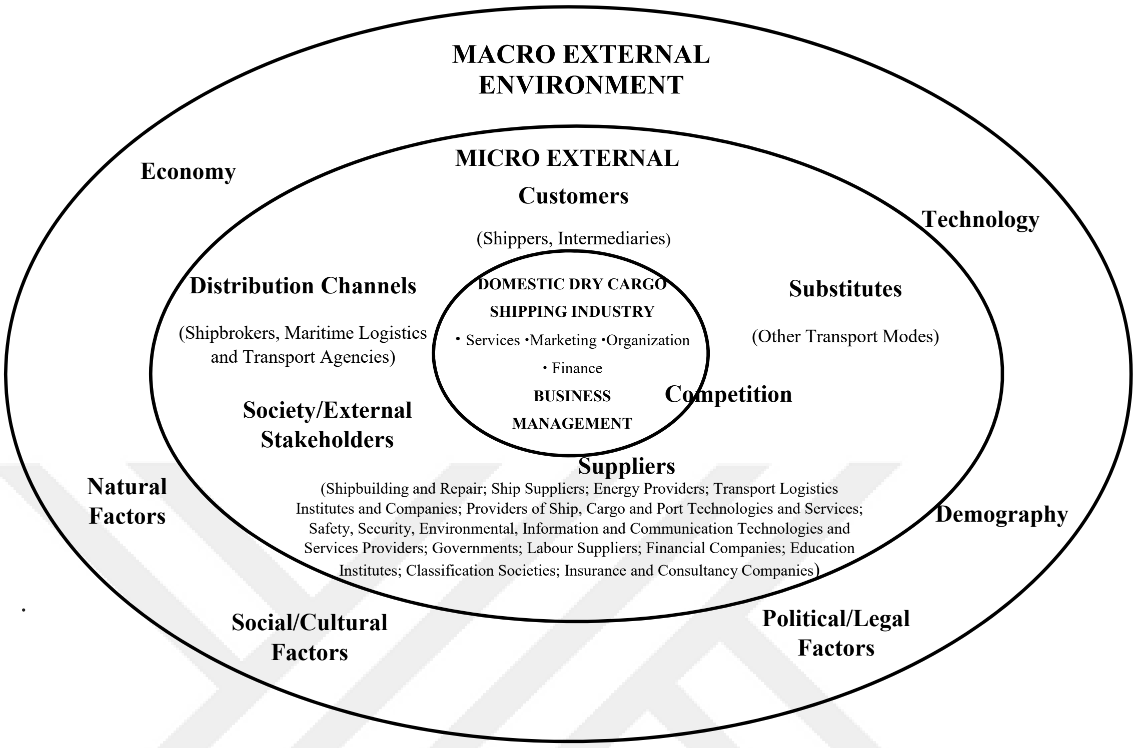
- **Customers**

In terms of shipping industry customers are shippers. In the case of dry bulk shipping, charterers are customers as well (Denktaş and Cerit, 2007: 3). It was mentioned by Denktaş and Cerit (2007: 3) most of the customers of the Turkish dry bulk fleet have been especially the foreign charterers.

- **Distribution Channels**

Distribution channels have similar hybrid structures as well. They are both industry actors and distribution channel members of the industry. Brokers and agencies in maritime transport services are the members of the distribution channels of domestic dry cargo shipping.

Figure 3. Domestic Dry Cargo Shipping Industry: Macro - Micro External Environment, Internal Environment



Source: Adapted from Cerit and Güler (1998), Cerit (2013)

1.2.3. Developments in Domestic Shipping Markets

This part provides a brief introduction to domestic shipping in selected regions. An overview of cabotage legislation and practices and domestic shipping cargo transportation statistics are presented across various regions of the world.

1.2.3.1. Domestic Shipping in the World

This part consists of the current situation of domestic shipping in the EU, North America, Australia, and Asia.

1.2.3.1.1. European Union

At 1992 Council Regulation (EEC) No 3577/92 was released by The Council of the European Communities that apply the principle of freedom (EC, 1992). Following Table 4. illustrates the current situation of cabotage legislation at EAA. There are degrees of cabotage at EEA After the exit of the UK from the EU, the UK did not have access to the EEA cabotage market (Casaca and Lyridis, 2018: 217).

Table 4. Overview of the Cabotage Legislation in the EEA for Vessels Registered in Member-States' First Register

Country	Liberalized to the EEA Member States	Liberalized to the Non-EEA Member States	Fully Liberalized	Country	Liberalized to the EEA Member States	Liberalized to the Non-EEA Member States	Fully Liberalized
Belgium	Yes	Yes	Yes	Norway	Yes	Yes	Yes
France	Yes	No	No	Ireland	Yes	Yes	Yes
Germany	Yes	No	No	Malta	Yes	Yes	Yes
Italy	Yes	No	No	No	No		Yes
Luxemburg	No maritime cabotage			Estonia	Yes	No	No
Netherlands	Yes	Yes	Yes	Latvia	Yes	Yes	Yes
Denmark	Yes	Yes	Yes	Lithuania	Yes	No	No
Ireland	Yes	Yes	Yes	Poland	Yes	Yes	Yes
United Kingdom	Yes	Yes	Yes	Czech Republic	No maritime cabotage		
Greece	Yes	No	No	Slovakia	No maritime cabotage		
Portugal	Yes	No	No	Hungary	No maritime cabotage		
Spain	Yes	No	No	Slovenia	Yes	No	No
Finland	Yes	No	No	Bulgaria	Yes	No	No
Sweden	Yes	No	No	Romania	Yes	No	No
Austria	No maritime cabotage			Croatia	Yes	No	No

Source: Casaca and Lyridis, 2018: 217

European Union has the largest share in terms of short sea shipping in the world (Papadimitriou, 2018: 184). In 2018, 1.92 billion tonnes of goods were handled at EU -28 with a slight increase of 0.2%. The United Kingdom continued to be the major short sea shipping country in Europe in 2018, with 313 million tonnes. Italy followed with 312 million tonnes and then Turkey with 295 million tonnes of goods are carried in their main ports.

Liquid bulk is the main type of cargo in EU short sea shipping. 805 million tonnes of liquid bulk were handled to and from main EU ports in 2018 with a decrease from the previous year. Then, dry bulks are carried at 413 million tonnes, and there was an increase in handling dry bulk cargoes at short sea shipping from the previous year. Containers at 300 million tonnes and roll on - roll off (Ro-Ro) units at 267million tonnes.

For liquid bulk, the Netherlands had the largest volume of short sea shipping in 2018 (152 million tonnes, followed by Italy (130 million tonnes) and the United Kingdom (113 million tonnes) and Turkey (89 million tonnes). Norway had the largest volume of dry bulk goods (62 million tonnes), followed by United Kingdom (59 million tonnes). Turkey with 82 million tonnes, was the main country carrying goods in containers, followed by Italy (60 million tonnes) and Germany at 49 million tonnes (EUROSTAT, 2020).

In the UK, domestic shipping has a share of %19 of all freight handled by UK Ports in 2018. There was a long term decline trend in domestic shipping of the UK. This decline is associated with the decline in North Sea oil. Liquid bulk cargo is the dominant type (47%) in 2018, followed by dry bulk (29%) (UK Department for Transport, 2019).

In Black Sea, goods transported in containers only accounted for 5 % of the short sea cargo, in dry bulk goods 33.4 %, in liquid bulk 56.1 %, in Ro-Ro 0.6%

1.2.3.1.2. North America

Cabotage policy in the US is regulated under the Jones Act 1920. It is referred as protectionist cabotage policy (Casaca and Lyridis, 2018: 222) and "*it requires that goods shipped between U.S. points be transported on American built, owned, crewed, and flagged vessels*" (Olney, 2019: 41)

Domestic shipping in America consists of "*operating vessels in the Great Lakes, the inland waterways, and in the coastwise, intercoastal, and domestic offshore trades carry a combined total of over one billion short tons of cargo each year*". The main domestic shipping products are crude petroleum, raw materials, coal, chemicals, and farm product (US Transportation Institute, 2019). Domestic water freight that includes coastal and Great Lakes, inland waterways, locks, and channels are accounted 42.187 millions of dollars in 2017 (US Bureau of Transportation Statistics, 2020)

US Transportation Institute (2019) referred that the economic contribution of the Jones Act is beyond the ship operations and creates benefits all shipping market actors. It is estimated that commercial shipbuilding and domestic waterborne transportation industries created approximately 82,000 jobs. These jobs directly resulted in $34.3 billion in U.S. economic output and $7.2 billion in U.S. labor compensation. However, Olney claimed that Jones Act shifts domestic shipments to other transport modes and adds some additional costs and increases the prices in coastal states (Olney, 2019: 41).

Similarly, Canada has a protectionist cabotage regime. However, relative to the US cabotage legislation, Canada follows a more relaxed cabotage policy. Canada, Mexico and the U.S. signed a memorandum to support SSS (Papadimitriou, 2018:75). Canada and EU ratified CETA that liberalize the repositioning of empty containers, dredging activities and feeder services (Casaca and Lyridis, 2018: 222). 98 % of domestic shipping and the trade between the U.S. and Canada are actively carried by Canadian Registered vessels. The main domestic shipping activity is the shipping of bulk cargo. 29% of total gross tonnage and %43 of total vessels are dry bulk carriers. General cargo and tanker vessels are the following vessel types. Total, 113 vessels with a total of 2.7 million gross tonnes are Canada's commercial registered fleet in 2018 (Canada Ministery of Transport, 2018: 23).

1.2.3.1.3. Australia

Australia follows a liberalized cabotage regime that allows the entrance of foreign shipowners to the domestic market at the expense of the licensing system (Casaca and Lyridis, 2018: 229). The licensing system established under Coastal Trading (Revitalising Australian Shipping) Act 2012 on 01 July 2012 (Australia Department of Infrastructure, Transport, Regional Development and Communications, 2019).

18 % of the total domestic transport is performed by coastal shipping here refers to the movement of cargo or passengers on ships between ports in different states and territories in Australia. Major cargoes move around Australia are coal, fertilizer, petroleum products, liquid petroleum gas (LPG), metallic ores and mineral sands, cement and steel as well as domestic cruises and ferries. Almost one million metric tons of fertilizer, 278,000 metric tons of LPG products and just over 6.4 million metric tons of petroleum products were carried by coastal shipping in 2013-2014. Around 90,000 Australians are employed in manufacturing sectors using coastal shipping as

including oil refining, cement, steel and aluminum production (Australia Department of Infrastructure, Transport, Regional Development and Communications, 2015)

1.2.3.1.4. Asia

Cabotage policy in Asia shows a well-established structure. Different policies have been applied among the countries. Some of them as Japan has strict cabotage regime, while some of them as India, Malesia, Indonesia, and China have been following relaxed cabotage policy. There are some bilateral agreements between countries to promote coastal shipping as it can be seen as the first step of the Asian short sea shipping area (Casaca, 2018: 227).

In recent years, Asian countries give importance to the modal shift from road to sea in terms of carrying containers. Most industrial zones are near the maritime gateways at South East Asian Region so that this region is coastal concentrated and has low hinterland coverage. Therefore, there is an extended port network that is handling a significant part of the world's trade volumes (Papadimitriou et al. 2018: 169-171).

China's domestic shipping remains low levels compared to trucking (Papadimitriou et al. 2018: 172). However, domestic dry bulk shipping in China has increased by 13.1% year-over-year. However, The Chinese Ministry of Transport expects a slowdown in dry bulk demand, while the number of vessels expected to increase at the same time. Therefore, the stabile domestic dry bulk shipping market will change with this over-capacity problem. This overcapacity threat seems to be a problem for other coastal shipping markets (Safety4sea, 2019).

Total coastal shipping in South Korea is approximately amounted up to 209,679 thousand R/T in 2019. Korean Flagged Ships are handled approximately amounts up to 141, 530 thousand R/T in 2019. Product of petroleum oils, other ores, cement and iron steel & articles thereof and vehicles and parts thereof are the items mostly transported by coastal shipping. Petroleum gases & other gases, products of the chemical, bituminous coal iron steel & articles thereof, and textiles & textile articles are the most handled items by Korean Flagged Ships (KOSIS, 2020). Korean

Government supports coastal shipping to overcome road traffic congestion and reduce air pollution (Papadimitriou, 2018: 175).

Inland waterways in India have not attracted adequate attention despite the 14,500 km inland waterways network. Lack of supporting infrastructure, navigational constraints, and the need for additional governmental support presented as the reasons for this underutilization (KPMG Report, 2006: 2). Inland waterways only 6% of the total transportation modal mix. It estimated that coastal shipping will increase to 250 MMTPA and inland shipping will increase 125 MMTPA until 2025. Ministry of Shipping in India has been promoting coastal and inland shipping with relaxation in licensing foreign-flagged vessels for special cargoes and for special vessels, priority berthing policy, discounts on port charges, granting of developing the infrastructure (India Ministry of Shipping, 2019).

ASEAN member countries have established the ASEAN Single Shipping market that aims to coordinate policy and harmonize rules and regulations to liberalize shipping services in the region (Asean, 2015:11). Domestic sea cargo throughput, that refers the total number of tons of cargo, including transit, loaded and unloaded by domestic merchant ships in the country's ports during the year, is accounted approximately 175 132. 00 thousand tons in Vietnam, 60 850. 00 thousand in Thailand, 101 496. 00 tons in the Philippines, 4 782.00 thousand tons at Myanmar, 965 126. 00 thousand tons in Indonesia, 2007. 00 thousand tons at Cambodia and 9. 00 thousand tons at Brunei Darussalam in 2017 (ASEANStats Data Portal, 2018).

1.2.3.2. Domestic Shipping in Turkey

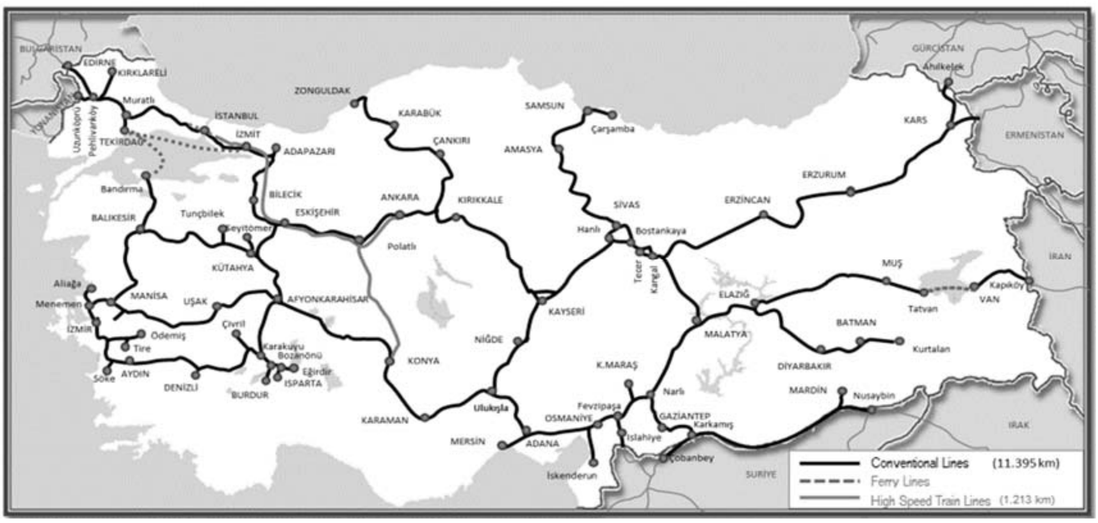
29 million tons handled the domestic shipping market of Turkey. Then, in 2018 this amount increased 60 million tons in which the share of total handling volume of Turkey is 13% (MTI, 2019a). This amount is planned to increase by up to 18% until 2023 (SBB, 2019: 127). When the domestic shipping market is analyzed by cargo volume, liquid cargoes are the most handled cargo type with 21 million tons. Moreover, 15 million tons' dry bulk cargo and 12 million tons' general cargo are handled. Of the total domestic shipping volume, 10 million tons are containerized cargo and 5 million tons are ro-ro (MTI, 2019a).

Following problems, the oldness and the technical deficiency of the coaster fleet, the need for acquiring a younger fleet and for increasing the tonnage and lack of demand to the domestic transport of Turkey, that were mentioned by Dalkanat (2001). However, domestic shipping has supported the application of fuel without SCT started in 2004. To 2018, 6 billion 789 million TL has been provided to the industry (MTI, 2018a: 451).

Substitute transportation modes which are composed of railway transportation, road transportation, air transportation, and pipeline conditionally can have the feature of being distribution channel, supplier, and competitor (Cerit, 2013: 15). Substitutes mentioned below also have the characteristics of being customers in dry cargo shipping in Turkey. 11 ports have railway connections throughout Turkey as illustrated in Figure 4.

Turkish Merchant Fleet (above 300GT) stood at 6723933 DWT with 1260 ships by end of 2019. Deadweight of different ship types in the Turkish Merchant fleet can be stated as follows: 1 141 894 DWT dry (general) cargo ships, bulk ships 2 224 742 DWT, container ships 1 047 502 DWT, Liquid /Gas Tankers 2 067 911 DWT (MTI, 2020). As for 2019, a total of 457 ships (above 1000 GRT) are acting with 6 831 000 DWT and 107 TEU under the Turkish Flag with Turkish ownership. The average age of these ships is 21.4 and this age steadily increasing year by year (MTI, 2018b: 15).

Figure 4. TCDD Network Map



Source: TCDD, 2018: 53

1.3. FORECASTING IN SHIPPING MARKETS

Stopford (2009: 698) emphasized Peter Drucker's opinion that forecasting beyond is a delusion for human beings and integrated into the maritime industry as stating the aspects of the maritime industry are not predictable. However, although predictions never are certain, it is better to forecast even without certainty than not forecasting at all (Poincare, 1913: 129). Forecasting future is crucial for the shipping industry stakeholders to make investment decisions on ordering a ship, establish the chartering type, plan the future, gain more profit, calculate the risk (Stopford, 2009: 697).

1.3.1. Forecasting Studies in Shipping Markets

Forecasting and modeling shipping markets have been studied for years, though it has attracted much attention widely in the last decades. The earliest studies found during the review as Tinbergen (1959), Beenstock and Vergottis (1993), Charemza and Gronicki (1981) are generally shown theoretical foundation. Several articles on maritime forecasting have been published after 2000, and the majority of these studies indicate empirical research and focus on quantitative models using different forecasting techniques as econometric modeling, time series, soft computing techniques. Qualitative forecasting techniques have not attracted much attention, only a few qualitative studies have found during the review. Reviewed studies generally concentrated on a specific region to increase the accuracy and to cope with data collection limitations.

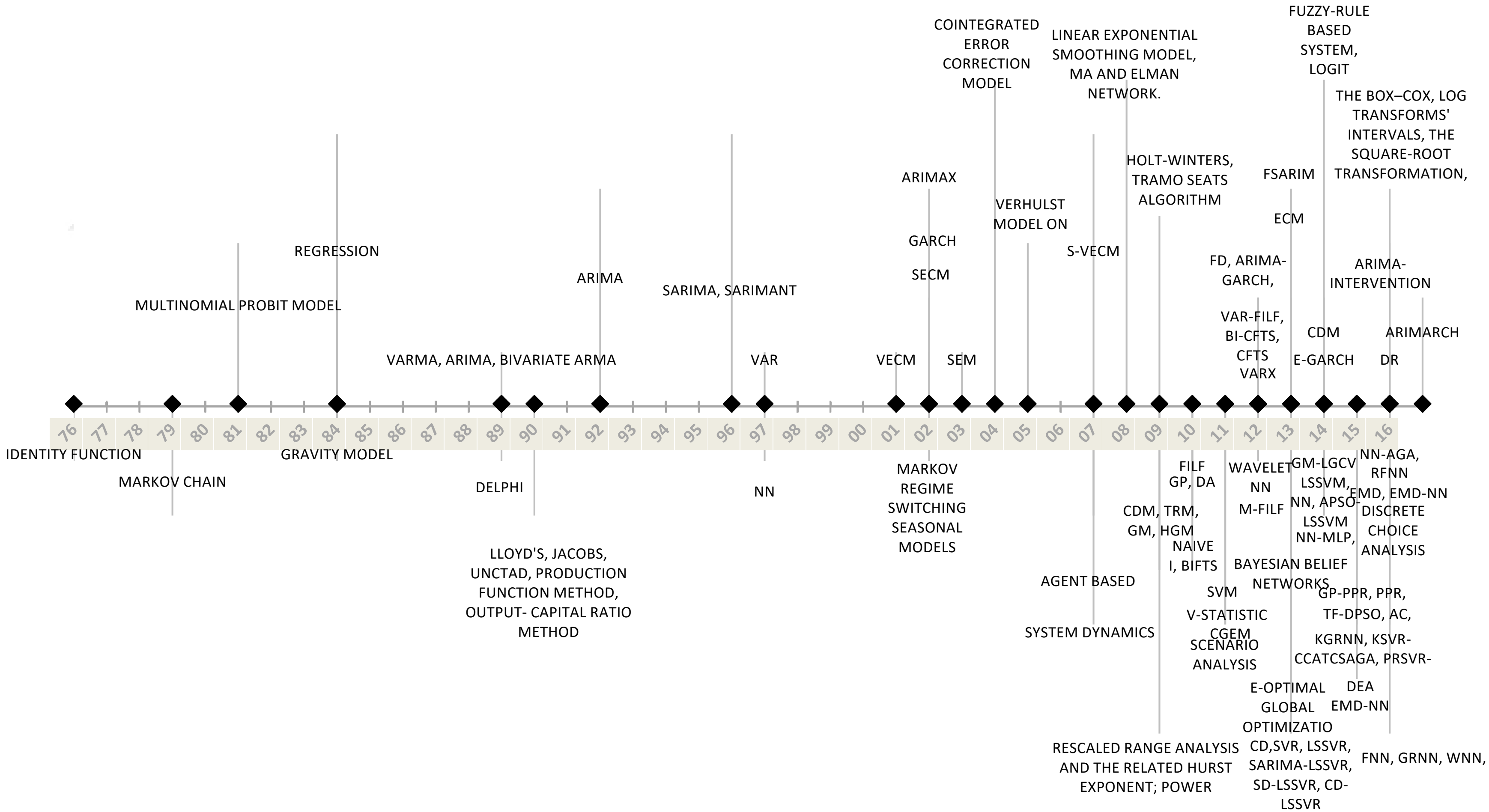
The timeline of the forecasting methods used in shipping with reviewed studies illustrated in Figure 5. It shows an overview of the progress accomplished by the previous literature. It has appeared that there has indeed been a significant leap forward since the 2000s in terms of numbers of studies and methods used. The methods are complicated and hybridized after 2010.

Used methods before 2000 were traditional methods such as multinomial probit model (Winston, 1981) and simple regression models (Tongzon, 1991; Tambakis, 1984), time series models such as ARMA, ARIMA, VARMA (De Gooijer and Klein, 1989); SARIMA, SARIMANT (Klein, 1996), VAR (1997). Markov Chain models first proposed by Chu (1979) as a useful tool for port management and trade diversion researches. Moreover, qualitative methods employed by Ariel (1989) and Wing (1973). Li and Parsons (1997) compared the traditional method ARMA with ANN. They proposed that ANN consistently outperformed for longer-term forecasting. After this pioneering study, soft computing methods have become used.

Mostafa (2004), and Lyridis et al. (2004), Lam et al (2004) and Satir et al. (2008) forecasted using ANN. Moreover, SVM proposed by Yang et al. (2008) a new effective practicable approach to predict freight rate in the shipping market. Along with the soft computing models, traditional methods have been used increasingly between 2000 and 2010. Seasonality (Schulze and Printz, 2009), decomposition (e.g. Peng and Chu, 2009), lags (e.g. Kavussanos and Alizadeh, 2002) ad causality (e.g. Alizadeh et al, 2007) are considered more frequently. Peng and Chu (2009) compared the classical decomposition model, trigonometric regression model, regression model with seasonal dummy variables, grey model, hybrid grey model, and SARIMA.

After 2010, models have started to be more complex and hybridized. To find out more accurate forecasts researchers used hybrid approaches such as combining soft computing and soft computing methods (eg. Li et al. 2015), combining traditional methods and soft computing (eg. Xie et al. 2013). Volatility has become important and several methods have employed to overcome this issue (eg. Yong Hui et al. 2014; Zeng and Qu, 2014). Moreover, different decomposition methods have increasingly adopted (e.g. Leonov and Nikolov, 2012; Zeng and Qu, 2014; Zeng et al. 2016). Although the literature provides plenty of researches, there is still no consensus on which models should use on which forecasting case.

Figure 5. Timeline of the Forecasting Methods Used in Shipping



Source: Author

Forecasting studies in shipping can be classified according to their subjects as seaborne trade forecasts, average haul forecasts, ship demand forecasts, merchant fleet forecasts, ship productivity forecasts, freight rate forecasts (Stopford, 2009:717), port/terminal traffic forecasts, other shipping forecasts.

1.3.1.1. Seaborne Trade Forecasts

Seaborne trade forecasting particularly guided to issues as planning, design, supervision, maritime safety (Feng et al., 2011: 446), economic cooperation development, construction and renovation (Li et al., 2015: 243), traffic control (Lv et al., 2016: 1). Forecasting seaborne trade is a complex nonlinear dynamic process, nevertheless, a variety of models have been developed to describe this issue (Li et al., 2015: 243-244). A simpler model (1) is revealed in the following regression model which indicates a linear relationship with GDP and seaborne trade (Stopford, 2009: 718):

$$ST_t = f(GDP_t) \tag{1}$$

Similarly, UNCTAD (2016: 6) estimated the seaborne trade volume based on the preliminary data. However, such simple models consist of the problem of continuity (Stopford, 2009: 720).

According to a comprehensive review, forecasting cargo flow and volume is the main concentration point of the seaborne trade forecasting literature. Related studies generally focus on the specific region as seen in Table 5 and qualitative and quantitative forecasting techniques as well as different models.

Table 5. Seaborne Trade Forecasting Studies

Study	Data Frequency	Region Focused	Modeling and Forecasting Methods	Forecasting Exercise	Research Theme
Babcock and Lu, 2002	Quarterly	Mississippi River	FC, Multiplicative SARIMA model, ARIMAX	Ex-post in Sample, Ex-post out of Sample	Short term forecasting of inland waterway traffic
Chou et al., 2008	Annual	Taiwan	Modified regression	FC, Ex-post In sample, Ex-ante	Forecasting the volumes of import containers
Claessens et al., 1984	Annual	Eastbound Suez	Gravity Model	Ex-post in Sample	Forecasting the transit traffic
De Langen, 2003	Annual	-	Identity function, scenario analysis	Ex-post in Sample, ex-ante	Forecasting container throughputs
Dinwoodie et al., 2014	-	Non UK Europe, UK, Asia, Africa, North America	Delphi	Ex-ante	Forecasting dry bulk shipping flows
Feng et al., 2011	Daily	Yangtze River	SVM	Ex-post out of Sample	Short term traffic flow forecasting
De Gooijer and Klein, 1989	Monthly	Port of Antwerp	FC, VARMA, ARIMA, bivariate ARMA	Ex-post Out of Sample	Forecasting the maritime steel traffic flow
Klein, 1996	Monthly	Port of Antwerp	SARIMA, SARIMANT	Ex-post Out of Sample	Forecasting the maritime traffic flows
Lee at al., 2011	-	Taiwan and China	CGE	-	Estimating the impacts of liberalization on seaborne cargo volumes
Li et al., 2015	Annual	Tianjin	FC, ARIMA, KGRNN, KSVR-CcatCSAGA, PRSVR-CcatCSAGA, KRSVR-ClogisticSAGA, KRSVR-CcatCSAGA	Ex-post out of Sample	Traffic flow forecasting
Lyk-Jensen, 2011	Annual	EU15, Switzerland, Norway	Gravity model	Ex-post in Sample	Forecasting future freight flows
Mostafa, 2004	Monthly	Suez Canal	FC, ARIMA, ANN	Ex-post in Sample, Ex-post out of sample	Forecasting maritime traffic flows

Source: Author

Table 5. Seaborne Trade Forecasting Studies (Cont.)

Study	Data Frequency	Region Focused	Modeling and Forecasting Methods	Forecasting Exercise	Research Theme
Schulze and Printz, 2009	Quarterly	Germany	FC, SARIMA, Holt-Winters exponential smoothing	Ex-ante	Forecasting container transshipment
Tavasszy et al., 2011	-	Rotterdam, Le Havre, Hamburg, Gioia Tauro, Bremen, Antwerp	Scenario Analysis	-	Estimating the impacts of changes in the transport system
Tsambolas et al., 2015	-	The Adriatic Region	Four Step Methodology	Ex-ante	Estimation of future traffic flows
Veenstra and Haralambides, 2001	Annual	United States, North Africa, Europe, Middle East, Far East	VAR	Ex-post in sample, ex-ante	Forecasting trade flow
Winston, 1981	-	West Coast of the United States	Multinomial probit model	-	Predictions of the market demand for ocean container service

Source: Author

Additionally, it is inferenced that literature generally focuses on regional forecasts with different models and techniques, while broader geographic forecasts encountered less frequently in the literature and adopted simpler models.

1.3.1.2. Average Haul Forecasts

Besides the volume, the distance over which the cargo is shipped also has an influencing factor of seaborne trade. Some routes generate more demand for seaborne trade and this distance effect referred to as average haul (Lun et al., 2010: 19). Average haul estimated through historic trends or trade matrixes (Stopford, 2009: 720). Particularly, studies related to average haul have not been encountered during the literature review. Nevertheless, Clarksons Research (Crowe, 2016) has estimated the average haul for specific commodities. Kim (2013: 62) mentioned the average haul forecasting of capesize carriers. Thien (2005) forecasted average haul based on the annual data of dry bulk cargoes with using the moving averages method and presented ex-post in sample and ex-ante forecasts.

1.3.1.3. Ship Demand Forecasts

Ship demand explained as the number of ships required to serve (Dumontier et al., 2016). Ship demand is one of the principal demand variables of seaborne trade and referred to as the tonnages of cargo transported in a mile. It is bound to several factors such as price, speed, reliability, and security, which thus derives the vulnerability to change miles (Stopford, 2009: 745, 139). Stopford (2007:13) forecasted that ship demand increases from 1 billion dwt to 3.7 billion dwt in 2055.

1.3.1.4. Merchant Fleet Forecast

One of the principal supply variables of the seaborne transport is the merchant fleet which also compromises scrapping, deliveries, conversions, losses and removals (Stopford, 2009: 745).

Table 6. Merchant Fleet Forecasting Studies

Study	Data Frequency	Region Focused	Modeling and Forecasting Methods	Forecasting Exercise	Research Theme
Ariel, 1989	-	-	Delphi	Ex-ante	Forecast of the dry bulk shipping industry
Erdogan and Sengoz, 2007	Annual	Turkey and Greece	ARMA	Ex-post in Sample	Forecasting merchant fleet
Gomez Paz et al, 2015	-	-	Delphi	-	Prediction of the factors which may affect the growth of the Large Container Ships
Kalindaga., 1990	Annual	-	FC, Production Function Method, The Output-Capital Ratio Method, Identity Function, A Series of Ratio	Ex-post in Sample	Estimation of capacity utilization
Kiiski et al., 2016	-	Northern Sea route	System Dynamic Modeling	Ex-ante	Long-term dynamics of shipping and icebreaker capacity
Luo et al., 2009	Annual	-	Regression with Three Stage Least Square	Ex-post in Sample, Ex-ante	Forecasting container fleet capacity
Marcus et al., 1976	5 Year	United States	Identity function	Ex-ante	Forecasting merchant fleet
Wing, 1973	5 Year	United States	Analysis of historical data and judgements	Ex-ante	Forecasting merchant fleet

Source: Author

The related literature review presents that researchers tend to avoid using complex forecasting techniques to forecast the merchant fleet. Surprisingly, eight of the three studies used qualitative techniques and ex-ante forecasting exercise employed by five of the studies as shown in Table 6.

1.3.1.5. Ship Productivity Forecast

Ship productivity is a dimension of the efficiency of the seaborne trade (Wing, 1973: 20) and quantifies overall cargo carrying performance (Stopford, 2009:243). Specifically, ship productivity is the number of tons of cargo delivered by a ship in a year (Kovatch et al., 1971: 5). Route length, ship speed and capacity, downtime, time spent in ballast, and turnaround time are the affecting measures for ship productivity (Wing, 1973: 20).

Crowe (2015) explained productivity as dividing tonnes of a trade by dwt fleet capacity to the average tonnes of cargo moved per dwt (in a year). Forecast of this productivity ratio presented as well for world cargo fleet, bulk carriers, tankers, and containerships. UNCTAD (2006: 45) also provided estimation for the productivity of tankers, bulk carriers, and the residual fleet. Future projection of ship productivity simply made by statistical series or more detailed methodology as stated in equation (2) (Stopford, 2009: 721, 243) where S is the average operating speed per hour, LD is the number of loaded days at sea per annum, and DWU is deadweight utilization:

$$P_{tm} = 24 \times S_{tm} \times LD_{tm} \times DWU_{tm} \tag{2}$$

1.3.1.6. Freight Rate Forecasting

Due to the uncertainty and volatility in shipping pricing the shipping market and price behavior of freight rates have attracted much interest in the shipping industry (Chen et al., 2012: 499). Forecasting shipping freight is crucial for the shipping ecosystem as ship management companies, charterers (Duru 2010: 5373). Besides transport planning, ship financing, pricing of the finished goods; forecasting freight rates also affected shipping-related industries. Freight rate forecasting studies mostly concentrated on econometric modeling, simultaneous equations model and time series methods (Duru, 2010: 5373). After all, researchers seek to increase the accuracy of the forecasts and present more liable models (e.g. Cullinane, 1992; Chen et al., 2012; Eslami et al., 2016; Zeng et al., 2016). Table 7. presents the studies encountered during the literature review regarding freight rate forecasting.

Previous literature presented that freight rate forecasting literature generally focused on the tanker and dry bulk markets, the container market has been relatively paid less attention (Nielsen et al., 2014: 668). However, reviewed literature suggests that freight rate prediction studies mostly focus on dry bulk market rather than tanker and container market in shipping. Most of the studies under review focus on freight rate index forecasting and generally dry bulk indices. Additionally, Santos et al. (2014: 73) suggested that the forecasting spot freight market has paid more attention than period charter. Throughout the review, it is found that studies based on time/period charter have paid similar and even more attention than the spot charter. Moreover, a considerable amount of forward freight forecasting studies also encountered.

1.3.1.7. Port Traffic Forecasting

Port throughput forecast generally comprehends a forecasting model designed by the historical data (Liu et al., 2014: 126) and provides a plan of the quantity, type and structure of the cargo that will be handled in the next period.

Table 7. Freight Rate Forecasting Studies

Study	Data Frequency	Region Focused	Modeling and Forecasting Methods	Forecasting Exercise	Research Theme
Alizadeh et al., 2007	Daily	-	FC, ARIMA, VAR, VECM	Ex-post out of sample	Predicting time charter rates
Bao et al., 2016	Monthly	-	FC, SVM, ANN	Ex-ante	Forecasting Baltic Dry Index
Batchelor et al., 2007	Daily	Panamax Atlantic Route 1 and 1A, Panamax Pacific Routes 2 and 2A, Transpacific route, US-North Pacific to South Japan, Japan/South Korea range to Skaw Gibraltar range	FC, VECM, ARIMA, VAR, S-VECM	Ex-post in sample	Short-term forecasts of spot and forward freight rates in the international dry bulk shipping market
Bulut et al., 2012	Monthly	Global (Panamax and Handymax bulk carriers)	FC, VAR-FILF, Bi-cFTS, cFTS, ARIMA, NAIVE I, VAR	Ex-post out of sample, ex-post in sample	Forecasting model of time charter rates in dry bulk shipping
Chang et al., 2012	Monthly	-	ARIMA, Non-linear prediction model	Ex-post in sample	Predicting freight rate
Chen et al., 2012	Monthly	Transatlantic, Fronthaul, Transpacific, Backhaul	FC, VECM, ARIMA, ARIMAX, VAR, VARX	Ex-post in sample, ex-post out of sample	Forecasting spot rates in the dry bulk market
Cullinane, 1992	Daily	-	FC, AR, MA, ARMA	Ex-post out of sample	Short term freight rate prediction
Cullinane et al., 1999	Daily	-	ARIMA	Ex-post out of sample	Comparing forecast outputs with before and after removal of all handy-sized trades from BFI in 1993.
Duru, 2010	Monthly	-	FC, FILF, EFILF	Ex-post in sample	Baltic dry index forecasting
Duru et al., 2010	Monthly	-	FC, Naive I, BiFTS, ARIMA, Holt-Winters	Ex-post in sample	Predicting long term freight index

Source: Author

Table 7. Freight Rate Forecasting Studies (Cont.)

Study	Data Frequency	Region Focused	Modeling and Forecasting Methods	Forecasting Exercise	Research Theme
Duru and Yoshida., 2009	Monthly	-	FC, Delphi, Holt-Winters, Arıma, Tramo Seats Algorithm	Ex-post out of sample	Baltic Dry Index Forecasting
Eslami et al., 2016	Annual	Ras Tanura–Rotterdam route	NN-AGA, Regression, MA	Ex-post out of sample	Short-term prediction of tanker freight rates
Fan et al., 2013	Daily	-	FC, WNN, ARIMA	Ex-post out of sample	Forecasting Baltic Dirty Tanker Index
Geomelos and Xideas., 2014	Monthly	-	FC, VAR, VECM, ARIMA, GARCH, E-GARCH	Ex-ante, ex-post	Forecasting spot prices in bulk shipping
Goulielmos and Psifia, 2009	Weekly	-	FC, Rescaled Range Analysis and the related Hurst Exponent; Power Spectrum Analysis; V-statistic and BDS Statistic	Ex-post in sample, ex-post out of sample	Forecasting weekly freight rates
Goulielmos and Psifia, 2011	10 Days	-	V-statistic	Ex-post out of sample	Forecasting short-term freight rate cycles
Han et al., 2014	Monthly	-	FC, SVM, NN, ARMA, VAR	Ex-post out of sample	Forecasting Dry Bulk Freight Index
Haigh, 2000	Monthly	-	FC, ECM, VAR	Ex-post in sample, ex-post out of sample	Forecasting future prices and spot prices
Jonnala et al., 2002	Monthly, Quarterly	US	Regression, GARCH	Ex-post Out of Sample	Estimation of an ocean grain freight rate
Kavussanos and Alizadeh, 2002	Monthly	-	FC, Markov Regime Switching Seasonal Models	Ex-post out of sample	Forecasting tanker freight rates with seasonality
Kavussanos and Nomikos, 2003	Daily	-	FC, VECM, SUR-VECM, VAR, ARIMA, Random Walk	Ex-post in sample, ex-post out of sample	Generate forecasts of the spot and futures prices

Source: Author

Table 7. Freight Rate Forecasting Studies (Cont.)

Study	Data Frequency	Region Focused	Modeling and Forecasting Methods	Forecasting Exercise	Research Theme
Leonolov and Nikolov, 2012	Daily	P2A Panamax Route, P3A Panamax Route	FC, Wavelet NN, GARCH	Ex-post out of sample, ex-ante	Prediction of dry bulk shipping indices
Li and Parsons, 1997	Monthly	-	FC, ARMA, NN	Ex-post out of sample	Short- to long-term prediction of monthly tanker freight rates
Luo et al., 2009	Annual	-	Regression	Ex-post in sample, ex-ante	Forecasting container shipping freight rate
Lyridis et al., 2004	Monthly	-	NN	Ex-post out of sample	Forecasting VLCC spot freight rates
Lyridis et al., 2013	Quarterly, Daily	Richards Bay – Rotterdam, Bolivar – Rotterdam, Skaw Gibraltar – Far East, South Korea – Japan Pacific R/V	NN	Ex-post out of sample	Forecast the future price of freight derivatives
Munim and Schramm, 2017	Weekly, Monthly	Far East – Northern Europe trade lane	FC, ARIMA, ARIMARCH	Ex-post out of sample	Forecasting container shipping freight rate dynamics
Nielsen et al., 2014	Weekly	Asia to European and Mediterranean Ports	SR	Ex-ante	Predicting container freight rate development
Papailias et al., 2017	Monthly	-	Trigonometric regression, linear regressions,	Ex-post out of sample	Forecasting Baltic Dry Index
Poblacion and Serna, 2017	Weekly	-	Stochastic factor models	Ex-post in sample	Forecasting freight rate
Randers and Göluke, 2007	Annual	-	System dynamics	Ex-ante	Forecasting the turning points in the 4-year cycle of the oil tanker freight rate
Santos et al., 2014	Monthly	-	FC, NN-MLP, NN-RBF, ARIMA	Ex-post out of sample	Forecasting period charter rates of VLCC tankers

Source: Author

Table 7. Freight Rate Forecasting Studies (Cont.)

Study	Data Frequency	Region Focused	Modeling and Forecasting Methods	Forecasting Exercise	Research Theme
Veenstra and Franses, 1997	Monthly	Tubaroo-Rotterdam, Tubaroo-Japan, Hapton Roads-Japan, Roberts Bank-Japan, Us Gulf-Rotterdam, Hampton Roads-Rotterdam	VAR	Ex-post out of sample	Forecasting dry bulk freight rates
Von Spreckelsen et al., 2012	Daily	Middle East Gulf to Japan, West Africa to US Atlantic Coast	RW, ARIMA, NN, VAR, VECM	Ex-post out of sample	Predict spot and forward freight rates
Uyar et al., 2016	Annual	-	FC, Naive 1, BiFTS, ARIMA, Holt-Winters, RFNN	Ex-post in sample	Long term dry cargo freight rates forecasting
Yang et al., 2008	Monthly	-	SVM	Ex-post out of sample	Forecasting freight rate indices
Yong Hui et al., 2014	Daily	-	GARCH	Ex-post in sample	Prediction of Baltic Capesize Freight Index
Zeng and Qu., 2014	Daily	Trans-Atlantic round voyage, Japan–S.Korea Nopac round voyage, Gibraltar/Hamburg trans-Atlantic, 4TC	FC, NN, EMD-NN, VAR	Ex-post out of sample	Baltic Dry Index Forecasting
Zeng et al., 2016	Daily, Weekly	Trans Atlantic round voyage,	FC, EMD, NN, VAR, EMD-NN	Ex-post out of sample	Baltic Dry Index Forecasting
Zhang et al., 2014	Weekly	-	FC, VECM, VAR	Ex-post in sample	Forecasting spot freight rates

Source: Author

Successful port management developed from the balance between supply and demand as well as the conflict between them causes several difficulties as lack of modernization and conversion (Jugović et al., 2011: 59, 67), sunk cost of port construction (Chen and Chen., 2010: 2054), loss of efficiency in the port, failure of investment policy (Chu, 1979: 293), failure of formulating appropriate strategies (Farhan and Ong., 2016: 1). Therefore, port throughput forecasting regarded as one of the most important basis of port planning, and constitutes a very complicated process because of the specific design of each port (Liu et al., 2014: 126); perishability of the port services; the need of a large amount of data; continuous monitoring of port traffic, capacity, foreign exchange, GDP values; changes in the market of the state of which the port is part of, and transit countries; the changes in technology; the change in the movement of commodity flows (Jugović et al., 2011: 67).

Reviewed studies presented both long term projections and short-medium term projections have great importance. Because long term predictions are decisions related to infrastructure that needs time to build (Chu, 1979: 293) and it is very difficult to change after the installation (Chen and Chen., 2010: 2054). Long term predictions have the characteristic of not being affected by the fluctuations of short term nature (Chu, 1979: 293), whereas short term predictions let to develop appropriate short to medium strategies to maintain competitiveness (Farhan and Ong, 2016: 1).

Liu et al., (2014: 126) claimed that most of the studies on port throughput are interested in container throughput and reviewed literature affirms this assessment as provided in Table 8 as well as non-containerized cargo forecasting at ports merely encountered in the literature. Moreover, only a few studies on port traffic forecasting have been published before 2000, the majority of the encountered studies published after 2000. These studies used a variety of methods to forecast port traffic including time series, econometric, soft computing, statistical and judgmental methods, and forecasting competition is preferred most of the researchers to find the appropriate model to forecast.

Table 8. Port Traffic Forecasting Studies

Study	Data Frequency	Region Focused	Modeling and Forecasting Methods	Forecasting Exercise	Research Theme
Chen and Chen, 2010	Monthly	Taiwan	FC, GP, SARIMA, DA	Ex-post out of sample	Forecasting container throughputs at ports
Chu, 1979	Annual	Britain	Markov Chain	Ex-post out of sample	Forecasting the nonfuel cargo traffic demand for the seaports
Coto Millan et al., 2013	Quarterly	Spain	SR, ECM	Ex-post in sample	Estimating short- and long-term port demand functions of imports and exports
Diaz et al., 2011	Monthly	Port of Long Beach, Port of Los Angeles, Port of Savannah	FC, Tioga Group Method, United Nations Method, Winters Method	Ex-post in sample	Forecasting empty container volumes at ports
Van Dorsser et al., 2012	Annual	Le Havre – Hamburg range	System Dynamic Modeling, Judgement, and Causal Relations	Ex-ante	A very long term forecast of the port throughput
Dragan et al., 2014	Quarterly	Port of Koper, Ravenna, Triest, Venice	FC, Holt-Winters exponential smoothing model, CDM, ARIMA	Ex-post out of sample	Forecasting of container throughput at port
Farhan and Ong, 2016	Monthly	20 Major International Container Ports	SARIMA	Ex-post out of sample, ex-ante	Seasonal container throughput forecasts at ports
Fung., 2001	Quarterly	East and Southeast Asia	VECM	Ex-ante	Forecasting of container throughput
Fung, 2002	Quarterly	Port of Hong Kong	SECM	Ex-post out of sample	Forecasts of demand for Hong Kong's container handling services
Gao et al., 2016	Monthly	Hong Kong port and the Shenzhen port	Structural Change VAR	Ex-post in Sample, Ex-ante	Monthly container port throughput forecasting

Source: Author

Table 8. Port Traffic Forecasting Studies (Cont.)

Study	Data Frequency	Region Focused	Modeling and Forecasting Methods	Forecasting Exercise	Research Theme
Geng et al., 2015	Annual	China	ARIMA, MBPNN, RSVR-CSAPSO, MSVR-CSAPSO, MRSVR-PSO, MRSVR-SAPSO, MRSVR-CSAPSO	Ex-post out of Sample	Port throughput forecasting
Goedhals-Gerber, 2016	Monthly	Port of Cape Town	ARIMA	Ex-ante	Forecasting the throughput of grain imports through the bulk grain terminal
Gosasang et al., 2010	Monthly	Bangkok Port	NN	Ex-post in sample	Predicting future container throughput at port
Gökkuş et al., 2017	Annual	İzmir, İstanbul, Mersin	FC, ANN-ABC, LSSVM, MNR-GA, ANN-LM	Ex-post out of sample, ex-ante	Forecasting port container throughput
Guo et al., 2005	Annual	China	Verhulst model on time series error corrected	Ex-post out of sample	Port throughput forecasting
Hui et al, 2004	Quareterly	Port of Hong Kong	FC, Cointegrated error correction model, regression	Ex-ante	Forecasting port cargo throughput
Huang et al., 2014	Monthly	Guangzhou Port	FC, experts domain knowledge, ARIMAX	Ex-post in sample, ex-post out of sample	Forecasting the container throughput
Huang et al., 2015	Monthly	Qingdao Port	FC, GP-PPR, ANN, PPR, SARIMA	Ex-post in sample, ex-post out of sample	Forecasting port container throughput
Jugović et al., 2011	Annual	Port of Rijeka, Trieste, Koper	Regression	Ex-ante	Predicting container traffic demand at port
Lam et al., 2004	Annual	Port of Hong Kong	NN, Regression	Ex-post out of sample, ex-ante	Forecasting port cargo throughput
De Langen et al., 2012	-	Hamburg- Le Havre Range	Scenario Analysis	Ex-ante	Forecasting port throughput forecasting
Lee at al., 2017	Monthly	Incheon New Port	Multinominal Logit, ARIMA	Ex-ante	Forecasting container port volume

Source: Author

Table 8. Port Traffic Forecasting Studies (Cont.)

Study	Data Frequency	Region Focused	Modeling and Forecasting Methods	Forecasting Exercise	Research Theme
Li et al., 2008	Monthly	China	Linear exponential smoothing model, MA and Elman network.	Ex-post in sample	Port throughput forecast
Liu et al., 2012	Annual	Qing Huangdao port	GM	Ex-post in sample	Coal port throughput forecasting
Liu et al., 2014	Monthly	Qinhuangdao Port and Nanjiang port	FC, LSSVM, NN, APSO-LSSVM	Ex-post out of sample	Predict the throughput of coal ports
Lopez et al., 2014	Daily	Port of Algeciras Bay	FC, SARIMA, NN	Ex-post in sample, ex-post out of sample	Predicting future values of Ro- Ro traffic at the Port of Algeciras Bay
Lopez et al., 2016	Daily	Port of Algeciras Bay	FC, NN, SVR	Ex-post in sample	Prediction of vegetable freight by Ro-Ro traffic at port
Pang and Gebka, 2017	Monthly	Tanjung Priok Port	FC, SARIMA, MSHW, VECM	Ex-post in sample, ex-ante	Forecasting total port container throughput
Patil and Sahu., 2016	Annual	Mumbai Port	Multivariate Linear Regression, Time series regression	Ex-ante	Forecasting future freight demand at a seaport
Patil and Sahu., 2017	Annual	India	Dynamic regression	Ex-ante	Forecasting seaport cargo demand
Peng and Chu, 2009	Monthly	Taiwan	FC, CDM, TRM, Regression, Grey Model, Hybrid Grey Model, SARIMA	Ex-post in sample, ex-post out of sample	Prediction of port container throughput
Rashed et al., 2016	Monthly	Port of Antwerp	FC, ARIMA, ARIMA-intervention, SARIMA, ARIMAX	Ex-post out of sample	Short-term forecasts of port container throughput
Ruiz-Aguilar, 2016	Daily	Algeciras Bay Port	k-NN, Bayes, NN	Ex-post in sample	Forecasting of short-term flow freight congestion
Sahu and Patil, 2015	Annual	India	Cointegrated error correction model	Ex-post in sample, ex-ante	Forecasting freight flows at port

Source: Author

Table 8. Port Traffic Forecasting Studies (Cont.)

Study	Data Frequency	Region Focused	Modeling and Forecasting Methods	Forecasting Exercise	Research Theme
Seabrooke et al., 2003	Annual	Port of Hong Kong	Regression	Ex-ante	Forecasting port cargo throughput
Shu et al., 2013	Quarterly	Hong Kong Port and Kaohsiung Port	FC, SARIMA, GM, FSARIMA, FGM	Ex-post in sample, ex-post out of sample	Forecast the cargo throughput at port
Tian et al., 2013	Monthly	Port of Hong Kong	S-ARIMA, VAR, RBFNN	Ex-post in sample, ex-post out of sample	Forecast port container throughput
Tsai and Huang, 2015	Annual	Asia	NN	Ex-post in sample	Predict container flows between the major ports
Tongzon, 1991	Annual	Port of Melbourne	Regression	Ex-post in sample	Forecast both the number of ship visits and their characteristics
Twrdy and Batista, 2016	Annual	Ports of Koper, Trieste, Venice, Ravenna, and Rijeka	Markov-chain annual growth rate model, Time-series trend model, Time-series trend model with periodicity terms, GM	Ex-post in sample, ex-ante	Forecast container throughput at ports
Souf-Aljen et al., 2016	-	Port Tanjung Pelepas	Simulation	Ex-ante	Forecasting port throughput capacity
Sun, 2010	-	Shandong province	Growing Function	-	Forecasting port cargo throughput
Xiao et al., 2014	Monthly	Shanghai Port and Tianjin Port	FC, TF-DPSO, AC, ARIMA, ENN	Ex-ante	Forecast of future container throughput of a port
Xiao et al., 2016	Monthly	Tianjin port	FNN, GRNN, WNN, SARIMA, intelligent ensemble model	Ex-post out of sample	Port throughput forecasting
Xie et al., 2013	Monthly	Shanghai Port and Shenzhen Port	FC, ARIMA, SARIMA, CDM, BPNN, SVR, LSSVR, SARIMA-LSSVR, SD-LSSVR, CDM-LSSVR	Ex-post out of sample	Container throughput forecasting at ports
Yoo et al., 2013	Monthly	Busan Port, Gwanyang Port, Incheon Port	FC, ARIMA, Simple Seasonal Model, Winters Multiplicate Model	Ex-post in sample, ex-post out of sample	Forecasting port traffic volume
Zhang et al., 2013	Annual	Southern China	Grey Model_Logistic growth curve model	Ex-post in sample	Forecast model of cargo throughput for the port

Source: Author

It is also found in some studies that (e.g. Chen and Chen, 2010; Farhan and Ong, 2016) as consistent with the Shu et al., (2013: 193) the cargo throughput has the characteristic of seasonality.

1.3.1.8. Other Forecasting Studies in Shipping

Except for the above-categorized topics, forecasting in shipping also includes issues related to shipping finance, port and ship operations, and traffic management, shipping marketing and shipping economics as shown in Table 9. Studies related to the shipping finance presents forecasting newbuilding, second hand and demolition prices and costs, oil spill costs, shipping cycles, shipping receipts, credit flows, excess returns and risk. Port and ship operations and traffic management related studies focus on predicting arrival and dwell times, ship delays, ship waste, maritime accident, the volume of the inspections and safety/detention performance, vessel type and volume traffic, route of the future. Additionally, marketing and economics related forecasting in shipping indicate forecasting demand for shipping business and future market share. During the review of the literature, oceanographic, navigational, meteorological forecasting studies have been excluded.

Table 9. Other Forecasting Studies in Shipping

Study	Data Frequency	Region Focused	Modeling and Forecasting Methods	Forecasting Exercise	Research Theme
Ana-Maria and Ghiorghe, 2013	Daily	-	ARIMA	Ex-post in sample, ex-ante	Forecast of ships' prices
Bulut, 2014	Monthly	Istanbul strait	FC, FILF, S-FILF, S-cFTS, SARIMA	Ex-post out of sample	Forecasting volume of vessel traffic
Cosgun et al., 2014	-	Istanbul-Bandırma	FC, Fuzzy-rule based system, logit	-	Demand forecasting of a maritime forecasting
Engelen et al., 2007	Daily	-	SR, Agent based system	Ex-post in sample	Estimation of newbuilding and second-hand ship prices
Fancello et al., 2011	-	-	NN	Ex-post out of sample	Prediction of arrival times of ships at the terminal
Hilmola et al., 2015	-	Helsinki and Tallinn	DEA	Ex-ante	Predicting the future of the route
Kagkarakis et al., 2016	Monthly	Southeast Asia	VAR, ARMA, Random Walk, Linear Trend	FC, Ex-post in sample, ex-post out of sample	Forecasting ship-demolition prices
Kavussanos and Alizadeh, 2002	Monthly	-	VAR	Ex-post in sample	Predictability of excess returns on shipping investments
Kourounioti et al., 2016	Monthly, Daily	-	NN	Ex-post in sample	Predicting dwell time of import containers in port container terminals
Lee et al., 2017	Monthly	Incheon New Port	Discrete Choice Analysis	Ex-ante	Estimate the future market share
Liu et al., 2010	Monthly	-	Decision support system	Ex-post in sample	Container demand forecasting for businesses
Lv et al., 2016	Daily	Fangcheng port	Markov Model, NN	Ex-post out of sample	Prediction of ship traffic flow
Malekipirbazari et al., 2015	Annual	Istanbul Strait	ARIMA	Ex-ante	Forecast vessel type traffic

Source: Author

Table 9. Other Forecasting Studies in Shipping (Cont.)

Study	Data Frequency	Region Focused	Modeling and Forecasting Methods	Forecasting Exercise	Research Theme
Michis and Nason, 2016	Monthly	South Cyprus	The Box–Cox, Log transforms' intervals, the square-root transformation, data-driven Haar–Fisz	FC, Ex-post in sample	Forecasting shipping credit flows
Montewka et al., 2013	-	Gulf of Finland	Bayesian Belief Networks, Scenario Analysis	-	Estimating oil spill costs
Mulligan, 2008	Weekly, Monthly	-	SR	Ex-ante	Estimating newbuilding costs
Pani et al., 2014	Daily	Port of Cagliari	Classification and Regression Trees	Ex-post in sample	Forecast late arrivals at ports
Satir et al., 2008	Monthly	Marmara Ereglisi	NN	Ex-post out of sample	Ship waste forecasting
Ruiz-Aguilar, 2014	Daily	Port Authority of Algeciras Bay	FC, SARIMA, SVR, SARIMA-SVR	Ex-post in sample	Forecast the inspections volume
Rousos and Ventikos, 2008	Monthly	South Crypus	ARIMA	Ex-ante, ex-post in sample	Forecasting safety/detention performance of flag states
Tambakis, 1984	Annual	Greece	OLS; CORC	Ex-ante	Forecasting total shipping receipts
Tezuka et al., 2012	Monthly	Japan	GARCH, OLS	Ex-post in sample	Estimate and draw the time-varying systematic risk β
Tsolakis et al., 2003	Annual	-	FC, SEM, AR	Ex-post in sample	Forecast shipping cycles
Zhao and Lv, 2016	Annual	Tianjin	GM, Markov GM	Ex-post out of Sample	Forecasting maritime accident

Source: Author

1.3.2. Shipping Markets and Demand Forecasting Variables

In this dissertation, to interfere the related variables of the demand forecast in shipping markets, literature review has been carried out. After reading the related articles that are published shipping literature, the variables are deduced. As seen in the Table 10., 46 articles in the shipping literature have been reviewed and 40 variables are reached. “GDP” has the most frequency that 21 articles have mentioned it. “Export” is another variable 19 times mentioned in the related articles, while “Import” found 14 times. “New building prices” and “Trade volume” are mentioned in articles 11 times. “Demolition prices” and “Cargo throughput” are found 10 times. “Exchange rate”, “Population”, “Second Hand prices” and “Fleet size” have been mentioned 8 times. “Oil prices”, “Trade value”, “Freight index”, “Freight rate”, “Charter rates”, “Commodity prices” are found 6 times in the articles. “Distance” and “order book” are mentioned 5 times. Rest of the variables are mentioned less than 5 times. All found variables have been considered in this dissertation due to their importance and none of them neglected. The results of this review have been used to characterize demand forecast aspects of the statements of the questionnaire that aimed to identify demand at domestic dry cargo market.

Table 10. Studies regarding Demand at Shipping Literature and Explored Variables

DEMAND VARIABLES AT SHIPPING FORECAST LITERATURE / VARIABLES / REFERENCES	1.Exchange Rate	2.Export	3.Import	4.Population	5.Industrial Production	6.GDP/GNP	7.Wholesale Price	8.Distance/Average Haul	9.Oil Dependency	10.Oil Consumption	11.Oil Price	12.Oil Production	13.New Building Prices	14.Second-Hand Prices	15.Demolition Price	16.Trade Volume	17.Trade Value	18.Freight Index	19.Cargo Throughput	20.Freight Rate	21.Fleet Size/Capacity	22.Demolition Volume	23.Operational Costs	24.Interest Rates	25.Inflation Rates	26.Seasonality	27.War And Crises	28.Regulation	29.Repair Cost	30.Charter Rates	31.Ship Size	32.Electricity	33.Profits	34.Terminal Tariff	35.Commodity	36.Order Book	37.Investment	38.Consumer Price Index	39.Ship Price	40.Expenditure of
1.Chu, 1979		x	x																																					
2.Winston, 1981																x				x															x					
3.Claessens et al., 1984		x				x		x	x																															
4.Tambakis, 1984		x				x										x		x			x																			
5.Fung, 2001																	x		x															x						
6.Fung, 2002																	x		x																					
7.Jonnala et al., 2002								x																		x					x									
8.Kavussanos and Alizadeh, 2002													x	x	x																		x							
9.De Langen, 2003		x				x										x	x																							
10.Seabrooke et al., 2003		x	x	x		x										x			x													x			x					x
11.Tsolakis et al., 2003													x	x																x						x				
12.Hui et al., 2004																	x		x																					
13.Lam et al., 2004		x	x	x		x											x															x								x
14.Lyridis et al., 2004											x	x	x	x	x	x					x									x										
15.Engelen et al., 2007													x	x								x	x							x						x				
16.Erdoğan and Sengöz, 2007	x					x										x		x			x			x	x										x					
17.Chou et al., 2008		x	x	x	x	x	x																																	
18.Lun and Quaddus., 2008													x	x	x	x				x	x																			
19.Yang et al., 2008																		x																						
20.Luo et al., 2009											x		x		x				x	x	x																			
21.Gosasang et al., 2010	x			x		x					x													x	x															
22.Jugović et al., 2011		x	x																																					
23.Lyk-Jensen, 2011	x	x		x		x		x																																
24.Chen et al., 2012	x				x													x																						

Source: Author

Table 10. Studies regarding Demand at Shipping Literature and Explored Variables (Cont.)

DEMAND VARIABLES AT SHIPPING FORECAST LITERATURE / VARIABLES / REFERENCES	1.Exchange Rate	2.Export	3.Import	4.Population	5.Industrial Production	6.GDP/GNP	7.Wholesale Price	8.Distance/Average Haul	9.Oil Dependency	10.Oil Consumption	11.Oil Price	12.Oil Production	13.New Building Prices	14.Second-Hand Prices	15.Demolition Price	16.Trade Volume	17.Trade Value	18.Freight Index	19.Cargo Throughput	20.Freight Rate	21.Fleet Size/Capacity	22.Demolition Volume	23.Operational Costs	24.Interest Rates	25.Inflation Rates	26.Seasonality	27.War And Crises	28.Regulation	29.Repair Cost	30.Charter Rates	31.Ship Size	32.Electricity	33.Profits	34.Terminal Tariff	35.Commodity	36.Order Book	37.Investment	38.Consumer Price Index	39.Ship Price	40.Expenditure of
25.Chang et al., 2012													x	x	x						x																			
26.Van Dorsser et al., 2012						x													x																					
27.Coto Millan et al., 2013		x	x			x														x															x					
28.Lyridis et al., 2013													x	x	x					x										x			x			x				
29.Tian et al., 2013	x	x	x																x																					
30.Geomelos and Xideas., 2014						x							x	x	x	x					x									x										
31.Nielsen et al., 2014																		x		x						x														
32.Santos et al., 2014												x	x		x							x								x										
33.Geng et al., 2015		x	x	x		x																															x			
34.Li et al., 2015		x	x			x										x			x																			x		
35.Sahu and Patil., 2015		x	x			x																																		
36.Tsai and Huang, 2015		x	x			x											x							x																
37.Eslami et al., 2016				x				x		x	x		x		x						x					x	x	x	x							x				
38.Kagkarakis et al., 2016	x										x				x																									
39.Lee at al., 2017		x	x																x																					
40.Patil and Sahu., 2016	x	x	x			x						x																												
41.Munim and Schramm, 2017																		x																						
42.Patil and Sahu., 2017						x													x																					
43.Gökkuş et al., 2017		x		x		x										x																								
44.Papailias et al., 2017	x					x					x																								x					
45.Hsu et al., 2018		x	x																																x					
46.Wada et al., 2018						x		x								x						x														x			x	
FREQUENCY VALUE/46	8	19	14	8	2	21	1	5	1	1	6	3	11	8	10	11	6	6	10	6	8	3	1	3	2	3	1	1	1	6	1	2	2	1	6	5	1	1	1	2

Source: Author

CHAPTER TWO
MARKET DEMAND: INDUSTRIAL MARKETING APPROACH

2.1. INDUSTRIAL MARKETS AND CHARACTERISTICS

Within the scope of this chapter, definitions and evolution of industrial marketing have been reviewed. Differences between industrial and consumer markets are presented and demand concept in industrial markets has been explained in detail. Demand and demand forecast concepts have been reviewed and related literature review in the field of industrial marketing has been presented. Finally, possible variables regarding demand forecasts in industrial marketing are identified.

2.1.1. Industrial Marketing: Definitions and Concept

In the traditional view, the market was a physical place for buying and selling goods. However, the latest developments in marketing have changed the definition of the market and the geographic place is excluded in the modern definition. Nowadays the market is defined only with buyers, sellers, and time keywords (Panda, 2007: 74). From the point of economists' view, the market is a collection of buyers and sellers (Kotler and Keller, 2016: 29).

Another definition of the market made by Smit (2007: 63) that the market is the place for the organizations' products or services consisting of people who have needed to satisfy and have the financial power to get them.

A common definition of industrial markets is that "*all the organizations that acquire goods and services used in the production of other products or services that are sold, rented, or supplied to others.*" (Kotler and Keller, 2016). Frauendorf (2007: 34) emphasized and explained the importance of the industrial markets for national economies and global economic activity. Industrial markets and industrial service sector has grown over the past decades and the importance attained has increased (O'Cass and Wetzels, 2019: 1).

Industrial customers are organizations and they are grouped in three categories *"(1) commercial enterprises buying goods and services, (2) governmental* *organizations purchasing goods and services, and (3) intuitional customers"* (Haas, 1989: 7). Industrial customers employ more transactions than consumers, while the market economy relies on the consumer market in the end. These transactions are generally consisting of raw materials and components that are a part of the final product and services sold to organizations (Morris et al., 2001:9). These goods and services are divided in seven general classifications *"(1) heavy equipment, (2) light or accessory equipment, (3) supplies, (4) component parts, (5) raw materials, (6) processed materials, (7) business services*" (Haas, 1989:11).

Industrial markets offer more goods and services than consumer markets. It is assumed that half or more of the manufactured goods are the issues of business markets and over half of the economic activity includes transactions between business markets (Jenster et al. 2005: 1-3).

Various businesses and multiple transactions are involved in the process until the final product reaches the consumer (Morris et al., 2001: 10-12). While products move throughout the process and attain value, they need to facilitate services at each step. Industrial services assist in producing the final or semifinal products or facilitate industrial businesses functioning (Arslan, 2012: 12).

Industrial marketing definition is inferred from the Industrial Marketing Committee Review Board (1954) as "*industrial marketing includes business activities involved in the flow of goods and services from production to consumption to other business in producing consumers' goods, other business or industrial goods, and services and/or in facilitating the operation of an enterprise*."

Cooke (1986) mentioned three approaches to the definitions of industrial marketing as (1) product definition approach, (2) market definition approach, and (3) marketing activity approach. Cooke (1986) criticizes the existing definitions and offers a new definition as "*marketing to the organizational buyer as contrasted to consumer marketing, which is marketing to the ultimate consumer."*

According to Haas (1989) industrial marketing is *"the marketing activities that are intended to acquire and sell goods or services to businesses or other organizations to be used directly or indirectly in their own operations."*

Industrial marketing can also be referred to as "business marketing", "organizational marketing" and "business to business marketing" (Morris et al. 2001:

3). Industrial marketing term has been surpassed by Business Marketing recently (Cherunilam, 2007: 3) especially after the 2003-2007 period B2B marketing term is used rather than industrial marketing (Pina, 2019: 916). Industrial marketing is defined by Morris et al. (2001: 3) as "*creation and management of mutually beneficial relationships between organizational suppliers and organizational customers.*"

Wright (2004: 3) summarized the definition of industrial (B2B) marketing as "*business markets products or services to another business for use in that business or to sell on to other businesses for their use*".

Another application area of the definition of industrial marketing is given by Lichtenthal et al., (2008) "*phenomena occur with all transactions, exchanges, and relationships between any dyad involving organizations, institutions, resellers and, within social networks. Individuals are included only when not personally motivated (i.e., acting on behalf of professional buying needs as opposed to those needs of households).*"

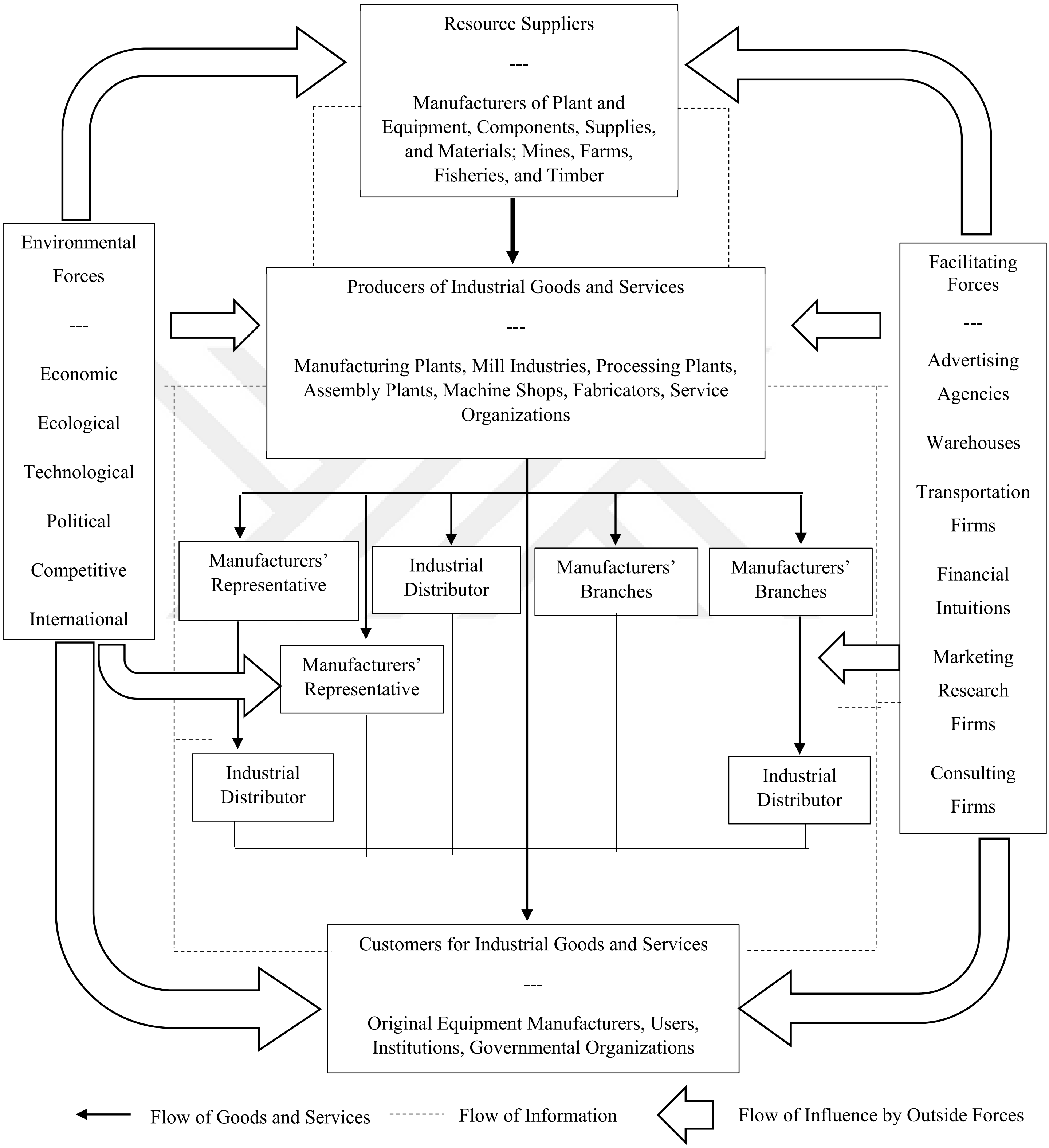
Brennan (2014) defined industrial (B2B) marketing as "*Business-to-business marketing concerns seller-initiated processes directed at creating mutually beneficial exchange transactions between organizations.*"

To better understand the importance of industrial marketing Morris et al., (2001: 9) proposed to look at the production chain. At a glance into the supply chain it is possible to emphasize the importance of industrial markets. Industrial markets are involved in every step of processes taking place in the supply chain that much and they are present in a variety of areas (Morris et al., 2001: 12).

The industrial marketing system is composed of the fundamental components such as "*(1) producers of industrial goods and services, (2) suppliers to these producers, (3) customers for industrial goods and services, (4) channel components linking producers and customers, (5) environmental and facilitating forces that affect the relationship among the market actors*" (Haas, 1989: 21).

Figure 6 shows the industrial marketing system that visualizes the flow of goods, services, information, outside influences and linkages between the components of the system.

Figure 6. Industrial Marketing System



Source: Haas, 1989: 22

Goods are flowing through the actors such as resource suppliers, producers, manufacturers' branches, industrial distributors, customers and channel components. The manufacturers' branch and industrial distributors link the producers and suppliers. The flow of information links the whole system and provides knowledge to the components of the system. External forces and facilitating forces affect the behaviour of the components (Haas, 1989).

After analyzing the definitions of industrial marketing, it can be seen that mutuality, social and business networks and relationships are recently emphasized perspectives of industrial marketing. Here it is also consistent with the findings of Brennan (2014) that the emphasis of industrial marketing theory has been changing from a dyadic perspective to a network perspective. In other words, factors affected in a relationship changes from two organizations to the all network space of this relationship.

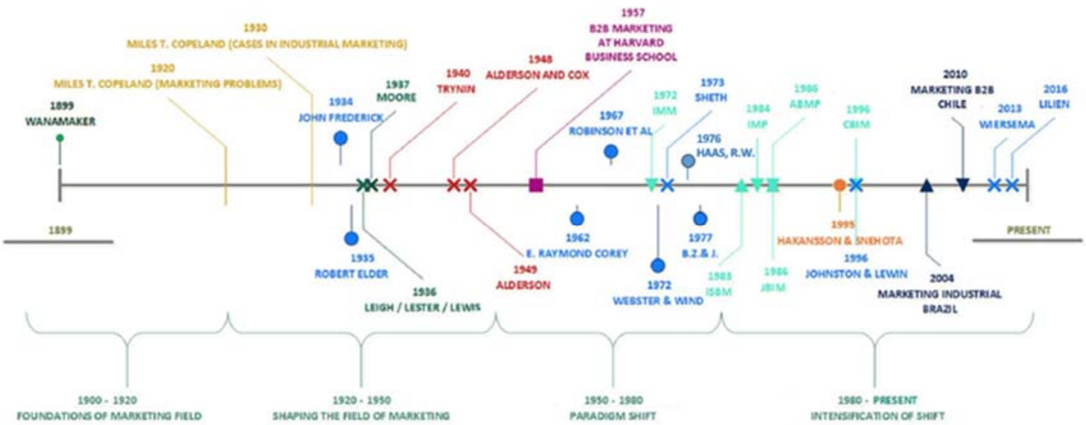
The definitions that are analyzed also point out the same perspectives with industrial marketing theory evolution. Comprehensive researches on industrial marketing theory have appeared in the last three decades. Although the practice of industrial marketing dates back to several thousand years, accelerated theory development stage has been continuing. Industrial marketing theory has been documented at the end of the 1800s and in the early 1900s. Wanamaker (1899) has regarded as an early pioneer in industrial marketing thinking (Hadjikhani and LAPlaca, 2013: 294). The timeline of the industrial marketing history that started with the study of Wanamaker (1899) was developed by Cortez and Johnson (2017: 91) as illustrated in Figure 7. Cortez and Johnson (2017) referred Leigh (1936), Lester (1936) and Lewis (1936), Trynin (1940), Alderson and Cox (1948), Alderson (1949) as pioneering researches on industrial marketing. Then, the first course in industrial marketing was developed at the Harvard Business School by Ray Corey (Vargo and Lusch, 2011: 182). One of the starting points for books on industrial marketing belongs to Haas (1976).

After the publication of Industrial Marketing Management (IMM) in September 1971, industrial marketing has emerged as an acceptable sub-field within marketing (Peters et al., 2013: 276). Following the publication of IMM, specialized industrial marketing journals started to be published as Journal of Business and

Industrial Marketing (JBIM) in 1986, Advances in Business Marketing and Purchasing (ABMP) in 1986, International Marketing Review (IMR) in 1988, The Journal of Business-to-Business Marketing in 1993, and Journal of Business Market Management in 2007. (LaPlaca and Katrichis, 2009: 6-8).

The first task in academic industrial marketing was to attempt to identify the characteristic differences between consumer marketing and industrial marketing. Then, industrial marketing literature converged more independent conceptual development and theory building (Vargo and Lusch, 2011: 183). Wilkie and Moore (2003: 117) proposed five stages of marketing theory as pre-marketing (before 1900), the foundation of the field (1900–1920), shaping the field (1920–1950), a paradigm shift (1950–1980), and intensification of shift (1980-present). The reflection of these stages is illustrated in Figure 7.

Figure 7. Evolution of Industrial Marketing Theory



Source: Adapted from Cortez and Johnson 2017: 91

During the pre-marketing stage, little theoretical development had been focused. Economic theory dominance had been followed during the foundation of the field and shaping the field stages. Behavioral theory dominance has been observed during the paradigm shift and intensification of shift stages. Recently, new theories as industrial relationships, business networks (primarily the vertical producer–wholesaler–retailer network), social theories, organizational theories have been introduced with recent studies to the industrial marketing theory (Hadjikhani and LAPlaca, 2013:300-305).

2.1.2. Classification of Industrial Markets

Kotler and Keller classified markets as; consumer market, business market, global markets and non-profit and governmental markets as the key markets. (Kotler and Keller, 2016: 29). Recently, Kotler and Armstrong (2018: 96) defined the activity of business markets as “buying goods and services for further processing or using in their production processes.”. Some scholars nested non-profit organizations into the industrial markets. Therefore, service markets are nested into the industrial markets as well. The most important characteristics of the service industries are being labor-intensive rather than material. Some scholars separate agricultural products from industrial markets. However, the general principles of industrial marketing are applied in agricultural markets as well (Tek and Özgül, 2013: 144).

Wright (2004: 33) classified business markets under the following headings such as (1) regional markets, (2) domestic markets and (3) global markets.

Regional markets are markets that are functioning specific zip code areas (Kotler and Keller, 2012: 214) and are localized within particular areas as particular towns, cities, states, areas or regions (Wright, 2004: 33). Some characteristics of regional markets for industrial goods are specified by Wright (2004). Industries tend to cluster into some particular areas that are acting in the regional market. Some subsidies and grants are provided to some particular areas as well. Regional markets might have a different approach due to culture and business needs.

Domestic (National) markets are places that businesses aimed in a single market with one set of national customers (Gillespie and Hennessey, 2011:7). Accessibility, understandability, culture, common purchasing behavior and logistical problems lead businesses to act in domestic markets. Most of the companies start their businesses within national boundaries (Wright, 2004: 33). National companies may address some export markets. (Gillespie and Hennessey, 2011: 253) and successful companies expand into international and global markets (Wright, 2004: 33).

Global markets are the places that businesses expand from its domestic market to foreign markets (Gillespie and Hennessey, 2011:7, 220). Acting at global markets provides tremendous opportunities to grow, promotes innovation and intensifies competition. Most industries have intense global competition and becoming fiercer with new emerging markets and businesses (Pride and Ferrel, 2009: 102-103). Countries encourage businesses in terms of internationalization and attracting capital to the country. The increasing importance of global markets and global marketing is explained by Tek and Özgül (2013: 156) with explanatory factors as rapid technologic advancement, globalization, privatization, economic cooperations ect., the theory of comparative advantages, and increase of export and imports.

2.1.3. Characteristics of Industrial Markets

Discussions on industrial markets start with the distinguishing characteristics of industrial markets from consumer markets (Cooke, 1986: 10). Several theoretical works were written that argue the differences between industrial and consumer markets (Coviello and Brodie, 2001: 383). Brennan et al. (2011: 19) emphasized the nature of the customer rather than the nature of the product that differentiates the industrial markets from consumer markets.

McTravish and Maitland (1980) classified differences of industrial and consumer markets into industrial buyers and differences in uses. Brennan classified differences as market structure differences, buying behavior differences and marketing practice differences. Table 11 summarizes the differences between industrial and consumer markets in terms of characteristics. The industrial market has different characteristics as the nature of markets, market demand, buyer behavior, buyer-seller relationships, environmental influences (economic, political, legal), and market strategy (Hutt and Speh, 2010: 13).

Industrial markets are more complex than the consumer markets and the marketing success deepens on these complexities (Havaldar, 2005: 10). According to Cooke (1986), industrial markets are concentrated markets with stable buying relations, rational buying motives and multiple buying factors. Price, time and product characteristics, post-shipment services and market characteristics are also mentioned as differences. Along with these differences, distinctions on marketing strategies are also pointed out.

Table 11. Differences between Industrial and Consumer Marketing

Industrial Market	**Consumer Market**
Market Characteristics	
Geographically Concentrated	Geographically dispersed
Relatively fewer buyers	Mass markets, many buyers
Oligopolistic Competition	Monopolistic Competition
Products Characteristics	
Technically complex	Standardized
Purchased for other than personal use	Purchased for personal use
Service Characteristics	
Customized to user preference	Service, delivery, and availability only somewhat important
Buyer Behavior	
Technical expertise an asset	Less technical expertise
Interpersonal relationship between buyers and seller	Nonpersonal relationship
Significant information exchanged between participants on a personal level	Little information exchanged between participants on a personal level
Stable, long term relationships	Changing, short term relationships
Involvement of various functional areas in both supplier and buyer firms	Involvement of family members
The purchasing decision is mainly made on rational/performance basis	The purchasing decision is mainly made on physiological/ social/ psychological needs
Channel Characteristics	
More Direct	Indirect
Fewer intermediaries	Multiple levels of intermediaries
Promotional Characteristics	
Emphasis on personal selling	Emphasis on advertising, monologue
Customer seldom aware of industrial brands and companies	Companies compete for visibility and awareness by the consumer market
Price Characteristics	
Complex purchasing process or competitive bidding and negotiated prices	Usually list and predetermined prices
List prices for standard products	
Demand Characteristics	
Derived	Direct
Inelastic	Elastic
Volatile	Less Volatile
Discontinuous	

Source: Havaldar, 2005 :4-5; Vitale et al., 2011: 9

Although these differences are explained, Coviello and Brodie (2001: 395) point out the similarities in the intent of marketing decisions, the managerial planning focus, and the purpose of exchange, resource investment, customer contact, and managerial level of market planning between industrial and customer marketing practices.

Along with these differences, the nature of the demand will be explained in detail in this dissertation. Demand in business markets has significance in affecting the decisions on which markets to serve, what business to be in, and where to invest company resources (Dwyer and Tanner, 2002: 20).

Demand is the amount of good or service that consumers show willingness and have the ability to buy at various price levels (Baack et al., 2019: 12). The demand placed at the very beginning of the marketing theory. Definition of the marketing consists of the demand concept as *"Matching the resources of the organization to the demands of the market place"* (Wright, 2004:7). Demand along with the needs and wants is the core concept of marketing (Kotler and Keller, 2012: 31) and building demand for products and services is the value created by marketing (Kotler and Keller, 2016: 25).

Besides creating demand, marketing has the task of regulating the level, timing, and character of the demand for product, service place or idea (Kotler, 1973: 43). Marketing management is essentially demand management and marketing has the task of coping with the different demand states. Eight different demand states and their corresponding tasks are distinguished as "*negative demand - disabuse demand, no demand - create demand, latent demand – develop demand, faltering demand – revitalize demand, irregular demand – synchronize demand, full demand – maintain demand, overfull demand – reduce demand, and unwholesome demand – destroy demand*". These tasks have to be handled by carrying out marketing research, planning, implementation, and control (Kotler, 1991: 11).

The nature of demand is unique in industrial markets (Hutt and Speh, 2010: 13) and it is derived from the demand for consumer goods and services (Havaldar, 2005:7). In other words, *"demand for industrial products stems from the demand for consumer products"* (Pride and Ferrel, 2010: 232). Derived demand is "*the demand experienced* *by the chain of suppliers and produces that contribute to the creation of a total offering*" (Vitale et al. 2011: 8).

Derived demand is usually multilevel. All firms involved in the production process is affected by a change in consumer demand (Pride and Ferrel, 2010: 232). Therefore, monitoring only the industrial buyers is not enough for the producers, they necessarily monitor the demand for consumer products. Any change at the demand of the final consumer can significantly affect the demand of producers. While the demand increases for the consumer products, demand for industrial products also increases. However, this increase does not indicate an increase at the same constant level. The demand is reflected much higher for each subsequent member in the distribution channel which is called as acceleration effect (Arslan, 2012: 21-23).

Elasticity is the change in demand occurred when there is a change in the price (Havaldar, 2005: 8). Demand is not easily affected by the change of price level since the price of the industrial product generally forms a small part of the final price of the supply chain (Wright, 2004: 89). An increase or decrease at the prices of the industrial products does not create a change at demand and demand remains almost the same. The reason is that the industrial buyer has to buy the product even if the price changes. Industrial buyers continue to buy industrial products, even if there is a high increase in price to avoid hindering the production (Arslan, 2012: 24).

Another point to consider for inelastic demand is, if the final consumer price is sensitive or not. There is an expansive effect of a final consumer through the whole supply chain (Hutt and Speh, 2001:10). Therefore, price elasticity is also indicated by the derived demand. If the final consumer is price sensitive, demand will be inelastic. Conversely, if the final consumer demand is driven by price, demand will be more elastic also in industrial markets (Dwyer and Tanner, 2002: 21).

On the other hand, when the goods are without substitutes, demand is not affected by the price and it is inelastic. However, when the market has more substitutes, the price will be more elastic and more affected by the price (Dwyer and Tanner, 2002: 21). Nevertheless, demand cannot be changed in the short term due to the obligation and orders of the producers (Brassington and Pettitt, 2006: 156).

Derived demand results in volatility in industrial markets (Pride and Ferrel, 2010:232). An increase in the final consumer demand can lead to a much larger increase in business demand (Kotler and Keller, 2014: 214). As seen in the acceleration effect, a small change in the demand of the final consumer product causes much more change in the demand for industrial products. This leads to rapid changes fluctuation in industrial demand (Arslan,2012: 25).

Organizations monitor and anticipate demand carefully (Fill and Fill, 2005: 6). As a characteristic of the industrial markets, fewer customers are acting and any decrease in the demand can create an immediate and disastrous effect on the producer (Wright, 2004: 90).

Volatile demand is also an obstacle for industrial forecasting. While volatilities in the short term do not necessarily affect long term trends and decision making is concerned with the future (McTravish and Maitland, 1980:106).

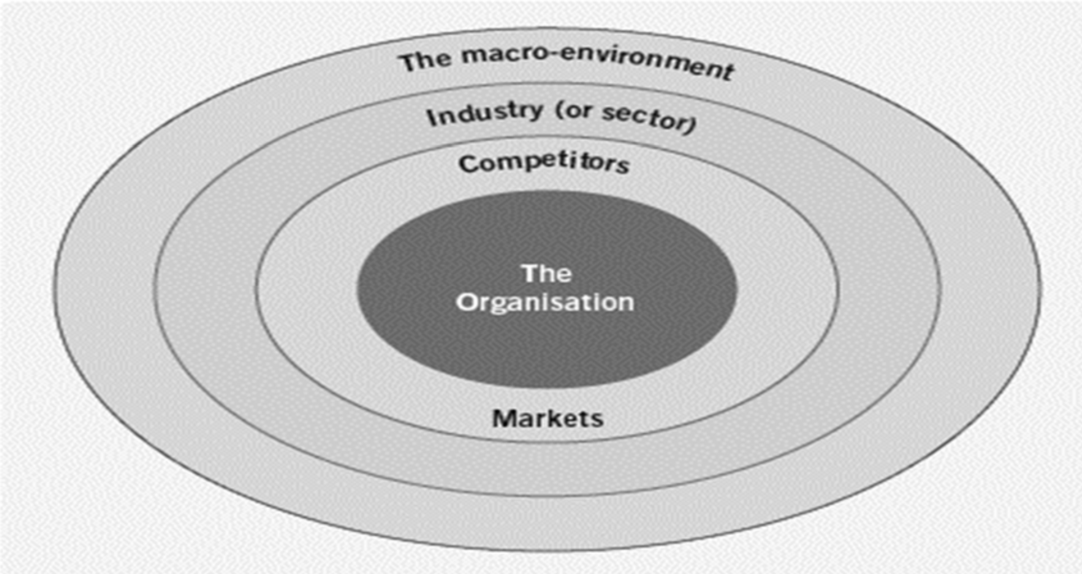
The amount of the demand for the products, services or ideas is subject to large changes in industrial markets. Any fluctuation in the market reflects large incremental changes in demand. This stems from the capacity utilization problem. In the case of an increase in demand, suppliers are encountered with the decision to increase production capacity. Therefore, this capacity increase cause increases in the demand for other related markets. Suppliers should develop good forecasts of the market and know their customers to tackle this discontinuous demand problem (Vitale et al. 2011: 11, 26).

Joint demand refers to the situations when two or more products are used or demanded simultaneously (Dwyer and Tanner, 2002: 22). If any problems occurred in supplying one of the products, then the final product cannot be prepared. This emphasizes that the suppliers and buyers need to plan and coordinate production schedules together in case of a joint demand (Brasssington and Pettitt, 2006: 155).

2.2. INDUSTRIAL MARKETING ENVIRONMENT

Environments are described as a series of layers by Johnson et al., (2017: 33) as shown in Figure 8. The marketing environment consists of the actors and forces that affect marketing management's ability to establish and preserve successful relationships with target customers (Kotler and Armstrong, 2018: 92). The marketing success of the businesses depends on the ability to manage marketing plans in this frame. Therefore, changes and the development of the environment should have been monitored and evaluated continually (Mucuk, 2014: 23).

Figure 8. Layers of Environment



Source: Johnson et al. 2017: 33

In the 1990s and before the evolutionary environment dominated the markets. Evolutionary environments are predictable and change gradually. However, the current business environment regarded as revolutionary that environments are unpredictable and characterized as discontinuous change (Smit et al., 2007: 63).

Macro external environment and micro external environment elements are regarded as non-controllable elements of marketing (Wilson and Gilligan, 2005: 129).

2.2.1. Macro External Environmental Factors Influencing Industrial Marketing

Industrial markets are affected, framed and exposed from the macro external environment. It is defined as larger societal forces that affect the microenvironment by Kotler and Armstrong (2018: 92). Macro external environmental factors have impact broader or lesser throughout many organizations, industries and sectors (Johnson et al., 2017: 33). Macro external environment influences are major and uncontrollable (LaPlaca, 2016: 2). There are various spheres of influence that affect industrial markets. Economic, politic, social, legal system and technology influences industrial markets. These influences are linked with each other and enhance their impacts through constant feedback-loop (Frauendorf, 2007: 20-22).

Kotler and Armstrong (2018) specified macro-environmental forces as demographic, economic, natural, technological, political, social and cultural in their books "*Principles of Marketing*". Johnson et al., (2017: 34) examined macro-environment under six key factors political, economic, social, technological, ecological and legal in their book "*Exploring Strategy*" as illustrated in Figure 1. Wright (2004: 8) classified macro-environment factors as political/legal, economic/demographic, social/cultural, technical/physical in his book "*Business to Business Marketing*".

The political element of the macro-environment emphasizes the role of states and other political factors. The economic environment consists of macro-economic factors such as exchange rates, interest rates, and economic growth rates. (Johnson et al., 2017: 33). The demographic environment is related to the human populations and regarded as the major interest of marketing. Any change occurred at demography also affects the markets. The natural environment refers to the physical environment and natural resources. The cultural environment is related to the societies' basic values, perceptions, beliefs, behaviors, and preferences. The technologic environment includes "*forces that create new technologies, creating new product and market opportunities*" (Kotler and Armstrong, 2018: 96, 104, 106, 111). Johnson (2017) explained the social environment under four headings as geography, culture, demographics, and distribution. Ecologic environment refers to green macro-environmental influences (Johnson et al., 2017: 45). The legal environment consists of various legal systems under businesses operates (Hamilton and Webster, 2015: 130).

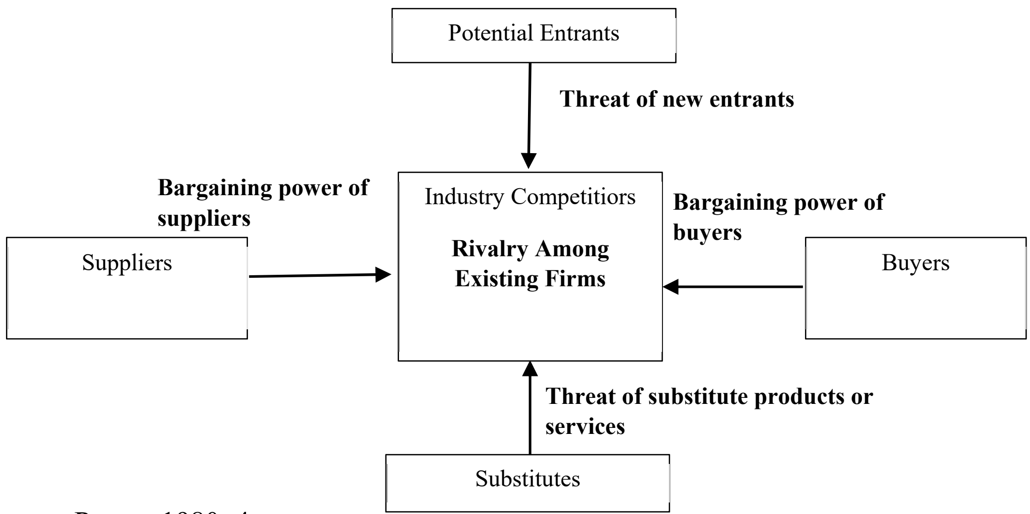
Analyzing the macro external environment is a key element for the strategic marketing planning of industrial businesses. Because, changes in the macro external environment affect strategic marketing decisions (Brennan et al., 2011: 92).

2.2.2. Micro External Environmental Factors Influencing Industrial Marketing

There are many people, groups, elements, and forces directly or indirectly influencing the companies (Brassington and Pettitt, 2006: 24). The micro external environment is composed of the nearest environment of the company that has the most immense and direct influence over its abilities with its markets. It includes the organization itself, its suppliers, its distribution network, customers, competitors and the public at large. (Wilson and Gilligan, 2005:129).

The micro external environment affects companies' abilities. However, companies can take action to influence the industry (Elearn Limited, 2005: 2). Porter (1980: 3) expressed firms' industry or competing industries as the key aspect of the firms' environment and developed the Five Forces Model to evaluate industry structure. The macro external environment influences all firms in the industry. However, competition relies on the industrial five forces. Five forces analysis is a framework for industrial analysis (Dasgupta, 2011: 4). Five forces analysis provides continuous monitoring of the microenvironment (Luck, 2010: 111) and reveals the most important aspects of the competitive environment illustrated in Figure 9. Good industry analysis provides an understanding of the underpinnings of competition, profitability at the appropriate time horizon, root causes of profitability, gives deeper and systematic insight into the overall industry (Porter, 2008: 29, 35).

Figure 9. Porter's Five Forces Framework



Source: Porter, 1980: 4

2.2.3. Internal Factors Influencing Industrial Marketing

Internal factors are all factors within the business organization and their influences of it working (Fernando, 2011: 37). The internal environment consists of all of the resources, actions and knowledge and system of the company (Elearn Limited, 2005: 2). Internal factors are all factors of a firm including marketing, finance, R&D, manufacturing, organization structure and human resources (Havaldar, 2010: 28). Wright (2004: 8) identified internal resources of an industrial organization under eight S (Strategy, Structure, Systems, Skills, Shared values (culture), Staffing, Style (corporate image), Sustainable competitive advantage) and eight P (Product, Price, Place, Promotion, People, Processes, Profit, Physical evidence). All these influencing factors are controllable and can be employed to enable companies' systems to perform effectively and efficiently. Internal influencing factors can shape companies' strategy and direct their resources to carry out their abilities (Elearn Limited, 2005: 2). Analysis of internal factors provides identifying the strengths and weaknesses of a company. The value chain is one of the known internal analysis instruments. The value chain describes all the company and its activities as well as functions (Laasch and Conaway, 2014: 165). It is a part of the strategic planning process. (Havaldar, 2010: 28).

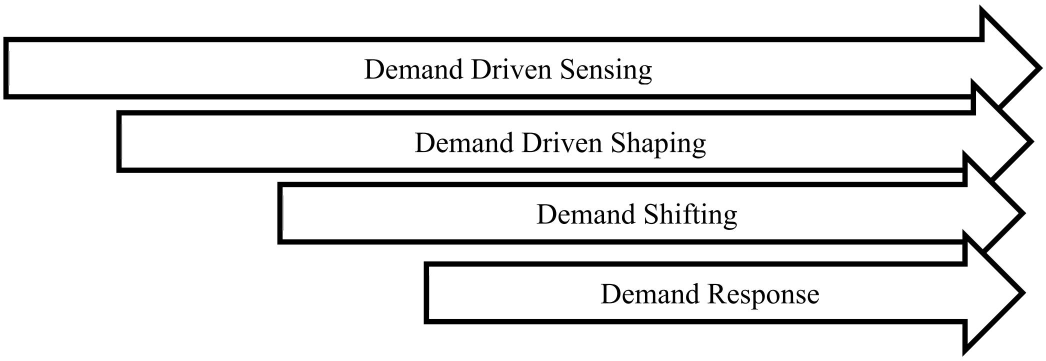
There are two views on the source of competitive advantage. The environmental view emphasizes the importance of companies' external environment on achieving competitive advantage. However, the resource-based view assigns a competitive advantage to the internal environment (Laasch and Conaway, 2014: 163). Integrating inside out and outside in practices creates greater value for the firms (Porter and Kramer, 2006: 11).

2.3. DEMAND FORECASTING IN INDUSTRIAL MARKETING

Demand at industrial markets must be forecasted to store and allocate resources efficiently, develop and implement strategies and make plans for the future. Future growth, sales potential and profit potential are the issues for forecasting demand (Wright, 2004: 93-94). Therefore, demand forecasting provides businesses formulating suitable production policy, formulate appropriate pricing policy, arrange for financial requirements, reduce costs, set sales targets, arrange for promotional efforts, assess suitable labor requirements. The demand forecast creates a link between the evaluation of external influencers of the firm’s internal affairs. (Nadar and Nijayan, 2012). Demand depends on many circumstances and changes and that causes difficulty while forecasting demand. Inaccurate demand forecasts can cause unwanted products to be produced and services to be given (Wright, 2004: 25, 93).

Traditional demand forecasts are concentrated on planning. The recently formulated process within the demand forecasting discipline consists of sensing, shaping, responding to demand as illustrated in Figure 10. Demand sensing is a core capability of firms collecting and managing various kinds of data and translate these data into insights and actions to create an efficient supply response. By sensing demand, market opportunities and key business drivers are uncovered through collaborating and coordinating internal and external data. Demand shaping is a proactive process consisting of optimizing sales and marketing tactics and strategies, assess financial impact, unconstrained demand forecast. Shaping demand crates a more accurate unconstrained demand forecast with advanced analytics. Demand shifting is the ability to promote another product, or service as a substitute when the demanded product is unavailable to close the demand expectations and supply availability. To match that supply, collaboration and coordination between sales, marketing and operations planning are necessary. Finally, a demand response by sales and marketing is provided to arrange forecasts and future demand. Demand response is used to develop a final supply response (Chase, 2013: 2-58).

Figure 10. Demand-Driven Forecasting Process

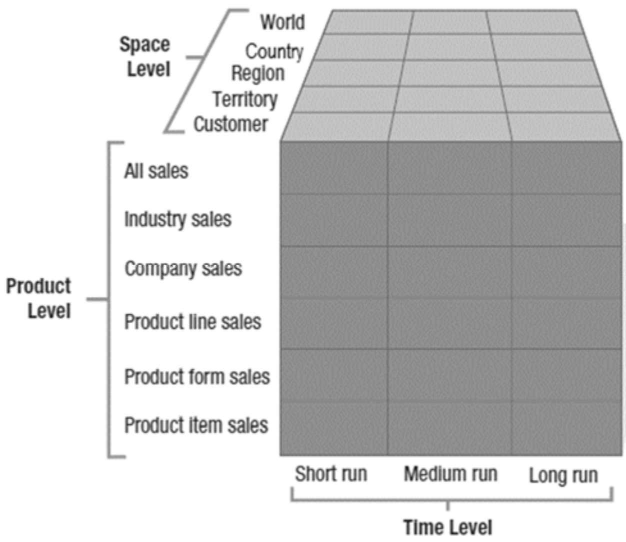


Source: Chase, 2013: 58

In the previous sections, demand and market are defined and explained separately. Here, market demand will be mentioned. "*Market demand for a product is the total volume that would be bought by a defined customer group in a defined geographical area in a defined period in a defined marketing environment under a defined marketing program.*". Market demand is a function of specific conditions (Kotler and Keller, 2016: 109) and it is explained with the price and time (Panda, 2007: 75).

Market demand can be measured under different levels. Kotler and Keller specified that ninety different market measure can be practiced as shown in Figure 1.

Figure 11. Demand Measurement Levels



Source: Adapted from Kotler and Keller, 2012: 85

Market demand analysis and marketing planning are based on the determination of markets that are illustrated in Figure 11. The potential market is a collection of customers who wants to benefit from a market offer (Kotler and Keller, 2016: 108). Available market is a portion of the consumers who have interest, income and access to available market (Kotler and Keller, 2016: 108). Qualified available market is a portion of customers who have been qualified to access the available market as well (Panda, 2007: 75). The penetrated market is a collection of consumers who have already bought the product or service. The target market is part of the available market that the company is interested in serving (Kuadaa, 2008: 84). The penetrated market is a portion of served marked while, the target market is the served market (Jenster et al., 2005: 105).

Market demand analysis might need to execute at all markets depending on the current and future markets. This need can be performed at "*existing products in existing markets, existing products in new markets, new products in existing markets, new products in new markets*" which are called Ansoff Matrix (Wright, 2004: 94).

Figure 12: Determination of Markets

Source: Adapted from Panda, 2007: 75

Businesses need to look for demand potential by sales territory, product category and customer to plan and set targets for its marketing activities. Demand potential process includes "*country demand potential, industry demand potential, market demand potential, organizational demand potential, territory–the customer–product potential*" (Wright, 2004: 97). Similarly, estimate total market potential, area market potential, and total industry sales and market shares are practiced to estimate current demand (Kotler and Keller, 2016: 110).

Country demand potential refers to the overall level of sales and services that could be achieved across the whole of the economy of a country. Macro environmental analysis is used to inspect and design processes to examine the future growth of the economy. Macroeconomic influencers help develop demand potential at the country level. Related statistics and data can be collected through government agencies at abroad countries (Wright, 2004: 95).

Industry demand potential refers to the maximum possible level of sales activity that might be feasible from a given industry. Macro and especially micro external influencers have some kind of impact on industry demand. Life cycles also have a significant impact on industry demand. The life cycle of industry changes around the world and identifying these differing demands can be challenging. Identifying these demand cycles provides advantages in forecasting. Therefore, businesses can plan resources effectively (Wright, 2004: 97).

The market forecast is the market demand at a specified market measurement level (Kotler and Keller, 2016: 110). It identifies what is expected to be sold based on the marketing efforts of the businesses. Market potential describes the total demand opportunities (Kress and Snyder, 1994: 219). Reports of trade associations and research companies are helpful in assessing market demand potential (Wright, 2004:96).

The companies estimated share of market demand at a specific time describes the company demand (Kotler and Keller, 2012: 87). The sales potential of a company is the amount of specific firm that could be expected to be achieved to sold. It is the portion of the market potential of a specific firm that could capture under maximum marketing efforts. Developing sales potential is starts with the developing market potential. Here, the market share should also be mentioned. The difference between market share and sales potential can be identified with one word. Sales potential is based on possible sales while market share is based on actual sales (Kress and Snyder, 1994: 238-240). The company sales forecast is the expected level of company sales in a specified time with the given marketing effort (Kotler and Keller, 2012: 87). Successful businesses seek to demand potential for both existing and new market segments (Wright, 2004: 96).

Business markets are more difficult to assess for potential due to having less available information than consumer markets. Moreover, there are substantial differences in estimating potentials and more difficult applications. The market potential for industrial markets is generally developed by the value of the shipment and the number of employees. ISIC codes are used to segment the industrial market and analyzing industrial markets (Kress and Snyder, 1994: 231-240).

Existing databases are focused mostly on consumer markets. Therefore, data for industrial markets are significantly fewer. Obtaining information on the market and usage of this information and developing adequate strategies are key elements in the success of businesses. For this reason, decision-makers need to have the ability to process obtained data and analyze markets (Kress and Snyder, 1994: 240).

2.3.1. Demand in Industrial Marketing

Demand in industrial markets is one of the main issues of this dissertation and in this section industrial marketing studies on demand will be presented. Entenberg and Menard (1966) proposed a methodology to forecast future octane number which indicates the number correlated to a fuel's "burnability," requirements for marketing strategy. Ball and Agarwala (1969) investigated the impact of advertising on demand for tea in the UK. Lowe (1973) issued a derived demand study in marketing. Weinrauch (1974) investigated excessive industrial buyer demand and emphasized the need for developing and implementing a strategy for managing demand. Lloyd (1976) presented a conceptual paper that includes types of forecasts and methods to estimate demand. Walhbin (1977) investigated the demand for pumps from the pulp and paper industry. In this study, both qualitative and quantitative methods are used and cyclical variations are referred. Research of Tajdini et al. (2013) is another demand estimation study. They conducted demand and supply estimation of the veneer that is one of the most important products for the wood-based panel industry. Petty and Pointon (1979) mentioned the importance of forecasting in industrial marketing by mentioning the advantages of forecasting as obtaining useful insights quickly, less costly corporate planning and formulating marketing strategies. Rosenberg (1982) presented a forecast for the nonresidential construction industry. Bishop et al. (1984) pointed out the importance of volatility of derived demand in industrial markets and proposed marketing strategies to reduce the effects. Wyner et al. (1984) developed scenarios and tried to simulate actual buying decisions. This model is found efficient in modeling price demand relationships. Bernard Trustum et al. (1987) reviewed demand forecasting literature in marketing and developed a marketing forecasting model process. Bernard (1988) emphasized the differences between consumer and industrial marketing. Darden et al (1989) attempted to develop a predicting model for the impact of logistic systems on sales of industrial products. Franses (1991) developed econometric and time series models to forecast beer demand in the Netherlands. Diamantopoulos and Mathews (1993) contributed to the perceived demand curve from the perspective of a multiproduct firm. Shemwell and Cronin (1994) analyzed the demand/supply imbalances and offered strategies to overcome these situations. Sullivan (1998) investigated the influences of brand names on demand in the used car market by examining the price ratios of used twin automobiles.

Moon et al. (2000) presented the importance of forecasting consumer demand to supply chain success. They presented a case study consisting of a sales forecast audit. Srinivasan et al. (2005) have an approach to add cannibalization effects into the forecasting models. They conclude that accurate product cannibalization forecast provides better decisions on new product introduction. Meredith (2006) presented a diagrammatical template to overview the demand evaluation process. Tsai et al. (2007) examined the prediction of demand choices of manufacturers in selecting a third-party provider. Industrial innovation was investigated from the demand side and supply side by Hung, 2010. Yan and Wang (2012) issued the importance of sharing information on demand forecast at high tech firms. Newton et al., (2014) examined contradicting organizational demands among organizational units.

Santos and D’Antone (2014) presented a systematic literature review and qualitative content analysis to give deeper insights on demand chain management. Jüttner et al. (2006) proposed an integrated model on-demand chain alignment and product life cycle. Jüttner et al., (2007) investigated the role of marketing within demand chain management and they provide some implications for further research. The demand and supply side of the supply chain were issued by Lorentz and Ghauri (2010). One of the aims of Anning-Dorson (2017) is to examine market demand's influence on innovation and firm performance relationship in the service industry. Iyer (2011) investigated the concepts of IT analytic capability, demand chain collaboration, market uncertainty, and operational performance and found that demand chain collaboration has a strong association with operational performance. As mentioned before, Shemwell and Cronin (1994) issued demand fluctuations and offered supply and demand match strategies. Phillips et al. (1994) aimed to explore the effect of demand certainty on technology adoption and found that culture is a catalyst for technology adoption when the demand is certain.

One of the aims of Ndubisi et al. (2019) is to test the hypotheses on the fact that innovation capabilities create superior service innovation even under demand uncertainty. They found that this relationship was not modified by demand uncertainty. Similarly, Park et al., (2020) issued demand uncertainty under levels of network governance. Gölgeci et al., (2019) investigated collaboration-competition, concord-conflict, and integration-differentiation paradoxes that exist at the demand-supply interface. They followed the exploratory research approach and conducted interviews on B2B firms. Recently, Kumar et al., (2019) presented an application of demand shaping, demand sensing and accurate demand forecasting with TV manufacturing supply chain dataset. The proposed data-driven framework for demand-driven forecasting and their model, assist researchers in understanding how advertising works.

2.3.2. Forecasting Methods in Industrial Marketing

Forecasting has a significant place in every major area of business. In the area of marketing, significance stems from both marketing itself and other areas of business (Makridakis and Wheelwright, 1977: 26). Forecasting has gained importance for marketing especially after the 1960s (Armstrong and Broodie, 1999: 16). Forecasting methodologies for marketing are categorized as qualitative and quantitative methodologies. Qualitative methodologies are divided into two as subjective assessment techniques and forecasting based on technological developments. Quantitative methodologies consist of time series and causal or regressive approaches (Makridakis and Wheelwright, 1977: 26). In the following chapter of this dissertation forecasting methods will be explained in detail.

Armstrong et al. (1987) presented forecasting methods that are used in marketing. Econometric methods are preferred while developing environment and market forecasts. Market size is affected by econometric variables and improved environmental forecasts can boost the accuracy of the market forecasts. Expert opinion, judgmental bootstrapping, extrapolation, and econometric methods are generally used methods. Another marketing forecast is based on the actions and reactions of decision-makers and this approach generally consists of the decisions of competitors. While forecasting these actions, expert opinions, intention surveys, role-playing, experimentation methods are proposed. In terms of sales forecast, customer surveys, focus groups, expert opinions, judgmental bootstrapping are the qualitative methods and extrapolation is proposed as the preferred method for quantitative sales forecast. New product development forecasts are a significant area for sales forecasts. The product life cycle has substantial importance for new product forecasts to assist managers in estimating the customers' possible response depending on the stage of the product life cycle. Intentions survey is a useful method for forecasting new product development. Forecasting profits and other outcomes as marketing costs, sudden changes and uncertainty are other issues of forecasting in marketing (Armstrong et al. 1987).

Tsai et al (2007) developed logit models to predict demand choices of manufacturers based on variables of confirmatory factor analysis. Yan and Wang (2012) presented a Bayesian forecasting model to capture the effect of information sharing on price decisions under uncertain market demand. Tajdini et al. (2013) used annual time series data and applied simultaneous equations according to the 3 stage least squares procedure to estimate veneer supply and demand. They mentioned the effects of explanatory variables on supply and demand as well.

Herbig et al. (1994: 68) concluded that industrial firms mainly used salesforce composite and jury of executive opinion for forecasting. Industrial firms develop forecasts and give value to forecasts more than consumer firms. Therefore, they discuss that in terms of forecasting behavior, consumer and industrial firms have more similarities than differences.

Forecasting models mentioned thereafter are collected from the forecasting models used in industrial marketing literature. Entenberg and Menard (1966) used three methods to forecast future octane number requirements as a weighted factor of sales method, a correlation of compression ratio to octane number method and combination of the first two methods. Ball and Agarwala (1969) developed regression models with quarterly data to analyze the demand for tea in the UK. Wahlbin (1977) used both qualitative and quantitative methods. In this study, historical data were used to develop regression and interviews were also made to forecast demand. Petty and Pointon (1979) presented a regression model with exogenous variables to forecast demand for recycling plant with issuing derived demand. One of the results obtained from Dolan and Jeuland's (1981) study is in the form of the optimal price depends on the elasticity of the demand, the evolution of the production costs and demand-side dynamics. Rosenberg (1982) used historical data with lagged periods and developed some equations to calculate the potential sales of specified industrial goods. Wyner et al. (1984) used interviews to design scenarios to model the price-demand relationship of purchase decision-makers. Darden et al. (1989) used factor analysis to combine interlinked logistics variables, then developed a regression model to test the impact of logistics factors on industrial products. Franses (1991) used bimonthly data and developed the ARMAX model to forecast beer demand in the Netherlands. Diamantopoulos and Mathews (1993) performed descriptive statistics, Wilcoxon signed-ranks matched pairs, and cluster analysis using the data collected from the perspectives of managers and they pointed out the complexity of the demand environment. Srinivasan et al (2005) used weekly sales of a consumer beverage product and benchmarked ARIMA and integrated ARIMA and cannibalization effect models. They conclude that the cannibalization effect integrated ARIMA model is performed better than the benchmarked model. Recently, Kumar et al., (2019) developed time series models using fuzzy neural networks and compared it with ARIMA, MLR, Random Forest, SVM, and ANN models.

2.3.3. Literature Review on Demand Forecast Variables in Industrial Marketing

In this dissertation, to obtain the related variables for the demand forecast in industrial marketing, a literature review has been carried out. After reviewing the related articles published in the industrial marketing field, the variables are deduced. As seen in Table 12, 37 articles in the field of industrial marketing have been reviewed and 54 variables have been obtained. "Price" has the most frequency and 19 articles have mentioned it. “Cost” is another variable which is 14 times in the related articles. “Sales” and “Market information” has a frequency of 8 times. “Orders” has a frequency of 7 times. “Integration-differentiation”, and “Innovation” have a frequency of 6 times. “Substitutes” has a frequency of 5 times. The rest of the variables mentioned less than five times. “Coordination” and “Promotion” have a frequency of 4 times. “Investment”, “Brand”, “Market Share”, “Import” and “Competitors” have been found 3 times. All variables have been considered in this dissertation due to their importance and none of them has been neglected. The findings of this literature review have been used to explore industrial marketing aspects of demand and to further investigate the applications at the domestic dry cargo market. At this point, research on the forecasting methods and models in depth is required.

Table 12. Studies on Demand in Industrial Marketing Literature and Demand Variables

DEMAND VARIABLES IN INDUSTRIAL MARKETING LITERATURE REFERENCES VARIABLES	1.Black, 1951	2. Entenber and Menard, 1966	3. Ball and Agarwala 1969	4. Lowe 1973	5. Weinrauch, 1974	6. Jones, 1975	7. Lloyd, 1976	8.Dolan and Jeuland 1981	9.Bishop et al. 1984	10.Wyner et al. 1984	11.Bernard, 1988	12.Darden et al.1989	13.Franses, 1991	14.Naor and Schmutzler 1991	15.Diamantopoulos and Mathews 1993	16.Philips et al. 1994	17.Shemwell and Cronin, 1994	18.Gendall et al. 1997	19.Moon et al. 2000	20.Cai et al. 2002	21.Prendergast et al. 2002	22.Baltas et al. 2003	23.Jüttner et al.,.2006	24.Meredith 2006	25.Ruzo et al.2006	26.Jüttner et al.2007	27.Tsai et al.2007	28.Srinivasan et al.2008	29.Lorentz and Ghaguri, 2010	30. Hung, 2010	31.Iyer, 2011	32. Yan and Wang 2012	33. Tajdini et al.2013	34. Santos and D'Antone 2014	35.Yan et al.2016	36.Anning-Dorson, 2017	37.Gölgeci et al.2019	Frequency
1.Collaboration-competition																																					x	1
2.Concord-conflict																																					x	1
3.Integration-differentiation	x																x						x			x								x			x	6
4.Price			x	x	x	x		x	x	x		x	x		x		x	x			x			x	x			x					x		x	x		19
5.Coordination					x																					x					x			x				4
6.Communication					x						x																											2
7.Orders				x			x			x							x							x									x					7
8.Investments				x			x																										x					3
9.Cost			x					x							x		x		x			x	x			x	x	x		x		x	x	x				14
10. Speed and punctuality/time			x	x								x					x						x				x				x							7
11.Innovation								x			x													x								x		x		x		6
12.Sales			x	x						x			x										x		x								x		x			8
13.Substitutes										x				x	x									x									x					5
14.Promotion						x						x					x																			x		4
15.Brand																						x						x							x			3
16.Market Share		x																						x				x										3
17.GDP/GNP																				x													x					2
18.Population																								x									x					2
19.Service channels and distribution	x																										x											2

Source: Author

Table 12. Studies on Demand in Industrial Marketing Literature and Demand Variables (Cont.)

DEMAND VARIABLES IN INDUSTRIAL MARKETING LITERATURE REFERENCES VARIABLES	1.Black, 1951	2. Entenber and Menard, 1966	3. Ball and Agarwala 1969	4. Lowe 1973	5. Weinrauch, 1974	6. Jones, 1975	7. Lloyd, 1976	8.Dolan and Jeuland 1981	9.Bishop et al. 1984	10.Wyner et al. 1984	11.Bernard, 1988	12.Darden et al.1989	13.Franses, 1991	14.Naor and Schmutzler 1991	15.Diamantopoulos and Mathews 1993	16.Philips et al. 1994	17.Shemwell and Cronin, 1994	18.Gendall et al. 1997	19.Moon et al. 2000	20.Cai et al. 2002	21.Prendergast et al. 2002	22.Baltas et al. 2003	23.Jüttner et al.,2006	24.Meredith 2006	25.Ruzo et al.2006	26.Jüttner et al.2007	27.Tsai et al.2007	28.Srinivasan et al.2008	29.Lorentz and Ghaguri, 2010	30. Hung, 2010	31.Iyer, 2011	32. Yan and Wang 2012	33. Tajdini et al.2013	34. Santos and D'Antone 2014	35.Yan et al.2016	36.Anning-Dorson, 2017	37.Gölgeci et al.2019	Frequency
20.Market information				x													x						x				x	x	x		x	x						8
21.Expertise/Past experiences																											x											1
22.Customer involvement																x								x														2
23.Culture																x											x											2
24.Finance status																											x											1
25.Customer expectations																							x			x												2
26.Available response alternatives																							x			x												2
27.Customer value																							x			x												2
28.Customer or market interface																										x												1
29.Social interactions																										x												1
30.Import														x										x									x					3
31.Export														x										x														2
32.Market size																								x														1
33.Market growth															x									x														2
34.Competitors			x												x										x													3
35.Risk management																								x														1
36.R&D																								x														1
37.Responsiveness																								x														1
38.Interest rate																								x														1

Source: Author

Table 12. Studies on Demand in Industrial Marketing Literature and Demand Variables (Cont.)

DEMAND VARIABLES IN INDUSTRIAL MARKETING LITERATURE / REFERENCES / VARIABLES	1.Black, 1951	2. Entenber and Menard, 1966	3. Ball and Agarwala 1969	4. Lowe 1973	5. Weinrauch, 1974	6. Jones, 1975	7. Lloyd, 1976	8.Dolan and Jeuland 1981	9.Bishop et al. 1984	10.Wyner et al. 1984	11.Bernard, 1988	12.Darden et al.1989	13.Franses, 1991	14.Naor and Schmutzler 1991	15.Diamantopoulos and Mathews 1993	16.Philips et al. 1994	17.Shemwell and Cronin, 1994	18.Gendall et al. 1997	19.Moon et al. 2000	20.Cai et al. 2002	21.Prendergast et al. 2002	22.Baltas et al. 2003	23.Jüttner et al.,2006	24.Meredith 2006	25.Ruzo et al.2006	26.Jüttner et al.2007	27.Tsai et al.2007	28.Srinivasan et al.2008	29.Lorentz and Ghaguri, 2010	30. Hung, 2010	31.Iyer, 2011	32. Yan and Wang 2012	33. Tajdini et al.2013	34. Santos and D'Antone 2014	35.Yan et al.2016	36.Anning-Dorson, 2017	37.Gölgeci et al.2019	**Frequency**
39.Value creation																								x														1
40.Security capability																											x											1
41.Exceptional management																											x											1
42.Service rate																											x											1
43.Rate of concession																											x											1
44.Damage claim																											x											1
45.Perceived utilities																x																						1
46.Customer price index																																	x					1
47.Added-value of the specified industry																																	x					1
48.Inflation rate			x																														x					2
49.The income of the buyer																																	x					1
50.The wealth of the buyer																																	x					1
51.Unemployment			x																																			1
52.Purchase frequency																						x																1
53.Profitability		x																																				1

Source: Author

CHAPTER THREE
FORECASTING METHODS

3.1. OVERVIEW OF FORECASTING

All forecasts will be wrong (Coyle et al., 2016: 245). However, various application areas have been using forecasting methods to empower people in the decision making process and strategic planning. Due to this importance, forecasting has been growing very rapidly (Wang and Chaovalitwongse, 2010: 1). In this chapter, forecasting concepts, definitions, and related terms, forecasting methods and models and evaluating forecasts will be investigated.

3.1.1. Forecasting Concept

Forecasting is predicting the future of a phenomenon as accurately as possible with organizing available information (Hyndman and Athanasopoulos, 2018: 12; Frechtling, 2001: 8). Uncertainty about the future is the basic reason behind the forecasting and uncertainty creates the need to forecast (Armstrong, 2001: 2). The need to forecast rises in many aspects of life. Individuals need forecasting to predict occupations, investments; whereas organizations need forecasting for scheduling, planning, acquiring resources (Makridakis et al., 1998: 5); and governments need for estimating economy and environmental impacts (Armstrong, 2001: 2). The major objective of forecasting is to discover the full range of opportunities and not to keep limited to the narrow certainty perspectives. In an explicable manner, the primary goal is mapping the uncertainty where acts in the present will influence the future (Saffo, 2007).

There is a belief that forecasts are impossible in a changing environment. However, every environment is changing and forecasting aims to reflect the way in which things are changing. Good forecasting model pictures not only how things are but also the way things move. That is, volatilities, fluctuations, and booms and busts occurred in the past and will continue to occur in the future (Hyndman and Athanasopoulos, 2018: 13).

The essence of forecasting is knowing when it is needed and integrating the qualitative and quantitative data. Moreover, the notion of forecasting is taking place in the scientific disciplines of model building. In light of these facts, the forecasting trend is to be able to forecast a wider variety of events and provide a better base for the plans (Hoshmand, 2010: 5). Especially in the business environment, the accurate or poor forecast affects the entire organization (Makridakis et al., 1998: 5). Good forecasts are required effective and efficient management, and it is crucial for decision making (Waddel and Sohal, 1994: 41).

Forecasting provides general ideas on markets, allows companies to be more profitable, helps to decrease costs, maintains competitiveness and supports in time production and service. However, making forecasts have serious limitations. It grounds on assumptions, approximations, and average conditions. It requires and relies on past data and collecting these data generally needs a lot of time and money (Dubey et al., 2016: 271-272).

While the business decreases its dependence on chance, dealing with the environment becomes more scientific (Makridakis et al., 1998: 5). Therefore, it is necessity to make forecasts during the decision-making process (Waddel and Sohal, 1994: 41). Table 13 presents some of the uses of demand forecasts and the implications of poor forecasts.

Table 13. Uses of Demand Forecasts and The Consequences of Poor Forecasting

Uses of demand forecast	**Consequences of poor forecasting**
Setting marketing goals	Over- or under-budgeting for marketing
Exploring potential markets	Marketing to wrong segments, ignoring the right ones
Simulating impacts on demand	Incorrect marketing mix
Determining operational requirements	Excess labor, or customer unhappiness with limited service
Examining the feasibility of a major investment in plant or equipment	Wasted financial resources, difficulty in financing interest payments
Predicting economic, social and environmental consequences	Environmental and social/cultural degradation; inflation or unemployment
Assessing the potential impact of regulatory Policies	Business losses, unemployment, price İnflation
Projecting public revenue	Budget deficits
Planning for adequate capacity and Infrastructure	Traffic congestion, delays, and accidents

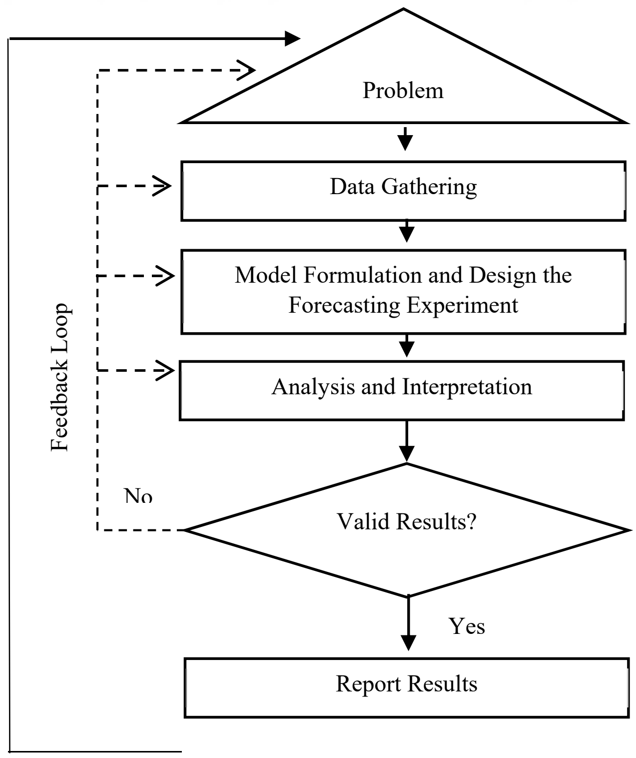
Source: Frechtling, 2001: 11

3.1.2. Forecasting Process

To develop accurate forecasts, a systematic process should be utilized as a forecasting process. The objective in the usage of the forecasting process is to ensure the accuracy of the developed forecasting model, reduce costs (Armstrong, 2001: 679) and support forecaster with the scientific ground (Makridakis et al., 1998: 5). The forecasting process copes with the issues as *"What kind of data will be used? Where the data will be collected? What kind of forecasts will be prepared? Where will the forecasting function reside? What will be the forecasting philosophy? What kind of forecasting approach will be used? Who will participate in the process? How will forecasts monitored and revised?"* (Jain and Malehorn, 2005: 76)

Since the forecasting process can be modified as needed and applied quickly (Hoshmand, 2010: 5), several forecasting processes have been presented by the researchers (e.g. Shim, 2009: 12; Chase, 2013: 57; Armstrong, 2001: 59; Cook, 2006: 12). Figure 13 presents the stages in the process of forecasting.

Figure 13. Forecasting Process



Source: Hoshmand, 2010: 6

The forecasting process starts with a question that is what should the forecast be directed? That is, determining what the problem is and what to forecast? In this stage, forecasting horizon, forecasting region, a reason to forecast, use of the forecast, the financial plan of the forecast should be considered (Cook, 2006: 12). In the next stage, related data are collected and processed. Before estimating the forecasting model, the nature of the data would be carefully absorbed (Hoshmand, 2010: 7). Model formulation and design stage consists of the selection model, constructing model, selecting software (Cook, 2006: 12). The selection of the method depends on the various indicators as forecasting horizon, last changes on the environment, variables, information on relationships. After selecting the forecasting method, software selection and programming, estimation of the model parameters steps are performed. It is followed by the analysis and interpretation stage which consists of obtaining required forecasts and making some subjective adjustments. Then in the validation stage, forecasting accuracy is monitored, the causes of any deviations are determined, the forecasts are revised, changed parameters are determined, new forecasts are generated from the existing model or developing a new model is developed. Finally, the model and its results are documented and presented (Frechtling, 2001: 52).

3.1.3. Determinants of Forecasting

According to Diebold (2007: 34, 35), there are six considerations in successful forecasting. These are related and intersectional with the research process. The first consideration is the decision environment that refers to the quantification of the good forecast and optimality of the forecast. Forecasting statement is another consideration that regards with stating the forecasts and associated costs and benefits. The following aspects also forecast object that includes the objective of the forecasting, data type, quantity, and quality of data and availability of the data. Similar to these considerations, after finding out the forecasting problem, the first step is data gathering as mentioned in the previous forecasting process section. Data used in forecast models are generally split into three categories as time-series, cross-sectional, and panel data and most of the forecasting models use time-series data. *"Time series is a sequence of data at equidistant intervals where each point represents a certain time."* Cross-sectional data refers to many observations collected at a specific time. Panel data is analyzing cross-sectional data with the same sample at different periods (Evans, 2003: 30,31).

Following the data gathering, model formulation and design are considered in the forecasting process. Data patterns and characteristics of data affects the choice of forecasting model and accuracy rate (Hoshmand, 2010: 6, 9). Forecasting method choice is also one of the considerations of the successful forecasting models (Diebold, 2007: 35). Several criteria have been proposed to select appropriate forecasting method as accuracy rate, time horizon, data characteristics and availability, the value of the forecasting, experience of the forecaster (Makridakis and Wheelwright, 1977: 25). Forecasting methods will be evaluated in the following part of this dissertation.

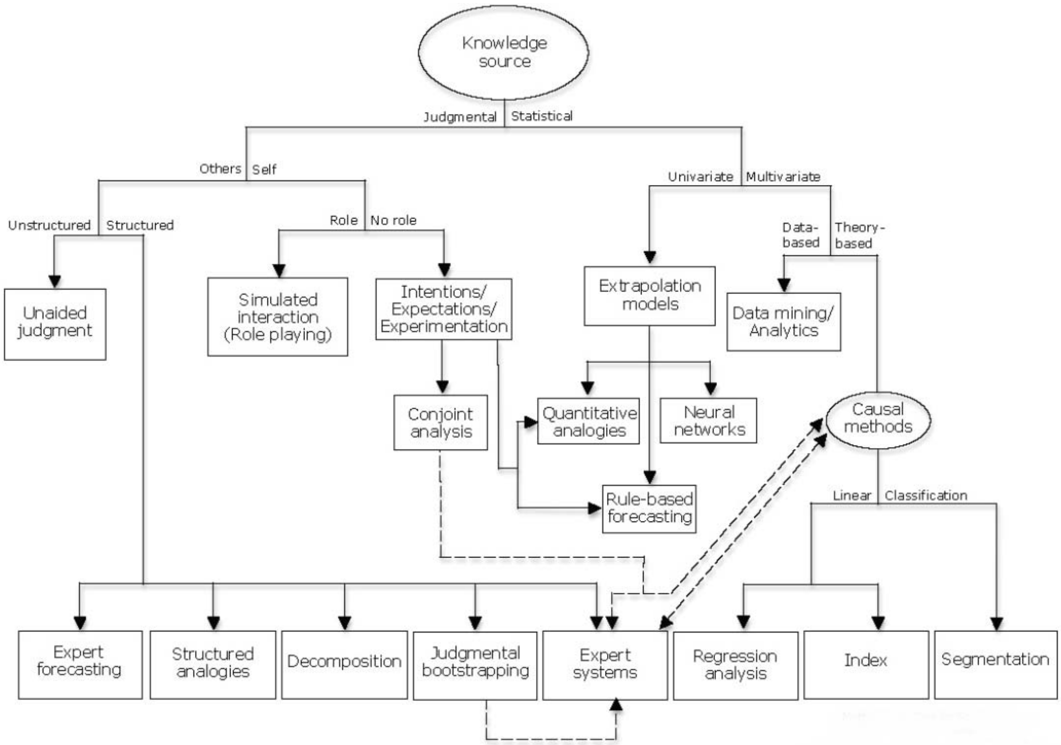
3.2. FORECASTING METHODS

Forecasting is a continuing process of building, using, evaluating and improving forecasting models (Diebold, 2007: 3). Forecasting model and method is defined as (Frechling, 2001: 21):

> "*A forecasting method is simply a systematic way of organizing information from the past to infer the occurrence of an event in the future.*"
>
> "*A forecasting model is one expression of a forecasting method.*"

Therefore, forecasting methods are used to build forecasting models. The developed model provides a connection between past and present characteristics and infers to the future. Hence, forecasting models depend on the characteristics of the forecasting situation such as (forecasting object, horizon, data set) (Diebold, 2007 :3, 46, 48). A wide range of forecasting methods available depending on these characteristics of the data (Hoshmand, 2010: 19). To create a forecasting model with such diverse characteristics, several methods have been developed (Makridakis et al., 1998: 8). Armstrong (2001: 9) published forecasting methodology tree in 2001. As shown in Figure 14, this methodology tree revised, extended and classified with represent to possible types of forecasting methods and presented their relations until today by Armstrong and Green (2014). These methods are majorly grouped into two major categories as qualitative and quantitative which are explained below.

Figure 14. Methodology Tree of Forecasting Methods



Source: Armstrong and Green, 2014

3.2.1. Qualitative Forecasting Methods

Qualitative forecasting methods depend on judgmental assessments. They accumulated knowledge and provide judgmental forecasts and insights to forecasters. These methods used when there are no available or sufficient data. Moreover, qualitative forecasting methods can be employed singly or in unified with the quantitative forecasting methods (Makridakis et al., 1998: 12). Access to the up to date information and domain knowledge are the advantages of the qualitative approach (Hyndman and Athanasopoulos, 2018). However, there are some limitations as influencing by biases such as favoring the desired outcome (Armstrong, 2001: 7). To overcome limitations, systematic and well-structured approaches should be considered (Hyndman and Athanasopoulos, 2018).

3.2.1.1. Classification

Chambers et al., (1971) summarizes qualitative forecasting methods and presents their accuracies at time horizons, and applications and limitations. Nevertheless, Hyndman and Athanasopoulos (2018) suggest that when the data available, quantitative methods should be preferred and used as a starting point. Some of the qualitative forecasting methods as “Intentions Survey”, “Expert Opinion”, “Delphi method”, “Jury of Executive Opinion”, “Focus Group”, “Judgmental Bootstrapping”, “Role Playing” will be explained in the following section.

3.2.1.2. Principles

- **Intentions Survey Method**

″Intentions are the measures of individuals′ plans, goals, or expectations about what they will do in the future and often used to forecast what people will do in the future.″ (Armstrong, 2001: 33). ″The Intentions Survey″ method accepts the quantifiable relationship between goals and real behavior in the future (Frechtling, 2001: 227). This method is generally used for measuring customers′ purchase intentions to forecast sales (Armstrong, 2001: 33). Mail-in questionnaires, online feedbacks, telephone calls, personal interviews are tools for collecting data (Kurtz, 2016: 362). Communicating with the actual purchaser is the advantage of this method (Frechtling, 2001: 227). However, because of the biases as overstating or understating, this method has accuracy issues (Armstrong, 2001: 34). The intentions survey method is preferred for tracking and informing as well (Chambers, 1971). Hence, it is suggested that intentions predict behavior only if they are steady and if it is implemented under the persons′ control (Frechtling, 2001: 47).

- **Expert opinion**

Expert opinion is a method that the experts' value and the opinions are taken into consideration to create forecasts (Franses & McAleer, 2009: 334). The most commonly used methods in this approach are the Delphi technique, the jury of executive opinion, sales force composite forecasts, and focus group or panel consensus (Hoshmand, 2010: 18).

- **Delphi Method**

RAND Corporation developed The Delphi method in 1963 as a forecasting method (Hoshmand, 2010: 18). This method systematically collects the judgments of experts with a series of questionnaires (Makridakis et al., 1998: 595). Respondent anonymity, iteration, and controlled feedback, statistical group response are the characteristics of the method (Frechtling, 2001: 217). At the beginning of the Delphi method, experts are selected. At this point, the quality of the forecast heavily depends on this stage, because of the number and the know-how of the experts, and willingness of the participating experts. Then questions should be clearly and unambiguously addressed to the experts. Background information could be provided to experts. After collecting the answers the other rounds are asked to reconsider their forecasts. Finally, results are presented. This method has an accuracy advantage according to other qualitative methods. However, this method also sensitive to the judges' expertise and clarity of the case (Frechtling, 2001: 218) and it is most appropriate to forecast a long horizon (Kurtz, 2016: 362).

- **Jury of Executive Opinion Method**

In a jury of executive opinion method, expert opinion are generated by experts that are executives in their organizations (Makridakis et al., 1998: 521). The jury of executive opinion method is quick and inexpensive and suitable for forecasting short-horizon (Kurtz, 2016: 362). This method is certainly more beneficial than a single forecast. However, the bias problem, hidden agendas, and organizational problems should be considered (Webby et al., 2002: 400). Similarly, sales force composite offers forecasts based on the organizations' members that are closest to the marketplace. The belief behind this method is that the closest member of the marketplace gives the best insights. This method generally develops short term forecasts and has some weaknesses as making conservative estimates and addicting perspectives of the sales force (Kurtz, 2016: 362).

- **Focus Group**

A Focus group as a forecasting method relies on the idea that several experts perform better accuracy than the one expert. A group of experts states their forecast in group meetings to reach an agreement. In this method there is no confidentiality and communication is encouraged. However, forecasts sometimes may not reflect a true agreement (Chambers et al., 1971).

As mentioned above, the main problem of expert opinion method is reliability. To strengthen the reliability of the experts' forecast "judgmental bootstrapping" methods could be adapted. This method is a type of expert model that the forecasts of the experts are examined. The judgmental bootstrapping method functions as follows: First, expert opinions are collected. Then, a regression model is developed using their opinions and the inputs they used. In this way, consistent forecasts are obtained. However, this method seldomly used because of the forecasters' overconfidence.

"Role-playing" is a forecasting method that people play roles and their judgments used as a forecast. This method offers a realistic simulation of the interactions between contradictory ideas. When two contradictory ideas emerge the large changes, this method is effective for forecasting. In this method, a decision-making situation should be simulated as similar as possible by the following literality in casting, role instructions, situation description, and session administration. Role-playing could result in a more accurate forecast than the alternative forecasts (expert opinion) especially for predicting decision making where two groups involved (Armstrong, 2001: 13).

3.2.2. Quantitative Forecasting Methods

Quantitative forecasting methods are grounded on the assumption of available past data, quantified data and data pattern that will sustain in the future (Sharma, 2014: 548). Quantitative forecasting methods have been studied and applied for years and have an important place in decision-making processes (Chase, 2013: 87).

3.2.2.1. Classification

Quantitative forecasting methods are classified into two as "causal" and "time series methods" (Archer, 1980: 5). Causal methods are constructed when forecasted factors and other factors are closely associated (Chase, 2013: 86). These methods are complex forecasting methods and express relationships mathematically (Chamber et al., 1971). Causal methods also provide defining causes of the variations (Li and Song, 2007: 6). Chamber et al., (1971) mentioned the economic input-output model, diffusion index, leading indicator, and life cycle analysis as causal methods. Chase (2013: 86) specified simple regression, multiple regression, ARIMAX, and unobserved components model. Lawrence et al., (2009: 5) pointed out regression techniques, neural networks, input-output models, disaggregated models. Georgoff and Murdick (1986) classified causal methods as correlation methods, regression methods, leading indicators, econometric models and input-output models. Schroeder and Goldstein (2018: 200) added simulation methods into Georgoff and Murdick′s classification.

Time-series methods are constructed when future observations will replicate past observations. Naïve, moving average, exponential smoothing, decomposition, ARIMA models are the classes of time series methods (Chase, 2013: 84). Time-series methods will be explained in the following section in detail.

Armstrong and Green (2014) grouped quantitative forecasting into two as univariate and multivariate. Univariate forecasts are based on the one dimensional collected data, while multivariate forecasts based on more than one variable collected data (Palit and Popovic, 2006: 50). Multivariate forecasts are more complex and difficult models to implement (Chatfield, 2000: 185).

3.2.2.2. Principles

- **Causal Methods**

Causal methods are included in statistics courses that these methods present familiarity with the managers. These methods are more accurate while forecasting in the short and medium-term and they support what-if analysis. However, these methods depend on the relationships between the variables, accuracy is also depending on the independent variables. Time, data storage, strong statistics knowledge requirement and expensiveness of the building and maintaining the models are the limitations of causal methods (Chase, 2013: 87).

Basic components of time series are trend, seasonality, cyclical variation and random or irregular variation. The trend is a long term change of time series that may be upward, downward or steady. Seasonality is regarded as iterative fluctuations that happen within a specific period. Cyclical variation is the movement over an extended period that varies from 3 to 15 years. Random variation is the movement that is not explained by the trend, seasonal and cyclical variations (Hoshmand, 2009: 60).

- **Time Series Methods**

Time-series methods are good at stable demand forecasts and short term forecasting. These methods can smooth small random fluctuations and they are also simple to use and understand and inexpensive to apply and store. However, time-series need a large amount of data and vulnerable to large fluctuations and long term forecasts (Chase, 2013: 86).

In this dissertation, used methods are considered under the multivariate time series models due to the usage of time series data. However, used models also (ARIMAX, neural networks) can be grouped under the causal forecasting methods as mentioned before.

3.3. TIME SERIES FORECASTING METHODS

Time series is a collection of observations taken consecutively which can be regularly or irregularly frequented. These observations can be numbers, labels, colors, and several other subjects. Moreover, time also can be discrete or continuous (Palma, 2016: 1). Time series analysis aims to describe, explain, predict and control some mechanisms (Chatfield, 2000: 6). When the future values of the time series have been predicted exactly with the past observations, this time series called a "deterministic time series". However, time series are generally "stochastic" in that exact predictions are impossible with the past observations and only partly explained by the past observations followed by the idea that future values have probability distribution (Chatfield, 2003: 5). Time series are used to comprehend the dynamics of a system (Bisgaard and Kulahcı, 2011: 1) which can be called as describing and explaining the system (Chatfield, 2003: 6) and to produce forecasts on its future situation (Bisgaard and Kulahcı, 2011: 1).

Formal time series models are grounded on the probability theory and time series are considered as a realization of the stochastic process (Kirchgässner and

Wolter, 2007: 12-14). “*Time series can be defined as a stochastic process which includes the value of a variable spread over time.*” (IJSMI, 2019). An important feature of time series is stationarity which is corresponding moments of the stochastic process (Kirchgässner and Wolter, 2007: 12-14). Therefore, autocorrelations that are described as internal correlations within the time series are useful in identifying the periodic patterns (Mills, 2019: 2).

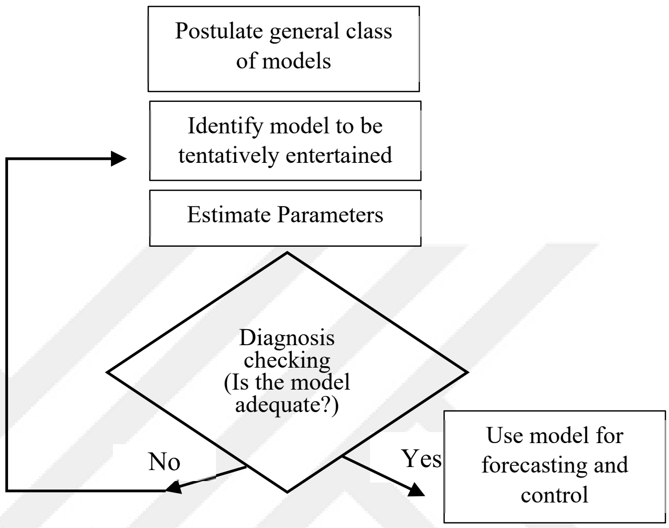
There are different time series methods as *“moving averages”, “exponential smoothing”, “autoregressive moving averages”, “autoregressive integrated moving averages”, “autoregressive conditionally heteroscedasticity”, “vector auto regression”, “spectral analysis”, “Kalman filtering”, “neural network”, “deep learning network”, “Bayesian time series models”* (IJSMI, 2019). In this dissertation, ARIMA and neural network methods will be considered and explained in the following sections.

3.3.1. Forecasting Using the Box-Jenkins Method

“Autoregressive integrated moving average models” were introduced in the 1990s and known with the studies of George Box and Gwilym Jenkins in the 1970s (Chase, 2013: 203). Time Series Analysis: Forecasting and Control by Box & Jenkins (1970, 1976) had a great impact on time series analysis and forecasting theory and applications (De Gooijer and Hyndman, 2006:5). ARIMA models represent a flexible class of models (Montgomery et al., 2015: 399). Box and Jenkins have developed general forecasting methodology (Palit and Popovic: 2006: 53) and provide a comprehensive approach to understand and use of ARIMA models (Chase, 2013: 203). This methodology develops forecasts based on historical patterns in data without initially adopting a fixed order (Hoshmand, 2010: 271). They offer an iterative three-stage approach as presented in Figure 15; identification, estimation, and diagnosis checking for time series forecasting models. At first, suitable models which interacted with the theory and practice are considered. Then, between the considered models' subclasses are identified (Box and Jenkins, 1976: 19). In that stage data preparation, which includes data transformation and stationarity of the series, and model selection, which includes data examination and identification of potential models, are applied

(Makridakis et al., 1998: 314). In the estimation stage, model parameters are estimated. Verification of the model is applied. If there is a lack of fit this cycle is repeated, while if there is not any inadequacy the identified model is used (Box and Jenkins, 1976: 19).

Figure 15. Stages in The Iterative Approach to The Time Series Forecasting Models



Source: Box and Jenkins (1976:19)

Box and Jenkins methodology proposes that one of the below mentioned three model categories are expected to fit into the pattern of any time series:

- Autoregressive (AR): p = order of the autoregressive part.
- Moving average (MA): q = order of the moving average part.
- Combination of both categories—autoregressive moving average (ARMA).

In the following sections, these methods will be explained.

3.3.1.1. Forecasting with Autoregressive (AR) Models

"AR models are the representations of a time series by functions of its lags." (Alexander, 2001: 329). AR function is still a regression function. However, function differs from the explanatory variables which are previous values of the time series (Makridakis et al., 1998: 335). The mathematical representation of the AR model is shown in Equation (3) (Makridakis et al., 1998: 335):

$$y_t = c + \varphi_1 y_{t-1} + \varphi_2 y_{t-2} + \cdots + \varphi_p y_{t-p} + e_t \tag{3}$$

y_t	series at a time period
p	order of the autoregressive part
φ_p	the regular AR polynomial of order p
e_t	errors at a time period
c	constant

3.3.1.2. Forecasting with Moving Average (MA) Models

MA models are the connections with the current value of the time series to previous periods' random errors (Hoshmand, 2010: 273). MA models represent the relationship between time series and successive error terms (Frechtling, 2001: 123). MA models could also have different orders as AR models (Hoshmand, 2010: 273). The mathematical representation of the MA model is shown in Equation (Makridakis et al., 1998: 335):

$$y_t = c + \theta_1 e_{t-1} + \theta_2 e_{t-2} + \cdots + \theta_q e_{t-q} + e_t \tag{4}$$

y_t	series at a time period
q	order of the moving average part;
θ_q	the regular MA polynomial of order q
et	errors at a time period
c	constant

3.3.1.3. Autoregressive Integrated Moving Average (ARIMA) Models

The combination of AR models and MA models produces the ARMA models which are the most known method to estimate stationary irregular or seasonal patterns in time series (Kočenda and Černý,2015: 23). This means ARIMA models combine past values and past errors (Hoshmand, 2010: 273). However, ARMA models are used only time series is stationary (Kočenda and Černý,2015: 23). These models are widened to non-stationary series with differencing series. This is called the autoregressive integrated moving average or ARIMA models (Makridakis et al., 1998: 336). ARIMA (p,d,q) model, described mathematically as equation (5) (Hyndman and Athanasopoulos, 2018: 235):

$$y'_t = c + \varphi_1 y'_{t-1} + \cdots + \varphi_p y'_{t-p} + \theta_1 \varepsilon_{t-1} + \cdots + \theta_q \varepsilon_{t-q} + \varepsilon_t \qquad (5)$$

y'_t	the differenced series at a time period
p	order of the autoregressive part;
d	degree of first differencing involved
q	order of the moving average part
ε_t	errors at a time period
θ_q	the regular MA polynomial of order q
φp	the regular AR polynomial of order p
c	constant

ARIMA models have the ability to handle most types of data set and generally have better accuracy than most of the time series methods. ARIMA can also model trend/cycle, seasonality, and explanatory variables as well as reduces the number of explanatory variables while sustaining higher accuracy (Chase, 2013: 226,236). However, ARIMA models need more data, and it is complex to systematize and use (Chase, 2013: 226,236). ARIMA models are preferred especially in short term forecasting (Wang and Jain, 2003: 174)

To improve the accuracy of the models, explanatory variables included the ARIMA models, when there needs to be additional information into modeling the forecast. It is called the ARIMAX, ARIMA model with exogenous variables (Chase, 2003: 226). This model simply includes explanatory variable and mathematical representation is shown as following equation (6) (composed from Hyndman, 2010):

$$y'_t = \beta x'_t + c + \varphi_1 y'_{t-1} + \cdots + \varphi_p y'_{t-p} + \theta_1 \varepsilon_{t-1} + \cdots + \theta_q \varepsilon_{t-q} + \varepsilon_t \qquad (6)$$

y'_t	the differenced series at a time period
p	order of the autoregressive part;
d	degree of first differencing involved
q	order of the moving average part
ε_t	errors at a time period
θ_q	the regular MA polynomial of order q
Φp	the regular AR polynomial of order p
c	Constant
x'_t	the differenced explanatory variable at time t
β	coefficient of the explanatory variable

As mentioned above seasonality component also creates the need for extension of the ARIMA method. ARIMA depends on serial dependency and in some situations, serial dependency may be cyclical which is contains seasonality (Suen and Ary, 1989:

217). A seasonal ARIMA model includes the additional seasonal terms in the ARIMA model which is called SARIMA. "*The SARIMA (p, d, q) (P, D, Q)s model has six parameters: autoregressive parameters (p), number of differencing passes (d) and moving average parameters (q); seasonal parameters contain seasonal autoregressive (P), seasonal differencing (D), and seasonal moving average parameters (Q); s is for the length of the seasonal period*" (Fu et al. 2018:121). Mathematical representation of SARIMA as in equation (7) (Vagropoulos et al., 2016:2):

$$\varphi_p(B)\Phi_P(B^s)\nabla^d\nabla_s^D y_t = \theta_q(B)\Theta_Q(B^s)\varepsilon_t \tag{7}$$

y_t	series at a time period
φ_p (B)	the regular AR polynomial of order p
$\Phi_P(B^s)$	the seasonal AR polynomial of order P
$\theta_q(B)$	is the regular MA polynomial of order q
$\Theta_Q(B^s)$	is the seasonal MA polynomial of order Q
∇d	the seasonal differentiating operator
$\nabla^D{}_s$	eliminate the non-seasonal and seasonal non-stationarity, respectively
B	the backshift operator
s	seasonal period
ε_t	errors at a time period

To increase forecasting performance and exogenous variables included in the SARIMA model which called SARIMAX. SARIMAX generally expressed mathematically as in equation (8) (Vagropoulos et al., 2016:2):

$$\varphi_p(B)\Phi_P(B^s)\nabla^d\nabla_s^D y_t = \beta_k x_{k,t}{}' + \theta_q(B)\Theta_Q(B^s)\varepsilon_t \tag{8}$$

y_t	series at time period
$\varphi_p(B)$	the regular AR polynomial of order p
$\Phi_P(B^s)$	the seasonal AR polynomial of order P
$\theta_q(B)$	is the regular MA polynomial of order q
$\Theta_Q(B^s)$	is the seasonal MA polynomial of order Q
∇^d	the seasonal differentiating operator
∇_s^D	eliminate the non-seasonal and seasonal non-stationarity, respectively
B	the backshift operator
s	seasonal period
ε_t	errors at time period
$x_{k,t}$	the vector including the k^{th} explanatory input variables at time t
β^k	the coefficient value of the k^{th} exogenous input variable

Within the scope of this dissertation, above mentioned ARMA models are used. Therefore, these are investigated in detail. Except for these extensions, there are also several extensions' of ARMA models. Fractionally integrated ARMA model (ARFIMA) refers to the integration parameter composed of the non-integer values. Impact ARIMA model is preferred to study the effect of an event. Vector ARMA model (VARMA) is the multivariate extension of the ARMA model. VARMAX is the VARMA process with exogenous variables. ARMAX is also a special type of VARMAX model. Conditional Heteroscedastic Autoregressive (ARCH) Models which indicate the prediction of the variance of the endogenous variable based on historical data. Threshold Autoregressive (TAR) Model, Markov Switching Autoregressive (MSAR) Model which are non-linear models based on switching regime triggered by AR process and hidden discrete Markov process relatively (Hamaker and Dolan, 2009: 191-217).

3.3.2. Forecasting using the Artificial Neural Networks

ANN are computing methods for analyzing data and generating models that reveal the patterns and structures in data. ANN are useful for various outcomes and used many different fields as predicting future issues, classifying of data and clustering data (Smith and Gupta, 2000: 1). They are widely accepted powerful tools. The reason behind this acceptance is the capability of handling enormous computational effort Palit and Popovic, 2006: 80).

ANN-based models are known as useful methods for time series forecasting that can model non-linear structure (Yolcu, 2013: 1340). The ANN-based model has been catching on across a wide range of disciplines. Having rich parameters, non - linear and flexible nature are advantages of ANN-based models. However, over-fitting, selection of appropriate parameters and assessing these parameters' significance are the major problems of ANN-based models (Mills, 2019: 188, 189).

While forecasting with ANN-based models, data preparation, network architecture determination, network training strategy, and overall evaluation steps are followed. First data are preprocessed, normalized and structured. The adequate sample size is determined, data filtering, data smoothing, data transformation, missing data imputation are considered if necessary. Then, data normalized which shaped data from the natural range to the operating range. Data also structured while multivariate data is used. Moreover, training, validation and test sets of the data are determined (Palit and Popovic, 2006: 105-111).

Second, the network architecture is tried to be built optimally with determining the required input, output nodes, and interconnection pattern, and selecting the number of hidden layers, neurons, and activation function. After determining network architecture, a training strategy is developed. Poorly developed training strategy resulted in the network overtraining or network overfitting. Various approaches as cross-validation and network structure reduction have been proposed to overcome these problems. At last, network parameters tuned and if necessary modifications are made. (Palit and Popovic, 2006: 112-129).

3.3.2.1. Basic Architecture of Neural Networks

Artificial neural networks are the mathematical interventions that stimulate the mechanism of learning in biological organisms (Aggarwal, 2018: 1). Perceptron is a simple algorithm outputs either 1 (yes) or 0 (no) that uses following threshold function (9) (Gulli and Sujit, 2017:11):

$$f(net) = \begin{cases} 1 & net > 0 \\ 0 & otherwise \end{cases} \tag{9}$$

Perceptron is a simple single layer as shown in the function (10). When the weights of the neuron changed, the network is also varying. The information does not flow between the internal neurons (Wang et al., 2010:616).

$$\text{yj} = \begin{cases} 1, & if \ \sum_{i=1}^{n} x_{\text{i}}\, \omega_{\text{ij}} \ \geq \theta_{\text{j}} \\ 0, & x \ \ otherwise \end{cases} \tag{10}$$

ω	vector of weights
n	n neurons and n inputs x1,x2,...,xn
w_{ij}	the weight of the i^{th} input about the j^{th} neuron
θ_j	is the threshold value of the j^{th} neuron
y_j	the output of the neuron

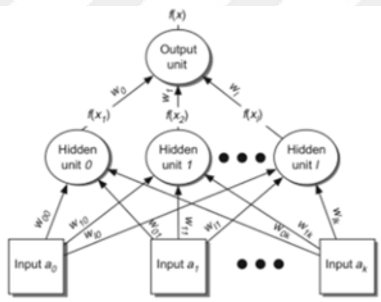
ANN is defined by four parameters as the type of neuron, connectionist architecture, learning algorithm and recall algorithm. The neuron is the basic processing unit that processes inputs and generates an output in terms of the activation function (Du and Swamy, 2013: 5). Architecture is the connection structure of the neurons. Connectionist architecture diversified in terms of used number of input, output neurons and hidden layers as auto-associative architecture that have the same input neurons and output neurons, and heteroassociative architecture that have separate input and output neurons as MLP. Moreover, the direction of the connections reveals feedforward and feedback architecture. Feedforward architecture does not have links back from the output neurons to the input neurons, while feedback architecture has links back from the output neurons. (Shanmuganathan, 2016: 7). The learning algorithm is the rules for estimating appropriate weights and parameters of neural networks. Learning algorithms are divided into three as supervised, unsupervised and reinforcement learning (Du and Swamy, 2013: 15). "*Supervised learning is a closed-loop feedback system*" (Du and Swamy, 2013: 1) that training examples consist of inputs and desired outputs. Unsupervised learning has only inputs (Shanmuganathan, 2016: 8) and involves no target values. Unsupervised learning is grounded on the correlations among the input data and tries to explore patterns or features in input data. Reinforcement learning is a type of supervised learning. However, the desired output is unknown. The reinforcement learning procedure rewards the good outputs while punishing for the poor outputs (Du and Swamy, 2013: 16-18). Recall algorithm is the process that learned knowledge is extracted from the network (Shanmuganathan, 2016: 8).

Palit and Popovic (2006) mentioned MLP, Radial Basis Function Networks, Recurrent Networks, Counter Propagation Networks, Probabilistic Neural Networks as networks used for forecasting. In this dissertation, only MLP, RNN, LSTM and NARX, which are used methods to develop models in Chapter 4, will be explained in detail.

3.3.2.2. Multilayer Perceptron Networks

Multilayer perceptron (MLP) is the most recognized and applied ANN structure (Zhang et al., 1998: 37). An MLP illustrated in Figure 16 consists of the input layer and output layer that are linked with the intermediate hidden layers (Palit and Popovic, 2006:84). Each neuron linked to all neurons and signals only distributed to the feed-forward direction (Yang et al., 2016: 70). The activation function manages the dependencies between the elements of each layer (Mills, 2019: 188). Input-output mapping of one hidden layer and non-linearity is achieved by the multilayer perceptron (Palit and Popovic, 2006: 84).

Figure 16. Multilayer Perceptron Network



Source: Witten et al., 2016: 267

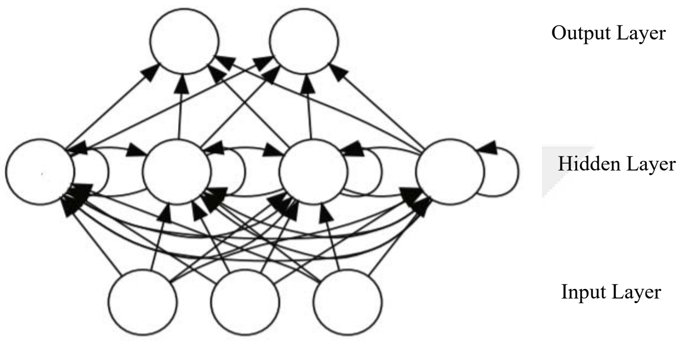
MLP can be expressed in the following equation (11), where x is the input of the neuron, w is the weight on each connection to the neuron, b is the bias and $f\ (\ldots)$ is the activation function (Gensler et al., 2016: 2).

$$output = f(\textstyle\sum_i^{inputs}(x_i\ .\ \omega_i\ +\ b_i)) \qquad (11)$$

3.3.2.3. Recurrent Neural Networks- Long Short-Term Memory

MLP does not contain any cycles and the output only based on the current input (Witten et al., 2016: 241). RNN structures have incorporated this dependence (Gulli and Pal, 2017: 175) and can map from the entire history of previous inputs to each output as shown in Figure 17 (Graves, 2012: 22). RNN is also designed to process sequential or time-varying patterns (Medsker and Jain, 2001: 1). RNN is time-stamped networks that weights are shared between different layers (Aggarwal, 2018: 310). While MLP does not present the effect of previous inputs, RNN achieved creating this effect (Aggarwal, 2018: 39).

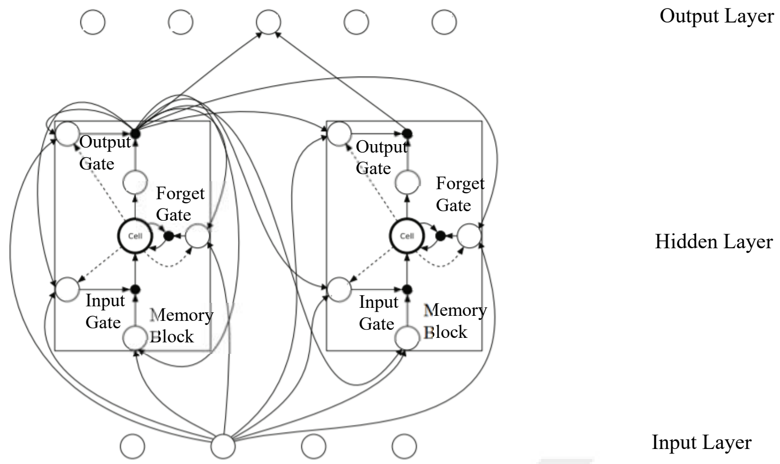
Figure 17. A Recurrent Neural Network



Source: Graves, 2012:22

However, standard RNN has vanishing gradient problem that results with the exponential degenerations of the input as it cycles around the network's recurrent connections. LSTM networks solve that problem (Graves, 2012: 37) and specify the concept of gates and a memory cell in each hidden layer (Zheng et al., 2017:3). LSTM is a redesign of RNN architecture around special 'memory cell' units (Graves, 2012: 1). An LSTM network is illustrated in Figure 18. The input, the output and forget gates are in each memory block and provide similar operations like writing, reading and resetting for the cell (Graves, 2012: 38).

Figure 18. An LSTM Network



Source: Graves, 2012: 40

3.3.2.4. Nonlinear Autoregressive Exogenous Model

The NARX model is a recurrent dynamic network that is based on the linear ARX model (Mathworks, 2019). "*NARX neural network model is a combination of multilayer feed-forward neural network (MLP), recurrent neural network (RNN) and time delay neural network*" (Mitrea, 2009:67). The mathematical equation (12) for the NARX is shown as following, where y_t is the series at the period (output variable), $f(..)$ nonlinear feedforward neural network and x_t is the explanatory input variables.

$$y_t = f(y_{t-1}, y_{t-2}, \dots \dots . y_{t-n}, x_{t-1}, x_{t-2}, x_{t-n}) \tag{12}$$

3.3.3. Hybrid Forecasting Models

The term hybrid refers to some process of one method integrated into the other method (Hong, 2018). There are several combinations of methods used in time series forecasting to overcome the deficiencies of single models and provide models to be more accurate (Khashei and Bijari, 2012: 4344). Both combinations of traditional methods and computational methods, and combinations of computational methods are presented in the literature (Palit and Popovic, 2006: 133).

Hybrid time series forecasting models have been proposed by several studies. No single model achieves the performing better than other models so that combinations of different forecasting models are offered to develop. Identical forecasting results also cannot be generated due to different orders of models and decisions of different analysts (Palit and Popovic, 2006: 133). In this dissertation hybrid model developed with Zhang's (2003) proposed hybrid methodology approach.

Zhang (2003) proposed that time series to be composed of a linear autocorrelation structure and a nonlinear component as shown in the following equation (13) where L_t denotes the linear component and N_t denotes the nonlinear component:

$$y_t = L_t + N_t \tag{13}$$

The hybrid methodology consists of two steps. First ARIMA models are used to analyze the linear component. Then, the neural network model is used to model the residuals from ARIMA models.

The first linear model has to be estimated, then the residuals of that linear model contain the only nonlinear relationship. Residual at time t from the linear model is expressed as e_t found with the following equation (14) where $\hat{L}_t$ is the forecast value for time *t* from the estimated relationship.

$$e_t = y_t - \hat{L}_t \tag{14}$$

With *n* input nodes, the ANN model for the residuals are modeled as following equation (15) where *f* is a nonlinear function determined by the neural network and ε_t is the random error

$$\hat{N} = f(e_{t-1}, e_{t-2}, e_{t-3}, \ldots\ldots e_{t-n}) + \varepsilon_t \tag{15}$$

Therefore, the correct model identification is critical and the combined forecast is as shown in the equation (16)

$$\hat{y}_t = \hat{L}t + \hat{N}_t \tag{16}$$

3.4. EVALUATING FORECASTING METHODS

The choice of selecting a forecasting method depends on the objective of the forecast, specifics of the situation and formal statistical criteria (Hoshmand, 2010: 17). Explanatory models are preferred when the objective of the forecast is understanding better the factors influencing the forecast variable. Forecasting methods have been selected according to the time horizon, cost, level of complexity. Characteristics of the time series data as seasonality, trend, randomness, and cyclicality; type of the data as monthly, yearly, daily; number and frequency of the forecasts are the reasons for the selecting different forecasting models as well (Makridakis et al., 1998: 534-537).

Armstrong (2001, 373-375) offered some general principles selecting forecasting methods as; using structured methods rather than unstructured methods, using quantitative methods rather than qualitative methods, using the good structure and simple causal models rather than naïve methods, using simple methods rather than complex methods and using method that is matching with the forecasting objective.

Good forecasts depend on the principle of parsimony that refers to simple models that are preferred over complex models when all other things equal (Hoshmand, 2010: 17). Accurate forecasts are the results of studying the past and knowing the presence while poor forecasts are the results of unsophisticated methods and untrained forecasters (Makridakis et al., 1998: 564,572). Makridakis et al., (1998) also offered some other strategies to get better forecasts as keeping the forecasting horizon short, using various accuracy measures, and using a combination of the forecasts.

All forms of forecasting methods have some prerequisites both qualitative and quantitative methods (Chase, 2013: 88). Table 14 shows the characteristics of three major types in terms of preferability. Qualitative forecasts depend on forecasters' judgment that causes a subjective approach (Hoshmand, 2010: 19) and they are preferred when there has been not collected any historical data (Frechtling, 2001: 20).

Table 14. The Applicable Situations for Different Types of Forecasting Models

Method Type	Applicable Situations	Horizon	Data Types
Qualitative Methods	No past data, no ideas about causality, data too costly to collect, short-run accuracy not required	Either long-run or short-run	Background information, survey
Time Series Methods	Historical time series data available, stable patterns exist, short-run accuracy needed	Short-run	Time series data
Causal Methods	Past data available, a causal relationship is clear and stable, explanatory variables are controllable	Short-run	Response and explanatory data

Source: Wang and Chaovalitwongse, 2010: 7

In terms of quantitative forecasting methods, econometric models were not present better forecast performance than alternative forecasting methods. Moreover, multivariate methods, nonlinear methods, and ANN-based methods also do not show superior performance that research findings do not present agreement on forecasting methods (Makridakis, 1998: 523:526). Table 15 presents the characteristics of the ARIMA and ANN models.

Table 15. Comparison between ARIMA and MLP Models

ARIMA	Neural Networks (MLP)
Linear model: assumes a priori behavior of the time series	Non-linear model: more degrees of freedom for the model
Modeling requires the series to be stationary	Any time series can be analyzed
Requires interaction with the user	Requires fewer interactions with the user
The model provides insight and information through its parameters	Difficult to interpret the model (black box)
No overfitting	Overfitting is possible

Source: Aburto and Weber, 2007: 140

In this dissertation, quantitative methods will be used. ARIMA, ANN-based models and hybrid models will be benchmarked in Chapter 4. One of the reasons for selecting these methods is that the literature review on performances of ARIMA and ANN models has resulted in different accuracies and needs for further study (Adebiyi et al., 2014: 2). Another reason is the further research suggestions of Chan et al. (2019). They benchmarked the time series forecasting methods which include MA, MARS, ARIMA, the Grey Model, ANN, and SVM for forecasting container throughput. They found that SVM model outperforms than the benchmarked models. The authors suggested further research by including more input data to increase the accuracy of the forecast. This dissertation investigates the ARIMA, ANN and hybrid models with more input data. Recently, these methods are preferred in industrial marketing literature as well. Kumar et al., (2019) developed time series models using fuzzy neural networks and compared it with ARIMA, MLR, Random Forest, SVM, and ANN models. They found ANN performed better than ARIMA and SVM. It is appeared that more empirical evidences of these methods are needed in industrial marketing literature.

3.5. FORECASTING ERROR MEASURES FOR FORECASTING MODELS

In terms of evaluating forecasting models, accuracy and bias are considered. Accuracy is the distance between the forecasted and actual values. Forecasting accuracy is measured with forecast error measures. The bias of forecast is concerned when errors are significantly large in one direction (Wang and Chaoyalitwongse, 2010: 7).

Forecasting errors of the models have been affecting by size or volume of the forecasts, aggregation of data, demand stability, competitiveness of the environment patterns and relationships in the data. Large data volume and more aggregated data and stabile demand for forecasted items or issues result in more accurate forecasting models. Furthermore, less competitive environments are yield more accurate forecasts (Chase, 2013: 89-93).

Measuring the forecasting errors concludes the accuracy of the forecasting methods (Armstrong and Collopy, 1992: 69). Accuracy is a vital part of selecting and testing a forecast model (Mahmoud, 1984: 139). It is a part of the validation process of the forecasting model (Montgomery et al., 2015: 65). The literature consists of several accuracy measures (Hyndman and Koehler, 2006: 3). Hyndman and Koehler (2006: 3-12) classified measures of forecasting error into four as scale-dependent measures, measures based on percentage errors, relative measures, and relative errors.

Scale-dependent errors based on the scale of the dataset. These error measures are useful for comparing the same dataset and inappropriate while comparing different scaled datasets. MSE, RMSE, MAE, and MdAE are the most commonly used scale-dependent error measures. Percentage error is defined as forecast error multiplied by a hundred and divided to observations at time t. Percentage error measures provide comparing models from different datasets. MAPE, MdAPE, RMSPE, RMdSPE are the most commonly used percentage error measures. The relative error is also used as a measure that refers to dividing each error by the error obtained using another standard method of forecasting. MRAE, MdRAE, and GMRAE are listed as measures based on relative errors. Relative errors are used as a measure as well. The relative measure is calculated as dividing benchmarked models measures to each other (Hyndman and Koehler, 2006: 3-11).

Several studies are conducted regarding best accuracy measures (e.g. Armstrong and Collopy, 1992; Makridakis, 1993; Hyndman and Koehler, 2006). In this dissertation, RMSE and MAPE will be used as error measures to get the accuracy of the forecasting models. Therefore, both scale-dependent and percentage errors will be collected. RMSE will provide comparing the forecasting models accuracies and MAPE will help to explain the accuracies simply and understandably with revealing information with percentages.

CHAPTER FOUR
RESEARCH ON MODELLING AND FORECASTING DOMESTIC DRY CARGO SHIPPING

This part is the empirical part of this dissertation that is composed of three sections. The first one includes the forecasts for the domestic dry cargo shipping market demand with a model of the Black Sea ports of Turkey. It starts with the preliminary research and review of the market environment. Then, current domestic dry cargo shipping market demand at the Black Sea (Turkey) is presented. Finally, forecast models of dry cargoes cement, copper, steel, and iron are developed and the methods used are benchmarked. The second part covers the application of a qualitative study which aims to identify domestic dry cargo shipping variables and reveal current trends. The third section constitutes the results of a quantitative field study. This part reveals the relationships between demand variables of domestic dry cargo shipping and presents the domestic dry cargo shipping demand model.

4.1. SUBJECT OF THE RESEARCH

Shipping demand has complex dynamics due to the nature of industrial markets. Derived, volatile and discontinuous demand characteristics are observed in the shipping industry. Therefore, to catch a balance between supply and demand, market information and market forecasts have gained importance in the shipping industry. Identifying demand accurately and taking the right reactions to the demand have the utmost importance to ensure the success and survival of the shipping companies. Any discontinuous demand increases in shipping lead shipowners to invest in new ships. This can cause overcapacity problems. Moreover, investment plans of governments, environmental regulations, national policies, and regulations, etc. directly influence the demand for shipping. To avoid the effects of supply and demand imbalances, shipping companies should have market information continually and perform the market demand forecasts. Accurate forecast of the domestic dry cargo shipping market could provide an increase in the productivity of the resources used by maritime businesses, provide market intelligence for the strategic marketing plan, increase the efficiency of the marketing efforts and overcome the severe competition.

In this dissertation domestic dry cargo shipping market demand is identified and related demand variables are explored. Demand forecast models for future dry cargo volumes are compared and proposed.

4.2. AIM AND SCOPE OF THE RESEARCH

This study aims to describe the domestic dry cargo shipping market, determine the demand variables of the domestic dry cargo shipping market, reveal relationships between these variables and establish a model for forecasting future cargo volumes. Table 16 presents the objectives, methods and summarized analysis of each step of this dissertation.

The sub-objectives in line with this aim can be listed as follows:

Several methods are proposed and used while forecasting demand in the shipping industry. However, there is a continuing debate on accurate forecasting models. Most of the developed models are considered only for specific ports. This dissertation aims to propose an accurate ex-post forecasting model for a specific region. Black Sea region of Turkey is selected as the area of application for this ex-post forecasting. Within this context, types of dry cargoes, which are handled most in terms of cargo volume in the region are chosen. To develop forecasts for the market, models are developed by using ARMAX, MLP, LSTM, NARX and hybrid model. These models are benchmarked and accurate models are presented.

To determine the demand variables and describe the domestic dry cargo shipping market, a qualitative study is carried out. In this step, additional macro external – micro external and company variables that are not used while developing the forecasting models are investigated. It is aimed to reveal the importance and relationships of these variables from the perspective of demand and supply side of the industry. Domestic dry cargo shipping market environment, current issues, future projections, weaknesses and competitive power of the industry are enlightened through the help of this study.

Table 16. Objectives, Methods, Analysis and Sample of the Research Steps

Aim	Method	Analysis	Sample
Identifying the demand variables in industrial marketing and shipping.	Literature Review	Industrial marketing literature and shipping forecast literature are reviewed and related variables are determined. Determining variables are used in both domestic dry cargo shipping forecasts and developing questionnaire.	“Shipping”, “port”, “dry bulk”, “freight” keywords are used with “forecasting” keyword to reach shipping forecast literature and related journal articles’, proceedings, book and books chapters are investigated. Industrial marketing journals are reviewed with “demand” keyword to reach demand forecast in industrial marketing literature.
Forecasting domestic dry cargo shipping	Forecasting Methods (Quantitative Study)	Ex-post forecasts of domestic dry cargo shipping are modelled with macro variables.	Domestic dry cargo shipping loads at Black Sea ports of Turkey, export, import, industrial production index, exchange rate, cement sales at Black Sea,…
Understanding the determinants of demand for domestic dry cargo shipping and its variables to explore additional variables that have not revealed with the literature review and developing questionnaire	Content Analysis (Qualitative Study)	Codes are inferred from the interviews and analysed with content analysis and MAXQDA Software 18.1.1.	Interviews are realized with the experts selected from the shipping industry as dry cargo shippers, dry cargo shipowners, dry cargo ports, dry cargo ship charterers, agencies.
Identifying the determinants of demand and relationships	Field Study (Quantitative Study)	Statistical analysis, frequencies, means and standard deviations, factor analysis and regression with SPSS 23.0	Actors operating at the domestic dry cargo shipping market in Turkey

Source: Author

A field study is designed to investigate the further the accuracy of the developed forecasting models. One of the objectives of this study is the discussion of forecasted increase in domestic shipping. The aims were set as revealing relationships between demand variables of domestic dry cargo shipping as well as developing domestic dry cargo shipping demand models. As a final objective, offering new model variables by complementing of these findings are aimed.

4.3. METHODOLOGY OF THE STUDY

This part of the dissertation is composed by the analysis and results of the identification and determination of domestic dry cargo shipping demand. Within this context, the scope of the researches, aim and model, qualitative and quantitative methods used, sampling, data collection tools, analysis and the findings will be explained, respectively.

4.3.1. Research Process

As a starting point for this dissertation, preliminary research is carried out to collect the opinions of experts regarding the research aim and scope. Then, the literature review process has been started and this process spread over the entire research process to keep the literature review up to date.

Data Mining Techniques in Statistics course is taken in the 2015-2016 fall term as a guest student from DEU The Graduate School of Natural and Applied Sciences Statistics, Department of Statistics. At the same time, Introduction to Econometrics 1 and Econometrics Seminar courses are taken as a guest student from the DEU Faculty of Economics and Administrative Sciences. In 2015-2016 Spring Term, Introduction to Econometrics 2 course is taken as a guest student from the DEU Faculty of Economics and Administrative Sciences.

During the quantitative study research process, Statistics and Econometrics Camp was attended on 7-16 September 2018 which was supported by TUBITAK 4005. Researches on developing ex-post forecast models for domestic dry cargo shipping were conducted as a visiting researcher at the Department of Industrial Economics and Technology Management, Norwegian University of Science and Technology during 29.10.2018-26-01.2019. Before conducting the qualitative study, Qualitative Paper Development Workshop in Management & Marketing was attended as a participant on 20-21 June 2019 in Eskişehir.

Within the scope of this thesis, a conference paper titled “Forecasting Domestic Shipping Demand of Cement: Comparison of SARIMAX, ANN and Hybrid SARIMAX-ANN” was presented in 2019 4th International Conference on Computer

Science and Engineering (UBMK), Samsun Turkey. An article titled "'Domestic Dry Cargo Shipping Demand of Turkey: A Qualitative Study" has been accepted for publication in DEU Maritime Faculty Journal.

This dissertation consists of a total of four chapters. The first chapter is designed as an introduction to shipping markets that especially explains the domestic dry cargo shipping market. Literature review on shipping forecast is presented and exploration of demand and forecast variables of shipping are deduced. The second chapter investigates industrial marketing and related literature. Demand and forecast variables regarding industrial marketing are examined. The third chapter aims to give a brief understanding of forecasting methods and explains the time series methods in detail. It presents used methods and approaches in this dissertation. Figure 19 illustrates the process of this dissertation including the objectives of each step.

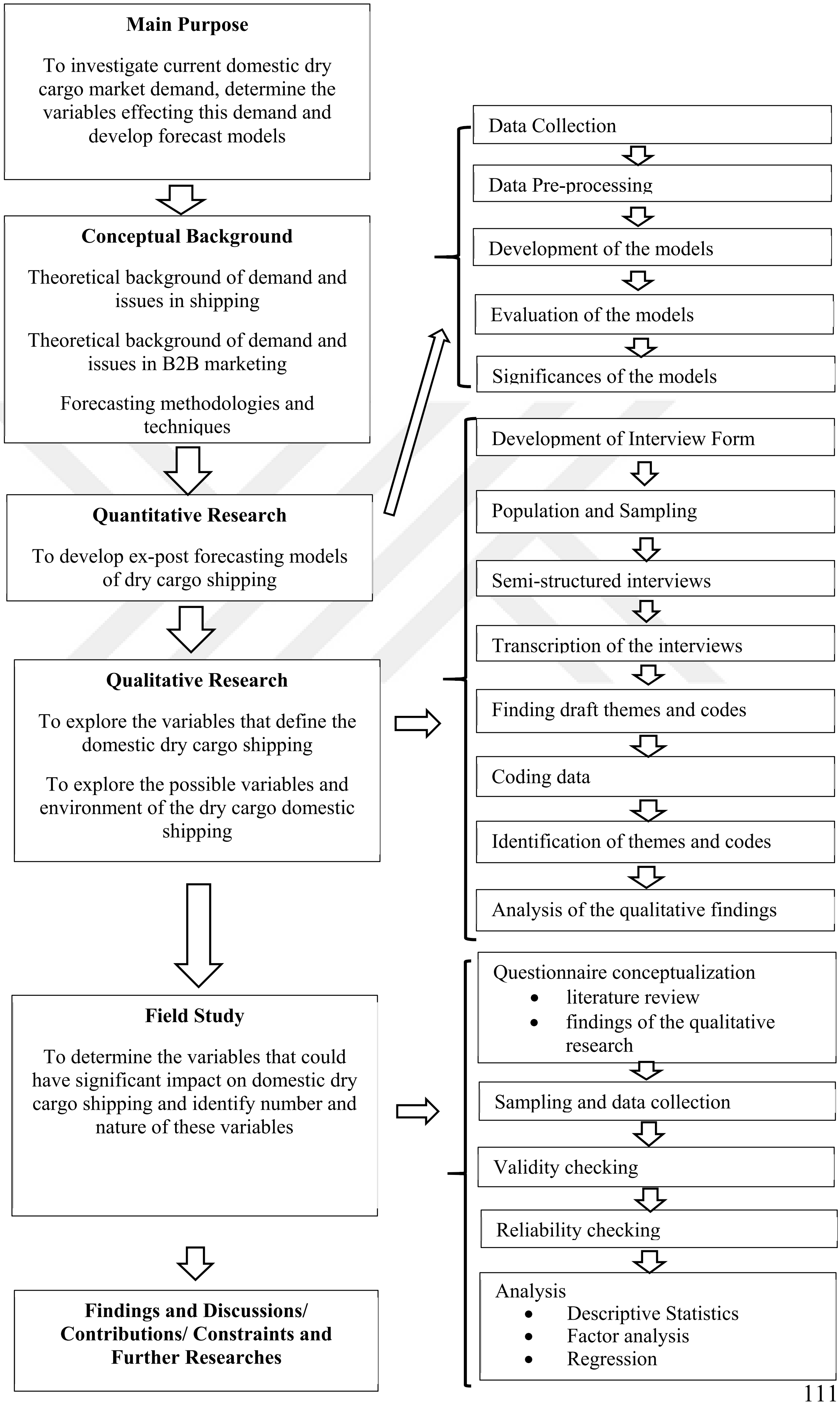
First, research aim and scope is given in the Figure 19.

After completion of the conceptual background, the research phases have started and they are included in the fourth chapter. This last chapter consists of three main parts. The first part is a quantitative study that aimed to generate ex-post forecast models of domestic dry cargo shipping demand. Initially, data are collected and pre-processed. Then the models are developed and compared. Finally, the significances of the models are calculated.

The second part aimed to explore the variables and environment of the domestic dry cargo shipping. For this qualitative study, semi-structured interviews are conducted with actors of the shipping industry. A summary of the codes is provided as a map, and a detailed presentation of each theme and co-occurrences are illustrated at this part.

The third part of the fourth chapter determines the variables that could have a significant impact on domestic dry cargo shipping and identifies the number and nature of these variables. This part consists of field study questionnaire testing that is designed through the literature review and the findings of the qualitative study. A survey is conducted on actors in the domestic dry cargo shipping industry. Using the variables of domestic dry cargo shipping and through the help of the relationship analysis domestic dry cargo shipping market forecast model is developed. Between two quantitative studies and developed models, a brief comparison is provided.

Figure 19: Research Process



4.3.2. Research Model

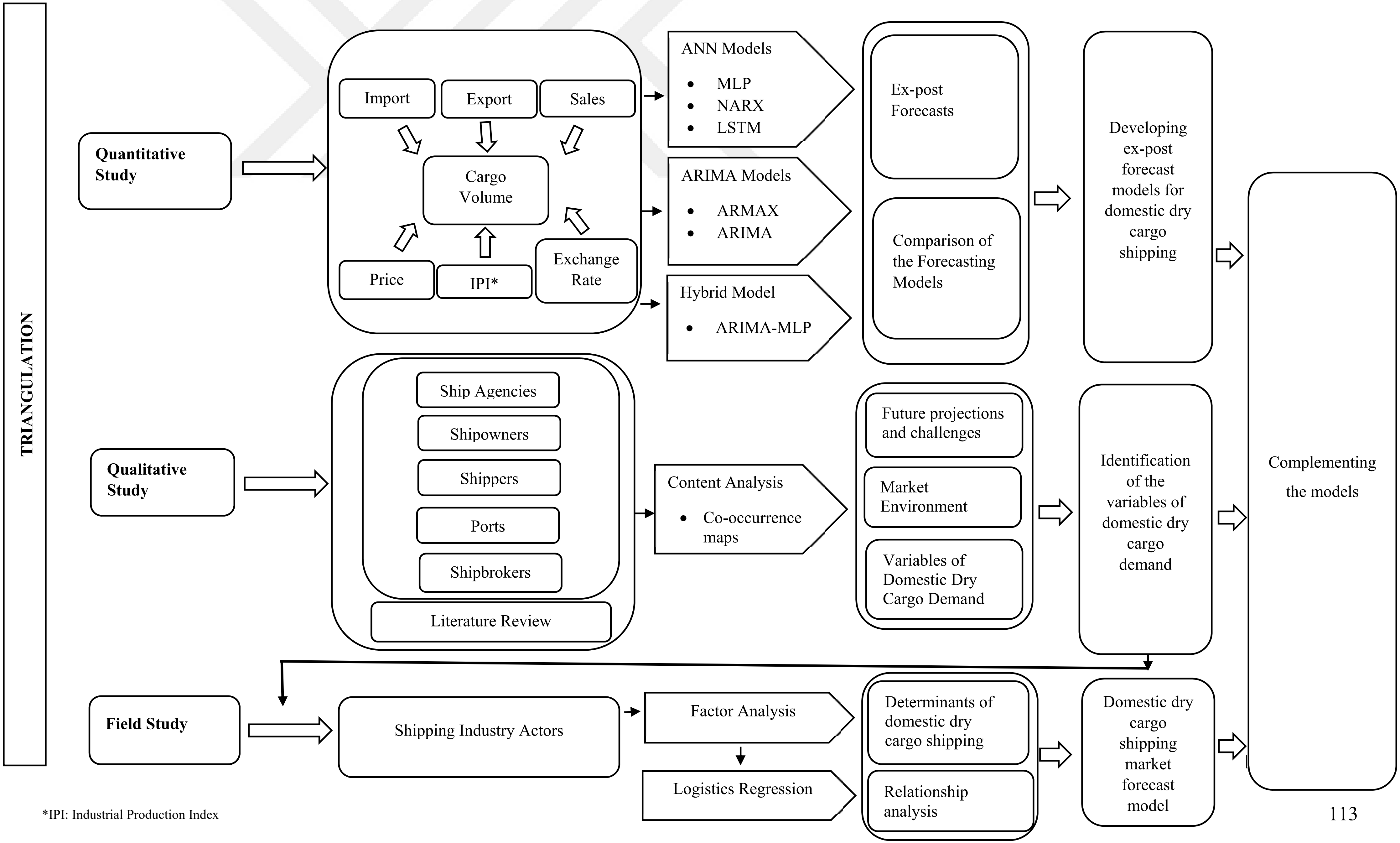
The empirical research has been carried out in three parts. Qualitative and quantitative studies and variables, methods and analyses used are presented in the conceptual model of the research in Figure 20. A related model is constructed in terms of triangulation that is a mixed method. It refers to the use of multiple methods while investigating the same problem to strengthen the validity of the results. With this aim two or more methods should be implemented simultaneously and independently (Greene et al. 1989: 256). In this dissertation, triangulation is applied to identify market demand and determinants. First, the quantitative study is conducted to develop ex-post forecasts. Variables are deduced from the literature review and demand forecast models are developed and methods are benchmarked. Therefore, the impacts of the variables on market demand are collected and assessed. Second, a qualitative study is conducted to collect additional market and geographic specific variables and to get an understanding of market trends and conditions. Shipping industry actors as ship agencies, shipowners, shipbrokers, shippers are interviewed. Third, a field study is applied to identify relationships between demand variables, and to reach the domestic dry cargo shipping market forecast model. Finally, as a result, these models are complemented.

4.3.3. Quantitative Study: Forecasting Dry Cargo Shipping Demand

This part of the research is conducted to reveal the current demand for the domestic dry cargo shipping market and develop ex-post forecast for market. The current demand for domestic dry cargo shipping is analyzed in terms of the loaded and unloaded cargo, and the general framework of the demand for the market is described. After analyzing the current demand, a comparison of the different forecasting models is presented.

This part presents the aim and scope of the quantitative study, the importance of the study, data and data collection tools, data characteristics and pre-processing, developed models and benchmarks and their significances.

Figure 20. Conceptual Model of the Research



*IPI: Industrial Production Index

4.3.3.1. Aim and Scope

The need for accurate forecasting stems from the perishability nature of the services in the shipping industry. Forecasting future is crucial for the shipping industry stakeholders to make investment decisions on ordering a ship, establish the chartering type, plan the future, gain more profit, calculate the risk (Stopford, 2009: 697). When demand for shippers' commodities increases, shipowners are forced to increase the fleet size. If the shipowner selects to invest in new ships, this increased capacity creates incremental changes in the whole supply chain. To overcome this capacity problem which is based on the derived and discontinuous demand characteristics of the domestic shipping, shipowners need to obtain good market forecasts. There is no consensus on the best forecasting models for the shipping. With this motivation, our paper benchmarks forecasting models for the players involved in the domestic shipping at a developing country case. In this respect, developing countries are unique in the sense that they generally do not have continuous data on related variables for a convenient model, and insufficient data restricts the use of different techniques (Akal, 2004: 568).

Based on the above reasons, shipping markets have been forecasted for years and different forecasting models have been developed. Studies generally focus on specific ports or regions and include mainly containerized cargo to increase the accuracy and to cope with data collection limitations. This study attempts to establish the model of forecasting the five major domestic dry cargo volumes. Therefore, it focuses on a wider geographic area and includes diversified types of cargo.

In terms of the methods used, ARIMA models, MLP, LSTM, and NARX and hybrid models are developed to compare the models. ARIMAX models are selected in that data has the time series characteristics. Besides, it can increase to explain the power of the model with the help of exogenous variables. The research is extended with a neural network and a hybrid technique that uses the methodology of the Zhang (2003) is developed. The selected hybrid model consists of both time series and soft computing methods. Furthermore, LSTM and NARX models are also included to improve the benchmarking portfolio. To the best of our knowledge, none of these methods have been used previously in shipping forecast literature. Moreover, data preprocessing is considered while comparing the methods used to increase accuracy.

4.3.3.2. Pre-Interviews

To be able to conduct the ex-post forecast study for the domestic dry cargo market, expert opinions are required before data collection. Literature review presents the background variables. However, industry approaches are necessary to proceed with the market variables before developing the forecasts. It is decided to conduct pre-interviews with the shipping industry representatives before performing the quantitative ex-post forecast study.

Such forecasts are necessary in particular for Turkey due to the potential to a modal shift from road to the sea. 95% of domestic shipping of Turkey is transported by road transport (Çelikkaya, 2012). Turkey attaches increasing importance on the domestic shipping due to the road transport excess and a requirement of Turkey's EU accession process (Ozen, 2007). Domestic shipping is a sustainable alternative to road transport. Forecasting domestic shipping in Turkey is essential to plan for the aging of the Turkish flagged coasters, develop incentives to Turkish maritime transport, generate prospects for the future of Turkey's domestic shipping. Failure on forecasting the demand of domestic shipping market may lead to discrepancies between demand and supply, errors in ship and port investments, dwell time in ports and congestion, and consequently the loss of stakeholders. To overcome these problems, it is necessary to apply accurate forecasting models for Turkey. For these reasons, pre-interviews were realized with experts in Turkey.

Pre-interviews were realized to identify the variables and collect the general information on the domestic dry cargo shipping market. Therefore, data sources were searched and general information on domestic dry cargo shipping routes and companies were obtained.

Unstructured pre-interviews were conducted with six experts in two days at İstanbul, Turkey. It is aimed to find out the data collection tool for forecasting domestic dry cargo shipping and determine the variables affecting the market. Another aim of these pre-interviews is to get general information on domestic dry cargo shipping market and actors and companies acting on the market.

Respondents were selected with purposeful sampling method to represent participants of the shipping business negotiations. A convenient sampling method was followed. Therefore, respondents were selected as one of the pioneering actors of domestic dry cargo shipping. The profile of the respondents and their companies are presented in Table 17.

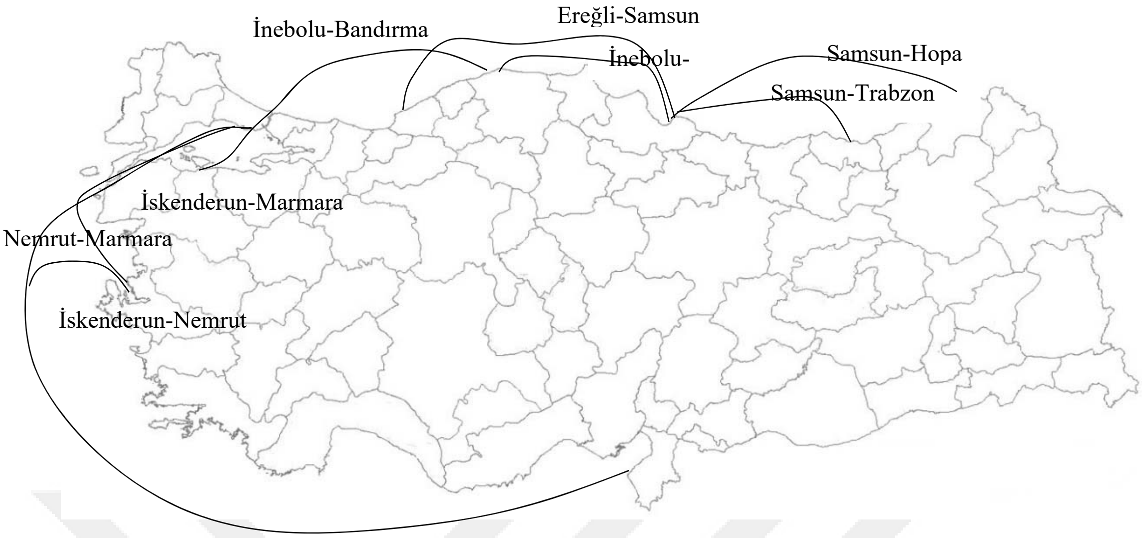
Table 17. Profile of The Respondents and Companies

	Position	**Residence of the Company**	**Services**	**Date**
R1	Head of Research	İstanbul	ISTFIX	08.12.2016
R2	Partner Manager/ Chartering Executive	İstanbul	Shipbroker	08.12.2016
R3	General Manager	İstanbul	Shipbroker	08.12.2016
R4	Shipowners cooperative	İstanbul	Operation manager	09.12.2016
R5	Merchant Fleet Manager	İstanbul	TCS	09.12.2016
R6	General Manager	İstanbul	Shipowner Company	09.12.2016

Source: Author

The experts mentioned the major domestic dry cargo shipping routes as İskenderun- Marmara, Mersin-Marmara, Nemrut-İskenderun, Nemrut-Marmara, Ereğli-Samsun, İnebolu-Bandırma, Hopa-Samsun, İnebolu-Samsun and Samsun-Trabzon. These routes are shown in Figure 21. Some of the shippers and shipowners performing in the industry were identified also through these pre-interviews. Some of these actors are used as a sample of the field study.

Figure 21. Major Domestic Dry Cargo Shipping Routes



Source: Author

To increase dry cargo domestic shipping, increasing railway transportation and multimodal transport was proposed. Moreover, port and port management issues were also pointed out.

R4 "*Port and port management is one of the most important problems of the industry. For the first time this year, the logistics fair had very high participation that had been made for more than ten years. This is proof of the importance of port management in terms of maritime and logistics.*

The Port management concept has been changing day by day. It has started to differentiate. It creates good competition in the industry. This perspective will change the maritime industry as well."

It was also claimed that providing logistics services by the ports will have an impact on increasing the dry cargo shipping market.

R4 "*Cargo owners should be supported on storage, stocking and stowing by the ports to increase dry cargo domestic shipping. Moreover, shippers are mostly complaining about high port tariffs at the feasibility studies*."

Following issues are also proposed to increase domestic dry cargo shipping;

- Decreasing port tariffs
- Supporting shippers on logistic services such as storage, stowage, etc.

- The age of the ships should be limited. Younger ships should be supported and incentives should be given.
- Older ships have additional costs as age premiums. Therefore, shippers tend to use other transport modes.
- Bureaucratic procedures should be facilitated
- Incentives should be given (Fuel prices have value-added tax
- Ship sale and purchase procedure of the Turkish Flagged ship also have some bureaucratic procedures as bill of sale of the ships.

4.3.3.3. Application Area: Black Sea Turkey

According to Table 20, and obtained routes from the pre-interviews pointed out the Black Sea Region for the application area. This reason is supported by the data collected through the Ministry of Transport and Infrastructure. In Black Sea Region approximately 38,831,671 tonnes of dry cargo had been loaded and approximately 47,083,135 tonnes of dry cargo had been unloaded during the fourteen years (MTI, 2019b). Below explained environmental influencers and current loaded and unloaded cargo demand volumes of the region point out the reasons for selecting the Black Sea as application area as well.

4.3.3.4. Environmental Influencers of Domestic Dry Cargo Shipping of Black Sea

Macro and micro environmental activity affect the industry demand at both the national and global levels. Analyzing the environment allows organizations to be cautious about upcoming happenings. The external environment described under macro (PEST) environment as Political/ Legal, Economic/ Demographic, Social/ Cultural, Technical/ Natural (Wright, 2004: 8, 97, 105).

4.3.3.4.1. Macro External Environment Influencers

- **Political/ Legal Structure**

When the policy coordination in the Black Sea Region is considered, States of Black Sea region still need to make much effort to increase the Black Sea region's relations peacefully and constructively. This region needed make an endeavour to become a reliable community that ensures no threat to itself or its neighbor. Much effort implies that security concerns, sustainable development, regional cooperation, and good governance. This region is composed of considerably diversified countries in terms of "*size and power of its countries, their systems of governance, the sophistication of their economic and financial structures and human development indicators*". Due to that diversity, creating comprehensive regional integration schemes is very difficult (Aydın and Triantaphyllou, 2010:374).

Security issues are another important political and legal element as The Black Sea region, located in an instability triangle (formed by the Balkans, the Caucasus, and the Middle East, presents a dichotomy of cooperation and conflict both national and international (Hajizada, 2018: 532). The future holds a serious risk for more conflicts in the region (Ozdamar,2010:355). Recent conflicts in relations between pairs of states, such as Russia and Georgia, Armenia and Azerbaijan, Russia and Ukraine or even the EU and Russia over various issues, create doubts on regionalism especially the security of Black Sea. The major challenge to the stability and the sustainable development of the region are these unsolved bilateral conflicts: Russia and Moldova (Transnistria), Armenia and Azerbaijan (Nagorno-Karabakh), Russia and Georgia (Abkhazia and South Ossetia), Russia and Ukraine (Manoli, 2010: 323,332).

Custom tariffs are also an effective influencer. A significant increase in tariffs is not expected to affect the operations of companies because Kardemir works mostly in the domestic market and Erdemir has a very small share among the export markets. However, these companies are exposed to indirect effects because of the domestic producers and traders sell some of their products to the USA (Dilekçi, 2018).

In terms of Free Trade Agreements, Turkey is a part of the Customs Union with EU countries as well as EU countries at the Black Sea. Due to the Customs Union obligation Turkey negotiates FTA's with third countries parallel with EU (TR Ministry of Trade, 2018). However, as a result of these negotiations with third countries, Turkey has got under additional obligations (Çelik, 2018). Protectionist foreign trade legislation on the Russian side limits the potential of regional firms (DOKA, 2014). At Black Sea Region, Turkey negotiating with Georgia that will be finalized soon. Meanwhile, negotiations with Ukraine has been actively remained (TR Ministry of Trade, 2018). Recently an important FTA signed between Beijing and Tbilisi that will affect the shipping market at the Region. The Chinese-Georgian Agreement facilitates exports in both countries, especially when it comes to wine, mineral water, and agricultural products. By the way, China has become a player in the Black Sea (Lambert, 2019).

Ministry of Transport and Infrastructure emphasized the following strategic aims that could be related with the domestic dry bulk shipping: increase the efficiency of intermodal transport by increasing the number of combined transport centers by the way it is expected to increase the efficiency of the domestic railway and maritime transportation, contribute to the development of merchant fleet, contribute to the strengthening of the position of Turkey in the logistics industry, developing the infrastructure of railway transportation with revitalizing the historical Silk Road by providing uninterrupted rail connections between our country and the Turkish Republics of Georgia, Azerbaijan and Central Asia and providing the most economical way of shipment to the Ereğli Demir Çelik ve Karabük Demir Çelik (MTI, 2017:65-96).

Special Consumption Tax Exemption has made significant contributions to the cabotage shipping. An increase of 106% was achieved from 2004 until 2018 (Alıcı, 2018:68). Renewal of the Coaster Fleet project is planned to launch. Project compromises nationally designed ships that will be produced at Turkish shipyards (Doğan, 2018). A regulation that encourages combined freight transport services has prepared by The General Directorate of Dangerous Goods and Combined Transport. The regulation also provides freight forwarders to act as multimodal transport operators under certain conditions. The regulation is planned to be carried into effect during 2019 (Lojistik Hattı, 2018).

IMO has set a limit for sulphur in fuel oil used on board ships of 0.50% m/m (mass by mass) from 1 January 2020 (IMO, 2019: 1).

- **Economic Structure**
  - Main Export Sources

At 2018 prominent exports of West of the Black Sea are iron and steel; natural, cultured pearls; precious, semi-precious stones; precious metals, metals clad with precious metal, and articles thereof; imitation jewelry; coin; rubber and articles thereof; products of the milling industry; iron or steel articles; apparel and clothing accessories; not knitted or crocheted; malt, starches, inulin, wheat gluten; nuclear reactors, boilers, machinery and mechanical appliances parts thereof (TUIK, 2019a).

At 2018 prominent exports of East of the Black Sea edible fruits and nuts; preparations of vegetables, fruit, nuts or other parts of plants; ores, slag and ash; salt; sulphur; earths, stone; plastering materials, lime and cement; vegetables and certain roots and tubers; edible (TUIK, 2019a).

  - Exporting and Importing Countries

In 2018 most of the exporting countries from West of the Black Sea are Iraq, UAE (United Arab Emirates), Germany, Italy, and Romania. In 2018 most of the exporting countries from East of the Black Sea are Germany, Russia, Italy, Georgia, China (TUIK, 2019b). In 2018 most of the importing countries to the west of the Black Sea are Russia, UAE, USA, China, Sweden. In 2018 most of the importing countries to the east of the Black Sea are Russia, Germany, Georgia, China, Italy (TUIK, 2019b).

  - Main Import Sources

At 2018 prominent imports of West of the Black Sea are mineral fuels, mineral oils, and products of their distillation; bituminous substances; mineral waxes; iron and steel; ores, slag and ash; precious metals, metals clad with precious metal, and articles thereof; imitation jewellery; coin; nuclear reactors, boilers, machinery and mechanical appliances parts thereof; cereals.

At 2018 prominent imports of East of the Black Sea are mineral fuels, mineral oils and products of their distillation; bituminous substances; mineral waxes; nuclear reactors, boilers, machinery and mechanical appliances; parts thereof; fruit and nuts, edible; peel of citrus fruit or melons; animal or vegetable fats and oils and their cleavage products; prepared animal fats; animal or vegetable waxes; food industries, residues and wastes thereof; prepared animal fodder (TUIK, 2019a).

Here, The Black Sea Region is investigated in terms of the Nomenclature of Territorial Units for Statistics of the Republic of Turkey. According to the NUTS Level 1, Turkey has four sub-regions at the Black Sea as illustrated in Figure 22; TR81 (Zonguldak, Karabük, Bartın), TR82 (Kastamonu, Çankırı, Sinop), TR83 (Samsun, Tokat, Çorum, Amasya) and TR90 (Trabzon, Ordu, Giresun, Rize, Artvin, Gümüşhane) (TR Official Gazette, 2002).

Figure 22. Nomenclature of Territorial Units for Statistics of Republic of Turkey

Source: EC, 2016

- Industry at TR81

Two main sectors determine economic activities in the TR81 Region: the first is the mining that extends to the middle of the 19th century and the second is the iron and steel industry. Agriculture (fruits and vegetables), furniture, shipbuilding, metal (iron-steel recycling), mining (coal and transport-carry) industries are prioritized in the region, while tourism, agriculture (livestock and organic farming), mining (marble), automotive, machinery and maritime logistics are also promising industries (BAKKA, 2013: 35-38).

Erdemir is Turkey's biggest flat steel producer located in Zonguldak Eregli (BAKKA, 2019a). As well as the iron and steel industry, mining, stone-soil industry, shipbuilding, food, textile, construction, chemistry, paper, furniture, auto-industry, machinery, energy industries are existing in Zonguldak. Forest products industry is a branch that can develop in the region due to the proximity of raw materials (BAKKA, 2013: 59). Additionally, ceramic, brick, cement enterprises are also available in the region. It is aimed to operate high and medium high technology sectors such as electrical equipment, machinery, equipment, and motor vehicles in the planned Filyos Industrial Zone (Haber61, 2018).

The steel industry dominates the industry of Karabük as Zonguldak. Kardemir which is the first integrated iron and steel plant of Turkey has 2,000,000 tons/year of raw steel production capacity with and provides basic input as blooms, billets, deformed reinforcement steel, beams, angles, mine poles, all kinds of rail, coke, and coke into the construction, mining, transportation, and industrial sectors. In addition to the iron and steel industry, textile and food industries are the prominent industries in the region (BAKKA, 2019b).

Textile and garment industry, chemical, coal and plastic industry, stone and soil-based industry are available in Bartın. Western Black Sea Region is one of the important forest product providers in Turkey with its width of forest area and density of businesses in the forest products industry. The enterprises operating in the industry usually produce timber, timber, and parquet (BAKKA, 2019c).

- Industry at TR82

In TR82 Region manufacture of wood and of products of wood and cork, except furniture; manufacture of food products, manufacture of apparel, manufacture of other non-metallic mineral products, manufacture of furniture, manufacture of electrical equipment are the prioritized industries (Ünal 2014:2).

Forest products and furniture industry, mining, tourism, agriculture and livestock farming are the prominent industries in Kastamonu. Food, mining, agriculture and livestock farming are the prominent industries in Çankırı while, tourism, fisheries, forest products and furniture industry are the prominent industries in Sinop (Investintr82, 2019a: 1). It is planned to establish Sanayi Evsaflı Joint Forest Products Processing Integrated Plant (Investinkastamonu, 2019a: 2). Çankırı is host to the largest Japanese investment at once in Turkey (Investincankırı, 2019:2).

- Industry at TR83

In TR 83 region, agriculture and food processing sectors are dominant at Amasya, Tokat ve Çorum, while agriculture, main metal industry and logistics sectors are prominent in Samsun.

Food and beverage manufacturing companies are clustered in Samsun. Turkey's one of the first specialized food OIZ is established in Samsun in 2007. The food industry is developed with the support of agriculture and the export of these products have great significance for the city. The main metal industry especially steel and copper are also developed in the city. Companies have high export potential and qualified to produce spare parts of all kinds of machines, spare parts of automotive and heavy-duty machines. One of the large-scale companies in the city has its port and put it for the use of industry. Samsun Copper Plant is the only producer of copper from ore in the country at present. Samsun facilities also service with the smelting, sulphuric acid, and concentrator plants. Moreover, there are also important enterprises in the forest products and furniture industry sector in Samsun. There are many small and medium-sized industrial facilities. Forest products and furniture industries are rapidly developing and prominent in the city with employment and production. Besides the mentioned industries, Samsun is also focused on the healthcare, medical instruments, agriculture industries (Investsamsun, 2019).

Merzifon OSB has contributed to the development of industry in Amasya on machinery and equipment manufacturing which are not classified elsewhere (electrical machinery and household appliances) and are exporting these products to many countries (Investamasya, 2019).

The textile and apparel industry contribute to the Tokat with 49.3% share of the exports. The food and beverage manufacturing industry are developed in Tokat. The sector's share in the city's exports is 42,4% (Tokat Valiliği, 2013). Turkey's first sugar factory Turhal Sugar Factory which is privatized in 2018 (Hürriyet, 2018) founded in 1934 and Dimes fruit juice company one of the top 500 companies contributed the industrialization process of the city. Tokat also specialized in the soil and stone industry that the city especially produced bricks, clinker, cement and forest products industry (Investtokat, 2019).

The machine metal industry sector, stone, and soil-based industry operate especially on brick and tile factories, food and beverage manufacturing industry have an important place in Çorum's industrial activities (Investcorum, 2019).

- Industry at TR90

Strong agriculture and food sectors occupy in TR 90 region. The region is also known for the fishing, tea and nut production. Prominent industries in Ordu are the food and beverage manufacturing industry, mining products processing, ready-made garments, forest products, and furniture industry. In Rize, 75% of the industrial enterprises constitute ÇAYKUR and private sector tea factories. The food industry that is operating mainly in fruit letter and churchkhela production and marble and stone quarries are the prominent industries with a 50% share. Major industries are manufacture of food products, mining, and quarrying, mining of metal ores, manufacture of other non-metallic mineral products, wood and wood products (except furniture), furniture manufacturing. The prominent industries in Giresun are the food and beverage industry with 38.22 % share, forest products manufacturing with 18.76 % share, mining/stone industry with 10.58 % share, construction industry with 10.30 % share. Food and beverage industry which companies mostly operates on subsector of nuts, tea, and water is the prominent industry in Trabzon. Metal and steel companies are following the food and beverage industry in Trabzon. The prominent industries in Artvin are the food and beverage industry, other mining and stone quarrying, wood and mushroom products and food product manufacturing. More than half of the firms operating in the city are micro-scale enterprises (DOKA, 2019b).

- Organized Industrial Zone

There is 53 OIZ at the Black Sea with 17.21% share of Turkey (TR Ministry of Industry and Technology, 2014).

There are continuing UR-GE projects for clustering of industries at the Black Sea as Eastern Black Sea Exporters Association – Mine Metal and Forest, Agriculture; Ordu Chamber of Commerce and Industry - Mine Metal and Forest, Samsun Furniture Businessmen Association – Mine Metal and Forest, Erbaa Chamber of Commerce and Industry - Mine Metal and Forest, Gümüşhane Chamber of Commerce and Industry - Agriculture, Zile Chamber of Commerce and Industry - Agriculture, Ordu Chamber of Commerce and Industry - Agriculture, Kapı Sanayicileri Derneği (Tosya) - Mine Metal and Forest; Çorum Chamber of Commerce and Industry - Machinery Automotive and Electronics; Trabzon Chamber of Commerce and Industry – Agriculture (Kobi İşbirliği ve Kümelenme Projesi, 2018a).

There is also accomplished UR-GE projects for clustering of industries at the Black Sea as Eastern Black Sea Exporters Association - Machinery Automotive and Electronics and Agriculture, Samsun Chamber of Commerce and Industry - Mine Metal and Forest, Agriculture and Machinery Automotive and Electronics, Trabzon Chamber of Commerce and Industry-Mine Metal and Forest and Machinery Automotive and Electronics (Kobi İşbirliği ve Kümelenme Projesi, 2018b).

The Black Sea has two mega industrial zone projects. Filyos Industrial Zone which is close to Turkey's largest port project and aims to operate in high and medium high technology sectors such as electrical equipment, machinery, equipment and motor vehicles (Yılmaz, 2018). Trabzon Investment Island aims to increase exports from the region in the direction of producing and developing products/services R&D and innovation based, value-added and containing advanced technology (Investintrabzon, 2019).

- Agriculture and Livestock

In 2018, the value of vegetable production for the TR8 Region is 10768417 (thou. TL), value for livestock is 12459448 (thou.TL) and value for animal products is 3044561(thou. TL) (TUIK, 2019c).

In 2018, the TR8 region has the highest levels of buffalo milk production in Turkey and one of the most cow's milk-producing regions. In terms of animal ownership, TR8 Region has the highest number of buffalo population in Turkey (TUIK, 2019d).

TR 81 Region is located in a rugged geographic area. Geographic area restricts both agricultural production and animal production (BAKKA, 2019c). Poultry farming is the first ranked livestock in the region. Fishing activities are relatively developed (BAKKA, 2019a; BAKKA, 2019b; BAKKA, 2019c). "Safranbolu Safran" that is a geographical signed plant emerging as a very high economic value. There is a wide range of applications and especially useful in the pharmaceutical and food industry (BAKKA, 2019b). Zonguldak and Karabük also have a considerable amount of honey production (BAKKA, 2019a; BAKKA, 2019b).

Samsun is particularly attractive for foreign investors especially in winter vegetables, organic products, good agricultural products, seeds, seedlings, storage, logistics, contract farming, bakery products, food processing, and packaging. Samsun produces seafood for industrial purposes and an important part of the anchovy fish and the whole of sprat fish are utilized in fish flour and oil facilities. In terms of animal products, the city is the first in the production of buffalo milk and 17th in cow milk production of Turkey (Investsamsun, 2019). Amasya's trade activities are concentrated on agricultural products. Amasya has high agricultural potential in terms of land existence and a variety of crops. Approximately, 45% of the total surface area is agricultural land. Besi OSB is also functioning for the agricultural development of the city (Invetamasya, 2019). The agricultural area of Tokat constitutes 37% of the province's surface area and has three different climatic structures and has five different agro-ecological characteristics. Animal products are obtained in the city dairy farming, cattle fattening, beekeeping and trout farming (Investtokat, 2019). Agricultural area of Çorum constitutes 44% of the province's surface area and agriculture has an important place in Çorum. However, these products mainly consumed in the domestic market. In terms of livestock, 6.1% of the eggs produced in Turkey are produced in Corum and the market also exported $ 6,868,208 eggs (Investcorum, 2019).

The agricultural industry and concordantly manufacturing of foods are prominent industries in the TR82 region. 20% of chestnut production and 25% of garlic production of Turkey occurred in the TR82 region. 100% of the sea snail hunting in the Black Sea is obtained from Sinop and exported to especially Japan and South Korea. Cattle fattening and beekeeping have development potential in the region (Investinkastamonu, 2019b). Fisheries are one of the prominent industries in the region. Especially, Sinop has an important position in the production of fish meal and oil. It is planned to establish a fisheries processing plant in Sinop OSB (Investinkastamonu, 2019c).

In 2018, the value of vegetable production for the TR90 Region is 7765610 (thou. TL), value for livestock is 3476017 (thou.TL) and value for animal products is 2063643 (thou. TL) (TUIK, 2019c). In 2018, in terms of animal ownership, TR90 Region is one of the least animal owned regions. TR9 is Turkey's second region in terms of honey production (TUIK, 2019d). The region produces tea, honey, nut, and kiwi and fisheries and beekeeping is one of the most important branches for the Region. Ordu has the most registered farmers in Turkey with over the 120 000 registered farmers. Turkey meets approximately 60-75% of the world hazelnut production while Ordu meets about 20-30% of Turkey's total hazelnut production. Additionally, Ordu ranks first with 15% share of honey production and second with 13% share of kiwi production of Turkey. Both fishing approximately 25,000-35,000 tons per year and fish farming have carried out in the city. More than 91% of its agricultural area of Rize is used for tea production. Agricultural activities are limited because of the inadequacy of agricultural lands. Rize is one of the centers of the important production of sea products in Turkey. Gumushane is suitable for organic farming in cereals, pulses, fodder crops, perennials, pestil-slab-mulberry molasses and fishing areas. It is the city that has the highest pasture area in terms of pasture existence among the East Black Sea cities. It has the potential in organic livestock and aquaculture. In Giresun, 64% of agricultural land is composed of hazelnut fields, 32% field area and 4% consists of tea, vegetable and fruit fields. Trabzon ranks first in corn, potato and feed beet production in Eastern Black Sea cities. 15% of hazelnut production and 29% of tea production of Turkey is carried out in Trabzon. Currently, there are organic farming for tea, honey, nuts, and kiwi. Fishing is one of the most important branches in Trabzon. Artvin has the potential for organic farming. 11.5% of tea production in Turkey is carried out in Artvin (DOKA, 2019b).

- Tourism

There are significant differences between the cities of TR81 region. The most developed cities in terms of the tourism industry in the region are Karabük and Bartın. One of the important economic activities of Karabük is the tourism industry. Cultural tourism has developed in the Safranbolu district of Karabük and the district welcomes 500 thousand domestic and foreign visitors on average. From the 2000s onwards, with the developments in world tourism conjuncture and being a becoming an important cultural tourism destination of Safranbolu, sea tourism started to rise in Bartın Amasra.

New tourism routes are created with the existing railways that traditionally carry coal. The route passes through Zonguldak, which has an industrial heritage with the presence of hard coal, Karabük to display its historical values and Bartın to display its natural beauties (Türker et al. 2011:25, 26). Congress tourism, ecotourism, cultural tourism, adventure tourism and industrial heritage tourism, coastal and natural tourism, culture and faith tourism, winter tourism and sports tourism are considered among the tourism types that exist and have development potential in the Western Black Sea Region (BAKKA, 2019d).

There are 2 national parks in the TR82 Region (Ilgaz Dağı Milli Parkı ve Küre Dağları Milli Parkı). 50% of the TR82 Region consists of forest areas. There are 6 approved tourism center and 1 Culture and Tourism Protection and Development Zone (KTKGB) in the region (TR Ministry of Culture and Tourism, 2019). The TR82 Region offers a favorable investment environment for the tourism sector and provides a variety of tourism: eco-tourism, winter tourism, sea, and coastal tourism, health tourism and thermal tourism, highland tourism, cave tourism, hunting tourism, faith, and historical art tourism, gastronomy tourism, youth tourism, congress tourism, event tourism (Investinkastamonu, 2019d). The first salt hotel in Turkey is located at Çankırı. It is planned to launch Salt Cave at Çankırı to alternative health tourism (Investintr82, 2019b).

There are 8 approved tourism center and 2 Culture and Tourism Protection and Development Zone (KTKGB) in TR83 Region (TR Ministry of Culture and Tourism, 2019).

There are 20 approved tourism center and 8 Culture and Tourism Protection and Development Zone (KTKGB)8 in TR90 Region (TR Ministry of Culture and Tourism, 2019). The Region has made great progress in recent years in the tourism industry (DOKA, 2014:134). The Region attracts a considerable amount of tourists from Gulf countries (DOKA, 2014: 134) and there are many tourism projects (DOKA, 2019c). One of these projects is Green Route that is planned to developed from Samsun to Hopa. Within the scope of this corridor, it is envisaged that tourism will be diversified with alternative tourism types in the TR90 Region (DOKA, 2014: 134).

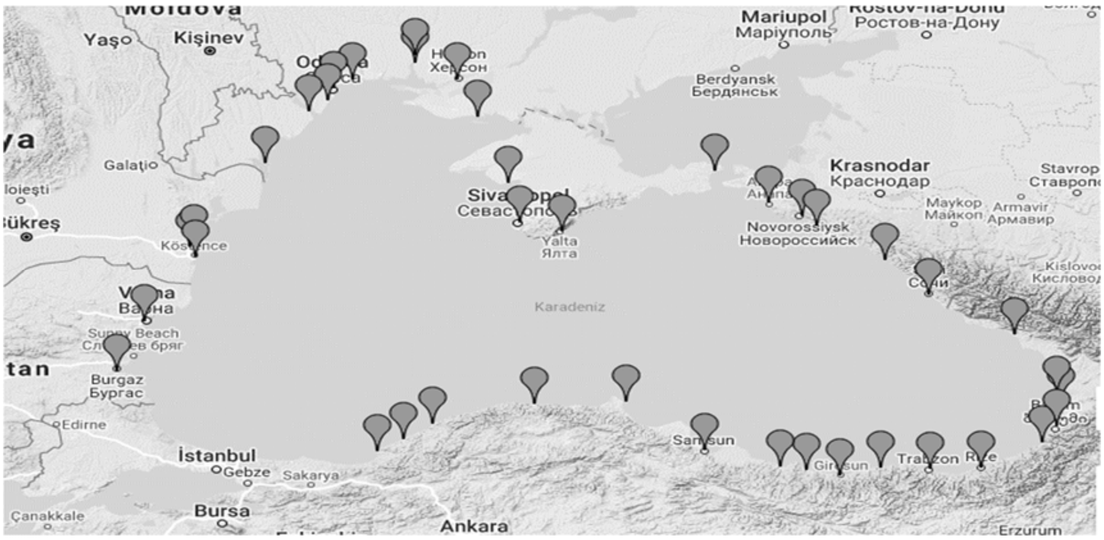
The TR90 region provides a variety of tourism types as nature tourism, eco-tourism, adventure tourism, winter tourism, highland tourism, hunting tourism, religion tourism, culture tourism, congress tourism, agritourism, thermal tourism (DOKA: 2014: 135, DOKA, 2016a: 8).

- Developments in Regional Trade,

A public offering of Trabzon Port is the first of its kind in the port services field in Turkey (Eker, 2018). Ereğli Demir Çelik decided to invest in new billion-dollar investment. The production capacity of the factory will increase with this investment

(Bloomberght, 2019). The European Union decided to financially support the Anaklia Deep Sea Port. For finance of the second phase of the Anaklia Deep Sea Port 233 million Euros have been assigned. Construction of the rail lines and highways throughout Georgia which will connect the Anaklia Deep Sea Port has been planned. Moreover, the German Development Bank (DEG) together with the Dutch development bank has also decided to invest in Anaklia. Moreover, to construct a multimodal transit terminal, a conceptual design of the expansion of APM Terminals Poti Sea Port has presented. (Avdaliani, 2019). Black Sea-Caspian Sea (BSCS) International Transport Corridor has been set up by Turkmenistan, Romania, Azerbaijan, and Georgia. This already existing route needs some sufficient infrastructure development to achieve its potential. Turkmenistan exports cement, textiles, carpets, wool, and fertilizers. Besides these products, Turkmenistan would benefit more from exporting petroleum products, including petrol, petroleum coke, ammonia and bitumen (Intellinews, 2019). As another development in the region, Milaha, a Qatar-based maritime transport, and logistics conglomerate have announced a direct container feeder service Black Sea Express Service (BSX). The service is the first European service of the company that links the Mediterranean and the Black Sea. Black Sea Express Service follows the route linking Greece, Turkey, Georgia and Russia (Hellenicshippingnews, 2019). The ports located in the Black Sea Region are presented in Figure 23.

Figure 23. Port Map of Black Sea



Source: World Port Source, 2020

- Demographic Structure
  - Employment

In Region TR81, the manufacture of basic metals and mining of coal and lignite sectors, which account for 20% of total regional employment, show that there is a strong specialization in these two sectors in the region. The other three dominant sub-sectors are smaller in size: land transport and transport via pipelines, food and beverage service activities, manufacture of wearing apparel sectors use less than 20% of the total regional workforce.

In Region 82 there has been a large agricultural sector, which constitutes 46.6% of the region's employment, followed by services (37.6%) and industry (15.7%). Manufacturing industries with a share of 10.8% occupies little space in the regions' employment. Moreover, there are difficulties in finding adequately trained personnel in the region.

The regional economy of TR83 has a strong agricultural sector, which accounts for 40.1% of the region's employment, followed by services (39.3%) and industry (20.6%). With a 10% share, the manufacturing sector occupies little space in the region. Manufacture of other non-metallic mineral products, manufacture of food products, food and beverage service activities are the dominant sub-sectors in the region in terms of employment.

The regional economy of TR90 has a strong agricultural sector, which accounts for 44.7% of the region's employment, followed by services (37.8%) and industry (17.5%). The manufacturing sector covers less place of employment with a 7.2% share. Land transport and transport via pipelines manufacture of food products, food and beverage service activities are the dominant sub-sectors in the region in terms of employment (OECD, 2015: 80-86).

  - Population and Migration

TR8 Region has 4.688.532 and the TR9 region has 2.719.113 population in 2018. In Black Sea population implies steady growth (TUİK, 2019e). The Black Sea region is known as the migrating region, but it has been observed that there is an increase in the net migration rate at 2016 and 2018, especially net migration rate increased at 2018 as 30,54% for TR9 region and 14,86% for TR8 region (TUIK, 2019f). It is projected that small cities locating at the Black Sea will be smaller in the future (TR Ministry of Development, 2016: 38).

- Socio-Cultural Structure

From the cultural and socio-economic point of view; sea, shipping, fishing, ship construction are very important elements for the community at the Black Sea. For centuries residents live intertwined with the sea in their daily life and that unique and rich accumulation influences the folklore of the region (Davulcu, 2015:96).

Turkish Marine Research Foundation has three active projects at the Black Sea. Black Sea Watch, in short, has launched together with the Green Balkans (Bulgaria), financed by the European Union and the Republic of Turkey. The objectives of the project are to raise public awareness on marine biodiversity and the public participation in biodiversity data collection in the Black Sea. The National Jellyfish and Gelatinous Organisms Watch Programme aims to collect data on jellyfishes in the Mediterranean and the Black Sea. Anemone aims to assess the status of the Black Sea based on the existing regional (BSIMAP) and national monitoring programs (TUDAV, 2014). The Black Sea where 75% of the fishing activities of Turkey is carried out and has a great contribution to the Turkish shipping industry with its manpower resource for shipping and shipyards (İşipek: 2018:6).

- Technological Structure

Black Sea Region has 7 active and 1 in progress technoparks (TR Ministry of Industry and Technology, 2018). In TR8 Region R&D expenditure is 557668 TL while the R&D workforce is 9146 in 2017. In TR9 Region R&D expenditure is 332608 TL while the R&D workforce is 6358 in 2017 (TUIK, 2019g). Samsun and Trabzon had the most patent applications in the Black Sea Region in 2018, while Rize and Trabzon had the most applications in the Black Sea in 2017 (TURKPATENT, 2014).

- Natural Structure
  - Mines

Bartın offers a suitable environment for the hard coal and industrial raw material deposits due to its geological structure. The most important mines in the city are mainly quartz sand and quartzite and the fireclay and dolomite (BAKKA, 2019c). The most important mines in Zonguldak are hard coal, bauxite, manganese, barite, dolomite, phosphate, quartzite, quartz sand and fireclay (BAKKA, 2019a).

In recent years, important marble (travertine) reserves have been identified in Karabük and the establishment of marble processing facilities has accelerated. Important industrial raw material mines such as travertine (marble), feldspar and bentonite, dolomite and quartzite have been revealed in the city (BAKKA, 2019b). Amasya Beige natural stone is exported to many countries and it constitutes approximately 20% of the registered natural stone reserves in Turkey and 10% of the known reserves of the world.

Amasya also has 30 million tons of lignite coal potential reserves with a calorific value of %3 of the highest quality of Turkey (Investamasya, 2019). The prominent mines work out in Tokat are marble, bentonite, antimony, and coal that are domestic and foreign markets (Investtokat, 2019).

In the TR82 region, copper, brick tile clay, marble, and salt are the main mining products that generate income. There are 22 types of mine in the TR82 Region which are rich in terms of mine diversity and potential. Çankırı has 800 million ton salt reserves. In Kastamonu, 1.100.000 tons of copper ore, 110.000 tons of copper concentrate and 400,000 tons of pyrite concentrate are produced annually. Additionally, 30 million tons of copper mine was detected in Kastamou Hanönü district (Investinkastamonu, 2019e).

TR90 Region has an important place, especially in copper, bentonite and basalt production. 40% of active mining sites in the TR90 region are located in Ordu. 8% bentonite and 50% basalt of the total production of Turkey produced in Ordu. 7% of the total metal ore exports of Turkey were realized by Rize. The reserves of the deposits in the city consist of 1.283.325 tons of metal zinc, 908.107 tons of metal copper, 10 tons of metal gold and 265 tons of metal silver. Çayeli Bakır İşletmeleri is operating the most important site (Çayeli-Madenköy Copper-Lead-Zinc) of the city and it is forecasted that the reserve will be finished at the end of 2020. 74 metallic mineral ore deposits and exposures are detected at Trabzon. The most important metallic minerals in the city are Copper, Lead, Zinc, Molybdenum, and Manganese mineralization. The province also has cement raw material, clay and kaolin. The main metallic mines are the gold and copper-lead-zinc in Gümüshane. Gumushane is not only rich in metallic mines as granites and the rocks in contact with them, silver, copper, lead or gold but also in precious stones such as beryl, sapphire, tourmaline, topaz, amethyst and agate. There are also cement raw materials, feldspar, clay, kaolin, limestone and barite formations in the city. In Artvin, 72 metallic mineral deposits, including 44 copper-lead-zinc, 1 iron, 17 manganese, 5 copper-molybdenum and 5 gold deposits and occurrences, were identified. Giresun is especially rich in copper, lead and zinc deposits. There is also barite, marble and alunite reserves (DOKA, 2019b).

- Energy

Turkey receives natural gas from Russia with the Blue Stream pipeline under the Black Sea which is approximately 380 kilometers of 1,200 kilometers of natural gas pipeline and has an annual capacity of 16 billion cubic meters. Natural gas supplies about 3% of the electricity need of Turkey since 2013 with a combined cycle power plant established in Terme District with 890 MW capacity. It is also one of the most environmental power plants of Turkey with its seawater cooling system (Investsamsun, 2019). In Samsun, there is also 3 natural gas plants, 8 Hydroelectric power plants, 1 waste heat, 3 solar power plant, 2 biogas power plant and 1 fossil fuel plant (Enerji Atlası, 2019). Tokat has 486,37 MW electricity production power with 12 hydroelectric power plants, 3 wind power plants, 1 fossil-fuel power plant. There are also 5 hydroelectric power plants under construction with 173,7 MW (Investtokat, 2019). Çorum has 5 hydroelectric power plants, 1 natural gas power plant, 1 biogas power plant and 5 solar power plants. Amasya has 11 hydroelectric power plants, 3 wind energy power plant, 1 fossil fuel power plant, 1 natural gas power plant, 2 biogas power plant.

Sinop has 6 hydroelectric power plants and the second nuclear power plant of Turkey is planned to establish at Sinop. Kastamonu has 9 hydroelectric power plants and 1 fossil fuel power plant. Çankırı has 1 hydroelectric power plant, 1 fossil fuel power plant, 1 solar power plant.

TR 90 Region composed of hydroelectric power plants. There are 28 active hydroelectric power plants in Artvin, 51 active hydroelectric power plants in Trabzon, 38 hydroelectric power plants in Giresun, 8 hydroelectric power plants in Gümüshane, 13 active hydroelectric power plants in Rize and 16 hydroelectric power plants in Ordu (Enerji Atlası, 2019). Besides, 10 MW wind energy power plant construction is continuing in Ordu (DOKA, 2019b).

Zonguldak has the highest annual production level in the Black Sea Region with 13.332 GWh and has 3 hydroelectric power plants, 3 fossil fuel power plants, 1 natural gas power plant. Karabük has 4 hydroelectric power plant, 1 fossil fuel power plant, 2 solar power plants. Bartın has the lowest annual production level in the Black Sea Region with 56 GWh and has 2 hydroelectric power plants and 1 solar power plant (Enerji Atlası, 2019).

4.3.3.4.2. Micro External Environment Influencers

Micro external environment influencers of domestic dry cargo shipping in the Black Sea are presented in this part of the dissertation. These influencers are mentioned below. The objective of this part is to reveal micro external environment influencers of domestic dry cargo shipping at the Black Sea to identify variables and support the forecasting models. Micro external environment includes the actors that are close to affecting the ability to serve as suppliers, intermediaries, competition and the publics (Kotler and Armstrong: 2018: 92).

- **Suppliers**

Suppliers of domestic dry cargo shipping at Black Sea region can be specified according to their occupational groups as follows:

There are four company operating machine processing of metals (milling, grating, varnishing, grooving, combining, welding, etc.) except laser-cutting metals) and the use of machinery, such as oxygen CNC, CNC plasma, CNC water jet, etc. and writing on top of the machinery located at Zonguldak.

There are nine company operating construction of passenger ships and boats, ferries, tankers, refrigerated vessels, dry bulk carriers, tower and pusher craft, dredgers, offshore vessels, hovercrafts and other vessels (except for those used for sports and recreation) five of them located at Zonguldak, two of them at Samsun and two of them at Trabzon. Moreover, two companies operating in reconstruction or large-scale alteration of ships, floating platforms and structures at Zonguldak (TR Chamber of Shipping, 2019).

Shipyards at Samsun and Trabzon have a smaller capacity. One of them in Samsun and Trabzon constructs fishing vessels. Another company in Trabzon produces excursion boats and fishing vessels. Shipyards at Zonguldak have a bigger production capacity and variety of products.

In terms of companies operating maintenance and repair of other machines unclassified in any other place (including refill and repair of fire extinguishers), three companies located at Trabzon and branch office of one of them located at Samsun. Five companies located at Zonguldak operating maintenance and repairment of ships and boats (including maintenance, repairment and caulking of floating structures, wherries, etc (TR Chamber of Shipping, 2019).

As seen above, companies related to ship construction and repair are mainly located at Zonguldak. This clustering can be attributed to the proximity of steel and iron.

Three companies located at Samsun, one company located at Zonguldak and Rize are operating screening and cleaning of water and water catchment areas (groundwater) include (sea, rivers, lakes, etc.). These companies are providing underwater services. Two companies at Samsun and Zonguldak are operating construction of port along the coast and related hydro structures (structures such as waterways, roads, ports and marinas, piers and wharves, breakwaters, channels and so on.).

In terms of ship chandling activities, below mentioned companies can be taken into consideration.

There are two companies in the region operating on wholesale trade of vehicles (including ships, tugboats, locomotives, air vehicles and their spare parts and container but excluding land vehicle, motorbikes and bikes) located at Samsun and Bartın.

There is one company in Bartın and one company in Zonguldak operated on the profession of intermediates who selling ships, air vehicles, and unclassified vehicles based on a price or contract.

There are three companies at Zonguldak and one company at Samsun operating at retails of hardware equipment (nails, staples, screws, locks, hinges, connection parts hammers, saws, pliers, screwdrivers, sets, hooks, etc.) (including agricultural and gardening products). One company at Rize is operating on hunting and fishing equipment and supplies retail trade (sporting/hunting rifles and ammunition and fishing rods, pins and mushrooms to the fish, to birds, etc.).

Three companies operating as intermediaries that carry out wholesales on a fee or contract basis of a variety of goods located at Samsun. Samsun and Zonguldak have one company each operating on wholesales of drinks and tobacco in shops not allocated to any certain product (excluding frozen products).

One company is the manufacturing of sealed beam lamp units of motor vehicles and, electrical lighting or visual signaling equipment for air, land, air and sea vehicles (including the external warning lights of police cars, ambulances, etc.) and one company operating on security systems service activities (installation, maintenance of systems such as burglar and fire alarms, security systems, electronic safe control, the verification of such systems with an alarm signal received, and the mobilization of the police and fire departments) at Zonguldak. One company operating at wholesale trade of paints, varnishes, and lacquers found at Samsun and Trabzon. Two bunkering companies that are the profession of wholesale trade of liquid fuels and related products located at Trabzon and Samsun (TR Chamber of Shipping, 2019).

Dry Bulk Cargo Handling Ports at the Black Sea are Akkonak Port which does not give service to the third parties (Amasra Kaymakamlığı, 2019), Bartın Port, Giresun Port, Sinop Port, Erdem Cement Plant Port, Erdemir Port, Eren Port, Fatsa Terminal, Hopa Port, İneblu Port, Riport, Samsunport, Ordu Port, Toros Samsun Harbour, Trabzon Port, TTK Zonguldak Port, Unye Port, Samsun Yeşilyurt Port. In terms of regional competitiveness, Samsun has an important project Samsun Logistics Village Project, which is Turkey's biggest major EU-funded project. Samsun Logistics Village Project provides a logistics warehouse facility to the companies and the village is located near Tekkeköy District, about 15 km east of the city center. Samsun Logistic Village is located close to Samsun Port, Yesilyurt and Toros Ports and Çarşamba Airport, Samsun-Ordu highway. The railway line connecting Anatolia to the Black Sea is also linked to the Samsun Logistics Centre (Investsamsun, 2019). Filyos Port is planning to launch in 2023 that will serve for combined transportation (Deniz Haber, 2019). Container Port is also planning to construct at Ünye, Ordu that will enhance the combined transport with the completion of Ordu Highway and the Black Sea – Mediterranean Highway (DOKA, 2016b). Trabzon Port can identify the cargoes of Iran as a transit trade opportunity if the fuel is supplied to the Turkish trucks at the price of the Iran fuel market (Trabzon Liman İşletmeciliği, 2018: 12). Modern Silk Road is also seen as an opportunity for the ports of the region (Trabzon Port, 2009).

There are nine cargo and baggage handling services related to waterway transport (including container-handling services) company at Blacks Sea one of them located at Rize and two of them are located at Zonguldak, Trabzon, Samsun, Bartın.

In terms of pilotage and towage services, four company located at Samsun, two companies located at Ordu and one company located at Sinop (TR Chamber of Shipping, 2019).

- **Distribution Channels**

Four companies are listed in the brokerage services profession. Two of them operating at the activities of land road cargo transport commissioner's profession. There is one company operating at the activities of insurance brokers profession at Samsun, and one company operating at bill auditing and freight rate information activities profession at Zonguldak. Nine companies operating at logistic activities profession group. Twenty companies are operating at sea freight forwarding activities and brokers. Nine of them located at Zonguldak, four of them located at Bartın, three of them located at Kastamonu, one of them located at Ordu, Trabzon, Karabük, and Samsun (TR Chamber of Shipping, 2019).

- **Competitors**

The competitive power of the maritime industry is affected by the distributors', suppliers', and substitutes' and competitors' competitive power. Competitors may be inside of the industry (Cerit, 2013: 15). According to the mentioned information, at first competitors of the domestic dry bulk shipping are shipping companies that are acting in the industry. Cabotage dry cargo shipping profession group has three companies at Trabzon, one company at Zonguldak and Giresun. Cabotage and inland Mediterranean dry cargo shipping profession group has one company at Artvin, Zonguldak, Bartın, and Rize (TR Chamber of Shipping, 2019). There are also shippers having their ship in the industry. However, shipping companies operated in the region are not limited to these companies.

- **Customers**

Domestic dry bulk shipping cargo load customers at the Black Sea are cement, slag, copper, steel, iron, coal and fertilizer shippers. Clinker, marble, quartzite, quartz, gypsum rock, lime are also loaded cargoes in the region. There are also many types of dry cargo loaded and unloaded at the Black Sea that will be mentioned in detail in the following section.

- **Substitutes**

Domestic container shipping is a substitute for domestic dry cargo shipping. There is no direct container shipping line service between the cities of the Black Sea. Arkas Line has Turkey – Poti route which includes Istanbul (Marport)-Poti, Samsun, Istanbul (Marport). Arkas line also has some port of calls at the Black Sea that consist of Russia Express, Intra Black Sea Express, Marmara- Russia, Turkey- Bulgaria, West Mediterranean- Black Sea, Constanta Arzew Express, Black Sea Express (Arkas Line, 2019). A direct feeder route that links Piraeus (Greece), Kumport (Istanbul), Poti (Georgia), Novorossiysk (Russia), Piraeus (Greece), has announced to launch by Milaha that is a Qatar-based maritime transport company (Hellenicshippingnews, 2019). Medlog shipping has a container cabotage line serving between the ports of Marmara Sea (Medloggemicilik, 2019). Main ro-ro shipping companies operated at the Black Sea are Akdeniz that has services between Samsun-Novorossiysk and Samsun-Gelincik and Cenk Group that has services between Zonguldak-Chornomorsk (Kılıç, 2019). After Russia banned imports over Ukraine, the direct Ro-ro line between Turkey and Russia is planning (Yücel, 2019).

11 ports have railway connections throughout Turkey. As illustrated in Figure 23. Samsun Port and Zonguldak have railway connections at the Black Sea. At the Western Black Sea, there is the Irmak-Karabük-Zonguldak railway line which is connected with Ankara. Besides, the tender bid preparation processes of Adapazarı-Karasu-Zonguldak-Bartin Railway Line, which will connect the region to the Marmara Region, are also carried out (BAKKA, 2019d). The railway line connecting Anatolia to the Black Sea located at the Samsun (Investsamsun, 2019).

Road transportation is another alternative of domestic dry bulk shipping at the Black Sea. Black Sea Coastal road is 542 km starts from Samsun ends at Artvin Sarp and connects 6 cities, 64 districts, 17 sub-district, 9 ports, and three airports (Trt Haber, 2018a). Moreover, there are many planning road and tunnel projects in the region. Ilgaz Tunnel connecting the Central Anatolia and Western Black Sea has accelerated the logistics industry in the region (Habertürk, 2018). The first stage of the Ordu highway is opened (Habertürk, 2019), half of the construction of New Zigana Tunnel is completed which will be the longest tunnel of Turkey (Sabah, 2019), Ovit tunnel which is the longest tunnel of Turkey after the New Zigana Tunnel (Trt Haber, 2018b) connects the Blacks Sea to the Eastern Anatolia and Cankurtaran Tunnel creates an important link between the Black Sea and Eastern Anatolia and Iran (Artvin Valiliği, 2018).

- **Society and External Stakeholders**

Istanbul and Marmara, Aegean, Mediterranean and Black Sea Regions Chamber of Shipping has Karadeniz Eregli branch and representations at Giresun, Hopa, Ordu, Inebolu, Rize, Samsun, Sinop, and Trabzon (TR Chamber of Shipping, 2019).

At Black Sea Region there are four maritime faculty located at Ordu, Rize, Trabzon and Zonguldak. Samsun and Giresun have also Maritime Faculties that do not accept students yet. There are two companies at Samsun and one company at Trabzon operating on maritime education and one company at Trabzon operating engineering and consultancy activities.

Black Sea Economic Cooperation which is a regional international economic organization paid special attention to cooperation in transport focusing on intra region capacity and growing transit potential of the Black Sea region. Memorandum of Understanding on the Development of the Motorways of the Sea (MoS) at the BSEC Region is projected to develop maritime infrastructure and links. This can be an extension to the Trans-European Networks and the development of Euro-Asian transport links. The BSEC Member States will also maintain the development of the intermodal transport within the Black Sea Region, to develop competitive alternatives to road transport. Moreover, to facilitate the international trade among the BSEC Member States electronic document exchange during the clearance of goods in the seaports of the BSEC region is also presented in the action plan of BSEC (Black Sea Economic Cooperation, 2018).

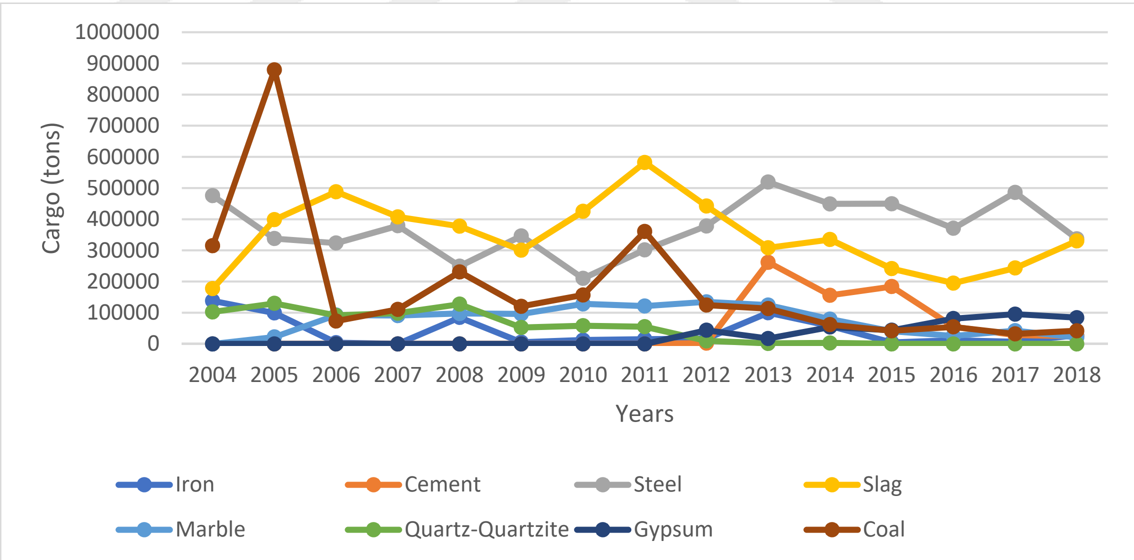
Black Sea Research Project analyzing the economic and social development of port cities at the Black Sea. This project focuses especially analyzing on sea and ports. This project consists of books, databases, statistics, and conferences (Black Sea Research, 2020). Black Sea Association of Maritime Institutions is an international organization aiming to increase the share of the seafarer supply of the Black Sea at the world (Black Sea Association of Maritime Institutions, 2019).

4.3.3.5. Current Domestic Dry Cargo Shipping Market Demand (Loaded Cargo)

The data used in this section is primarily collected through the Ministry of Transport and Infrastructure to reveal current domestic dry cargo market demand in the Black Sea. Loaded and unloaded domestic cargo volume data at the ports of Turkey were obtained. Data consists of fourteen years (01-2004 and 12.2018).

At TR 81, approximately a total of 18,273,671 tonnes of dry cargo had been loaded during the fourteen years. Figure 24 illustrates the loaded cargo volume in TR81. Karadeniz Eregli has the most of the cargo volume loaded in the region. Steel, slag, and coal are the most loaded cargoes especially between 01.2015 and 12.2018.

Figure 24. Most Loaded Dry Cargo Types and Volumes in TR81 Region



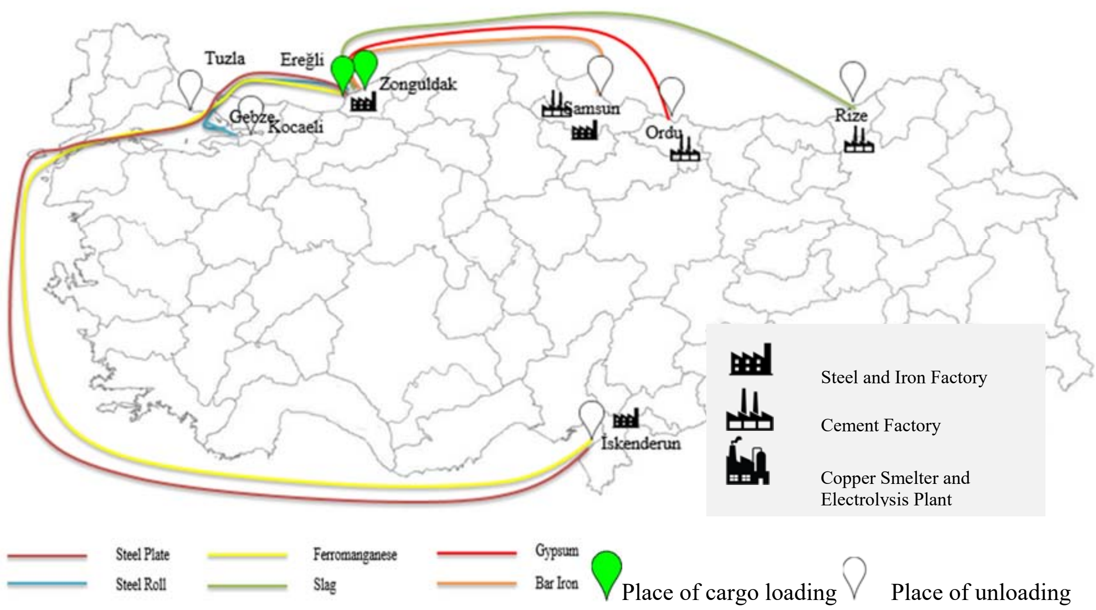
Source: Compiled from MTI, (2019b) by the Author

The route of the steel is mostly directed to Gemlik, İskenderun, Aliağa and Kocaeli. Slag is generally unloaded at Ambarlı, Ünye and Kocaeli. Slag has a wide range of usage as briquettes and brick making, railway ballast, cement industry, concrete aggregate, asphalt aggregate, filler material, insulation, glass production

(Uysal and Bahar, 2018: 48). Coal is frequently unloaded at İskenderun. Hopa and Zonguldak were also unloaded port for the coal loaded at Karadeniz Eregli. Figure 25. shows the loaded domestic dry cargoes from Zonguldak and factories located at its hinterland.

Cement is the most loaded dry cargo at Bartın between 01.2015 and 12.2018 and almost the whole of the cement is unloaded at Trabzon. Clinker that is mostly unloaded at Tekirdağ and slag that is mostly unloaded at Kocaeli and calcitic are the other cargoes shipped from the Bartın. Bartın Cement Plant is located at the Bartın's hinterland with 1 million metric tons of clinker and 1.5 million metric tons of cement production capacity per year (SANKO, 2019). Marble has not been loaded from Bartın anymore which was created a considerable amount of movement for the city until 2010.

Figure 25. Loaded Domestic Dry Cargoes from Zonguldak



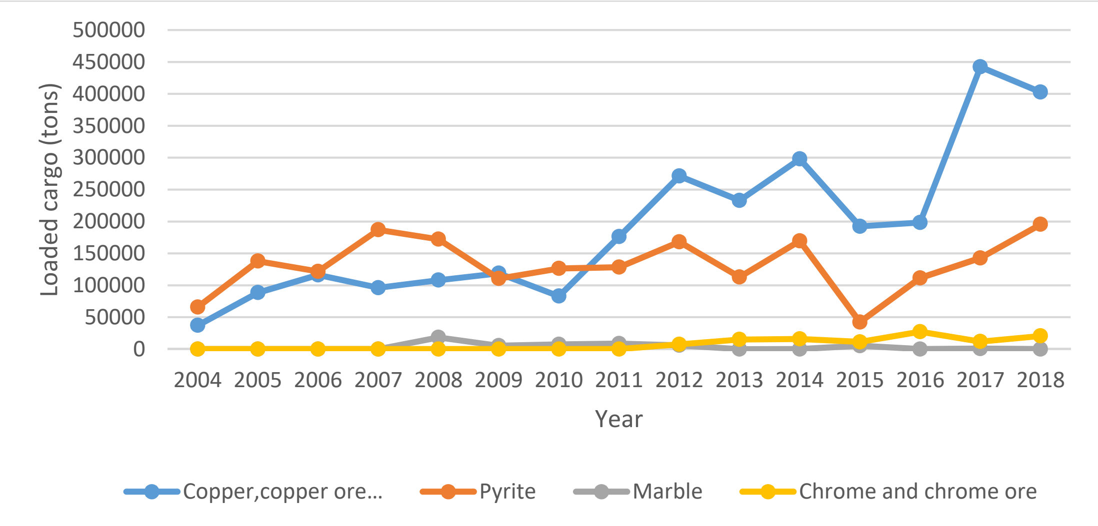
Source: Compiled from MTI, (2019b) by the Author

For Zonguldak, gypsum is the most frequently loaded cargo during the 01.2015 and 12.2018 which is unloaded at Unye. Slag is also another important cargo type that is directed to Bandırma, Hopa, Rize, and Unye.

Marble is the most important cargo type for Amasra and mainly unloaded at Ambarlı. Quartzite and quartz were loaded at Amasra until 2014 which was generally shipped to Tekirdağ.

In TR82, approximately 4,011,484 tonnes of dry cargo had been loaded during the fourteen years. Figure 26 illustrates the loaded volume at TR82. Inebolu has the most of the cargo volume loaded in the region.

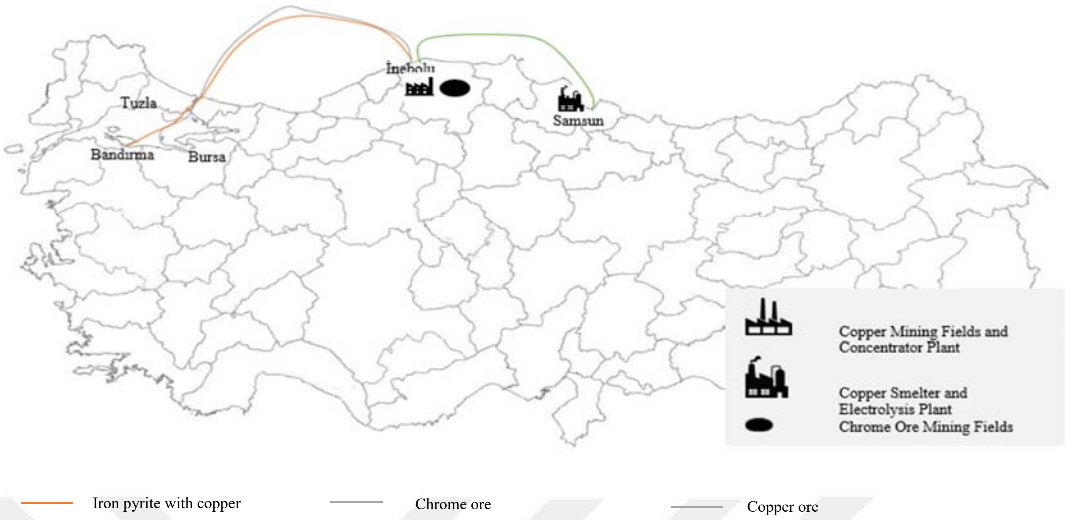
Figure 26. Most Loaded Dry Cargo Types and Volumes in TR82 Region



Source: Compiled from MTI, (2019b) by the Author

Figure 27 shows the loaded domestic dry cargoes from İnebolu and factories located at its hinterland. Eti Bakır A.Ş. leased the 49-year operating rights of the Inebolu Port on 26.07.2016 (Eti Bakır, 2019). Inebolu Port has Küre Plant of Eti Bakır A.Ş. which produces raw copper ore, copper concentrate, pyrite concentrates in its hinterland. Copper ore and copper concentrate, copper, iron pyrite with copper, pyrite, marble and chrome ore and concentrate are the most loaded cargoes in the region. The route of the copper was mostly directed to Samsun which has Smelter and Electrolysis Plant of Eti Bakır A.Ş. in its hinterland. Pyrite and iron pyrite with copper were shipped to Bandırma which has Boron and Acid Factory of Eti Maden in its hinterland. It is observed that cooper and pyrite load generally follows a similar pattern. Chrome ore and chrome concentrates were shipped to Ambarlı and Gemlik with an increasing trend. Cide is also a port authority in the region and there were marble and coal loads until 2010 which has not handled any dry cargo in last years.

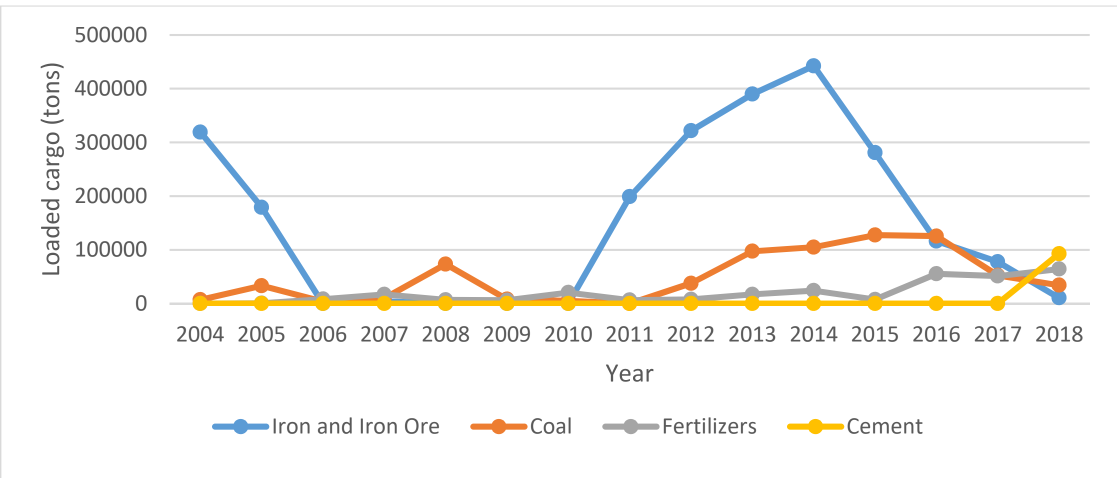
Figure 27. Loaded Domestic Dry Cargoes from İnebolu



Source: Compiled from MTI, (2019b) by the Author

In TR83, approximately 4,790,163 tonnes of dry cargo had been loaded during the fourteen years. Figure 28 illustrates the most loaded cargo types at Samsun. Iron and iron ore, coal and fertilizers are the most loaded cargo types in the region. Iron and iron ore were not handled at Samsun ports between 2006 and 2010. However, the gradual increase had occurred until 2014. In 2018, it was decreased extremely at low volumes.

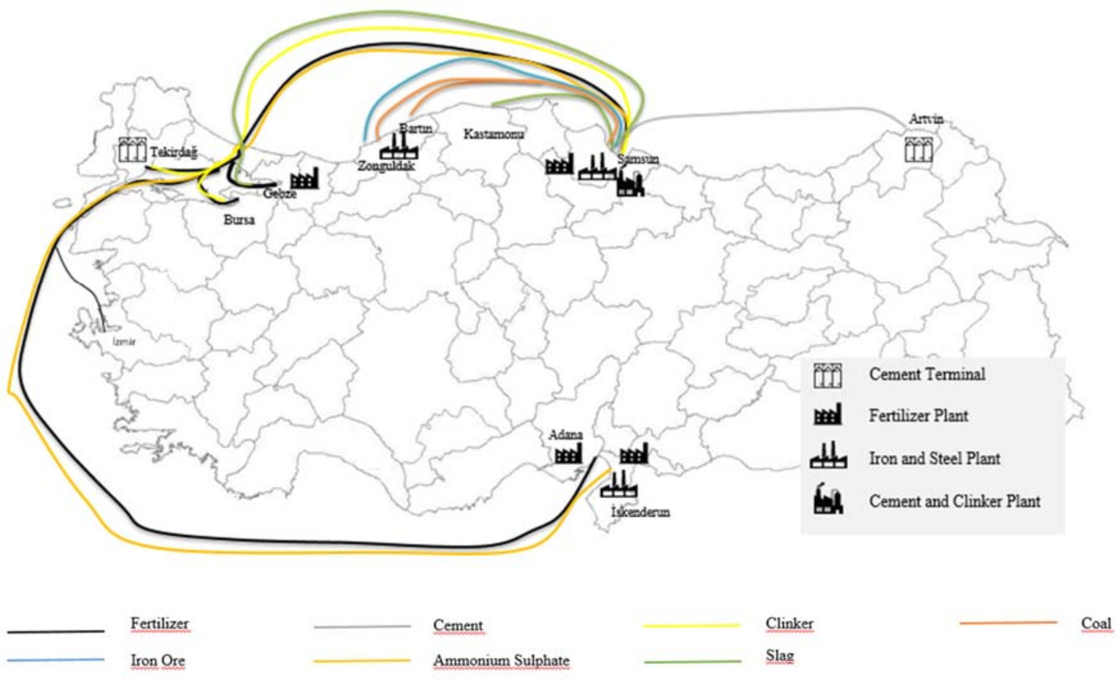
Figure 28. Most Loaded Dry Cargo Types and Volumes in TR83 Region



Source: Compiled from MTI, (2019b) by the Author

Figure 29 shows the loaded domestic dry cargoes from Samsun and factories located at its hinterland. Fertilizer loads have encountered an increase after 2015 which dates back the investment started in 2012 by Toros Agri. This new plant put into operation by 2015. Samsun Fertilizer Production Plant has a production capacity of 575.000 tons/year of fertilizers. Besides, Toros Samsun Terminal operated under the structure of the Samsun Production Plant (Toros, 2019). Coal loads increased in 2005 and 2008. The increase in 2008 was contrary to the high coal prices that year. Cement was shipped from Samsun to the Hopa frequently in 2018 and it was loaded more than other cargo types that year. This shipment could be a new market for the acting shipowners. In the last three years, a considerable amount of ammonium sulphate loaded from Samsun.

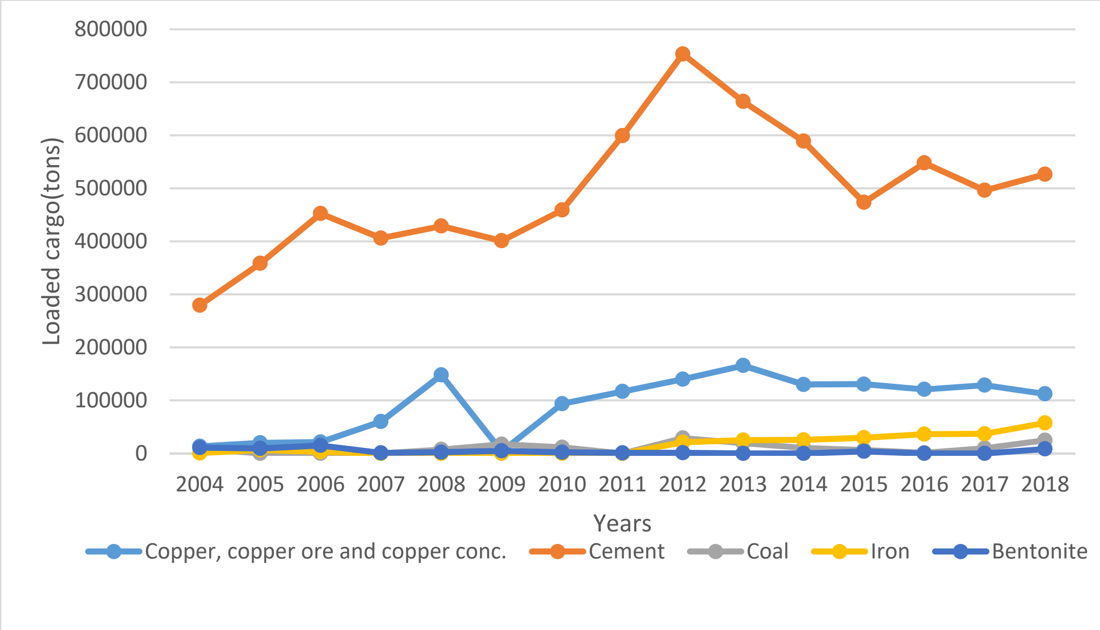
Figure 29. Loaded Domestic Dry Cargoes from Samsun



Source: Compiled from MTI, (2019b) by the Author

TR90, approximately 9,953,355 tonnes of dry cargo had been loaded during the fourteen years. Figure 30 illustrates the most loaded cargo types in the region. Pazar, Fatsa, Giresun, Hopa, Ordu, Rize, Sürmene, Tirebolu, Trabzon, Unye are the considered port authorities in the region.

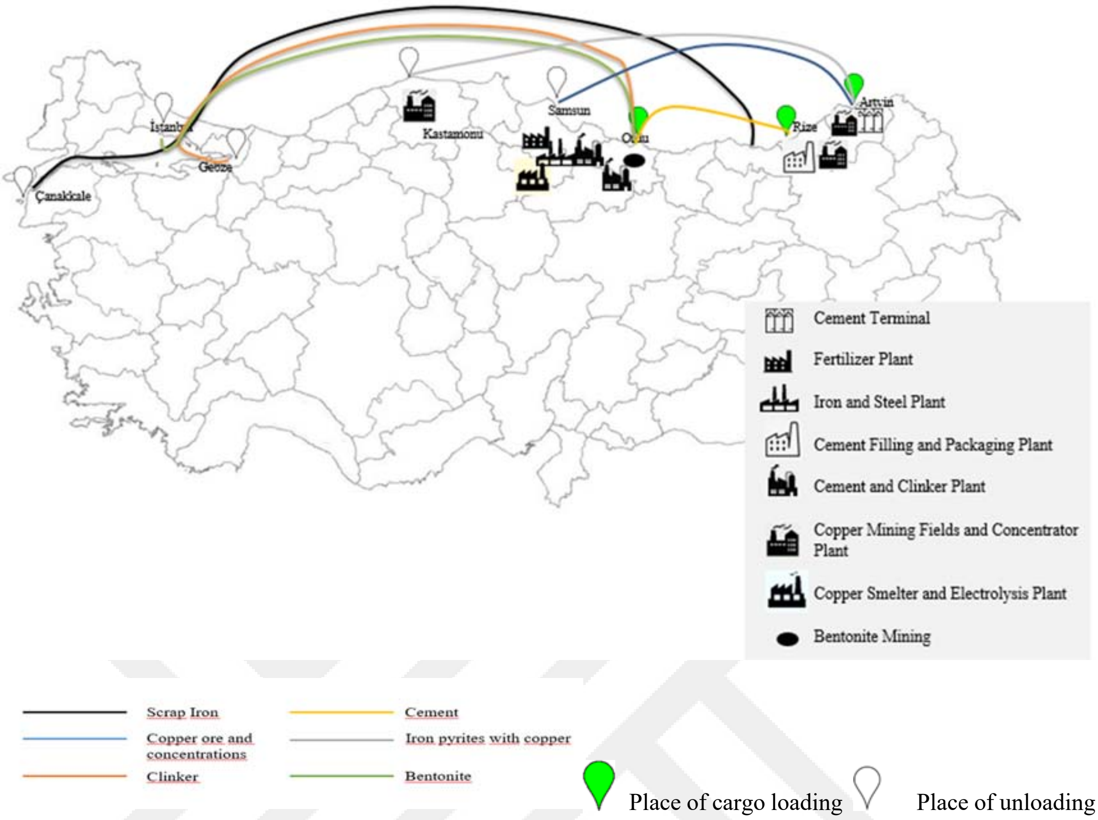
Figure 30. Most Loaded Dry Cargo Types and Volumes in TR90 Region



Source: Compiled from MTI, (2019b) by the Author

Figure 31 shows the loaded domestic dry cargoes from TR90 and factories located at its hinterland. Cement was the most loaded cargo type at the region which was generally shipped from Unye to Rize. Unye Cement which produces clinker and all types of cement located at Unye. Cement Filling and Packaging Plant of Unye Cement is located at Rize (Unye Cement, 2019). Copper, copper ore and copper concentration were the second most loaded cargo type at the region which was generally shipped to Samsun. Artvin also has Murgul plant of Eti Bakır A.Ş. in its hinterland. Coal at the region was generally loaded at Trabzon and Hopa. Bentonite was loaded at Unye. Iron was generally shipped from Trabzon to Karabiga and Hopa to Inebolu.

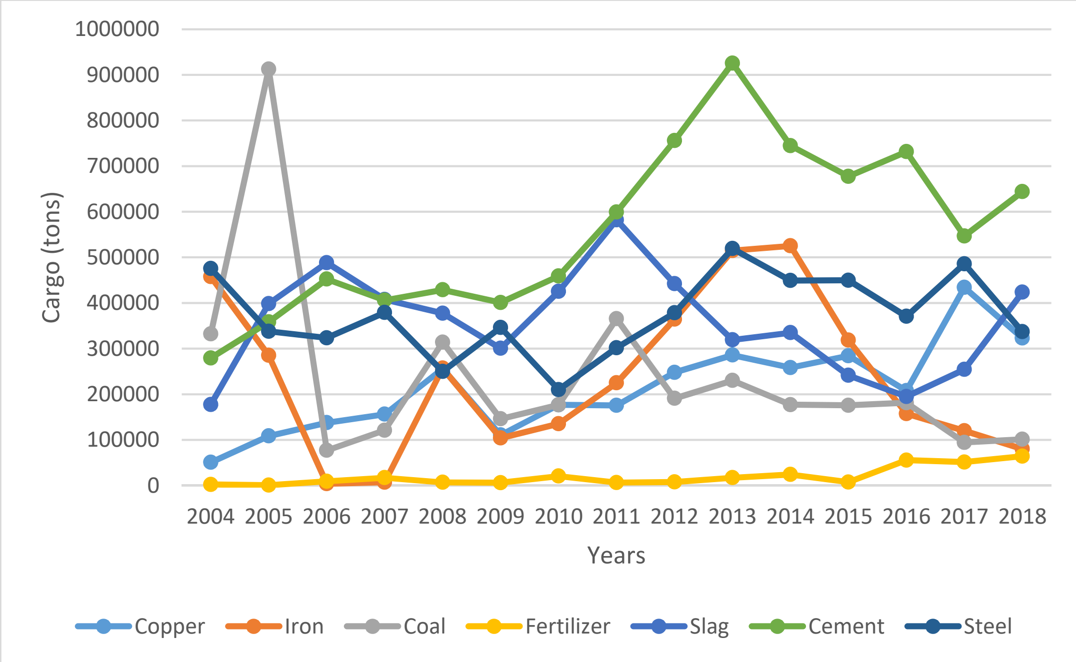
Figure 31. Loaded Domestic Dry Cargoes from TR90



Source: Compiled from MTI, (2019b) by the Author

In Black Sea Region approximately 38,831,671 tonnes of dry cargo had been loaded during the fourteen years. Figure 32 illustrates the most loaded cargo types in the region. Cement was the most loaded cargo type in the region. Steel and copper loads showed similar patterns in specified years. Iron loads had been presented a sharp decrease after 2014. Coal loads showed spikes every three years (2005, 2008, 2011). Despite the decreasing trend in the last two years, coal loaded at the same volumes after 2011. Iron and coal cargo loads also showed similar patterns. Cement and slag loaded nearly at the same volumes until 2011, nevertheless slag loads had been decreased after 2011. They still have followed a similar pattern.

Figure 32. Most Dry Cargo Types and Volumes Loaded at Black Sea Region

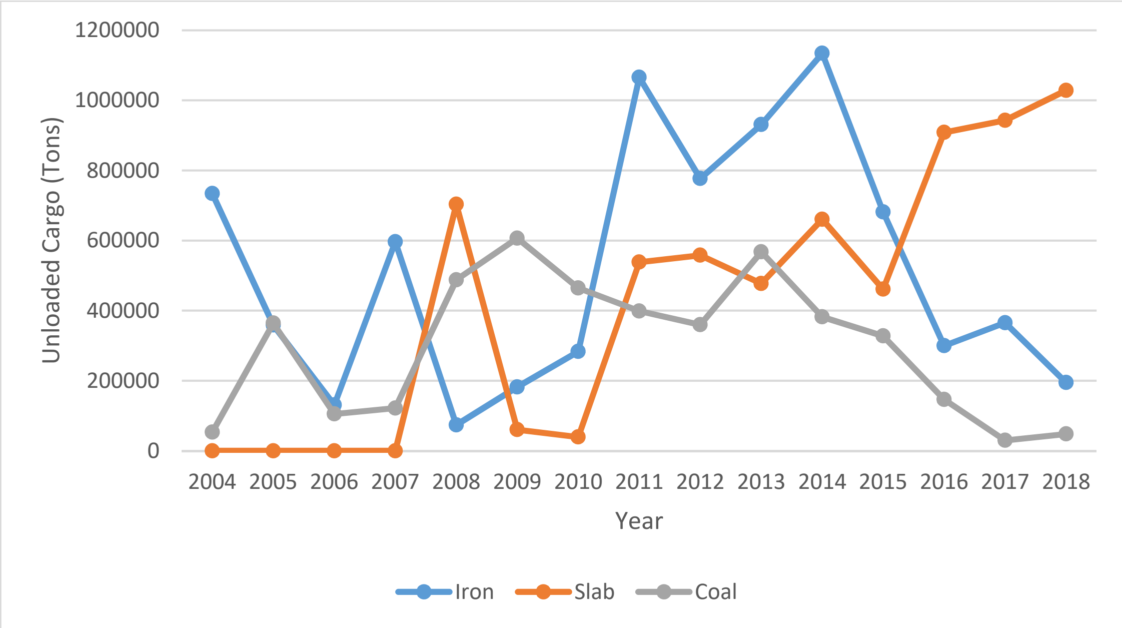


Source: Compiled from MTI, (2019b) by the Author

4.3.3.6. Current Domestic Dry Cargo Shipping Market Demand (Unloaded Cargo)

In TR81, approximately a total of 21,920,897 tonnes of dry cargo had been unloaded during the fourteen years. Figure 33 illustrates the unloaded dry cargo volume at TR81. Iron and iron materials, slab and coal are the most loaded cargoes in the region. However, there is a considerable amount of decrease in iron and coal unload since 2014. The slab loaded mainly from İskenderun and unloaded in Karadeniz Eregli with an increasing trend.

Figure 33. Most Dry Cargo Types and Volumes Unloaded at TR81 Region

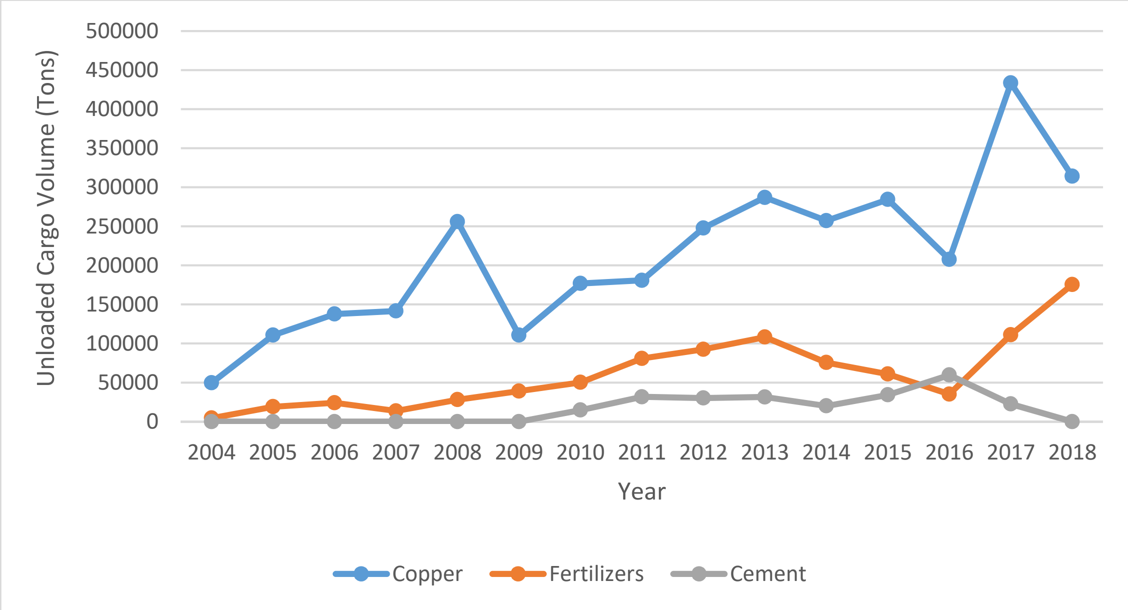


Source: Compiled from MTI, (2019b) by the Author

In TR82, approximately 126,975 tonnes of dry cargo unloaded during the fourteen years. Copper, iron and chrome ore and concentrates are the most unloaded cargo types at the region in parallel with most loaded cargoes. Iron pyrites with copper unloaded in Inebolu and loaded mainly from Hopa. Hopa has Murgul plant of Eti Bakır which produces 3,500,000 mt all in copper ore and 130,000 mt copper concentrate per year. A.Ş. in its hinterland (Eti Bakır, 2019).

In TR83, approximately 5,051,742 tonnes of dry cargo unloaded during the fourteen years. Figure 34 illustrates the unloaded dry cargo volume in TR81. Copper was the most unloaded cargo type in the region that is generally loaded from Inebolu and Hopa. Samsun has the only smelting plant of Turkey producing cathode copper from ore and Eti Bakir Co. Samsun plant produces 42,000 mt electrolytic copper and 200,000 mt sulphuric acids per year (Eti Bakır, 2019). Fertilizer unloaded in Samsun mainly shipped from Gemlik. Gemlik Gübre that has an important share of the domestic fertilizer market (Gemlik Gubre, 2019). Cement mainly loaded from Canakkale to Samsun. It is also important to note that cement and clinker producing factories are located at Çanakkale and Samsun which belongs to one of the main cement producers of Turkey (Akcansa, 2019).

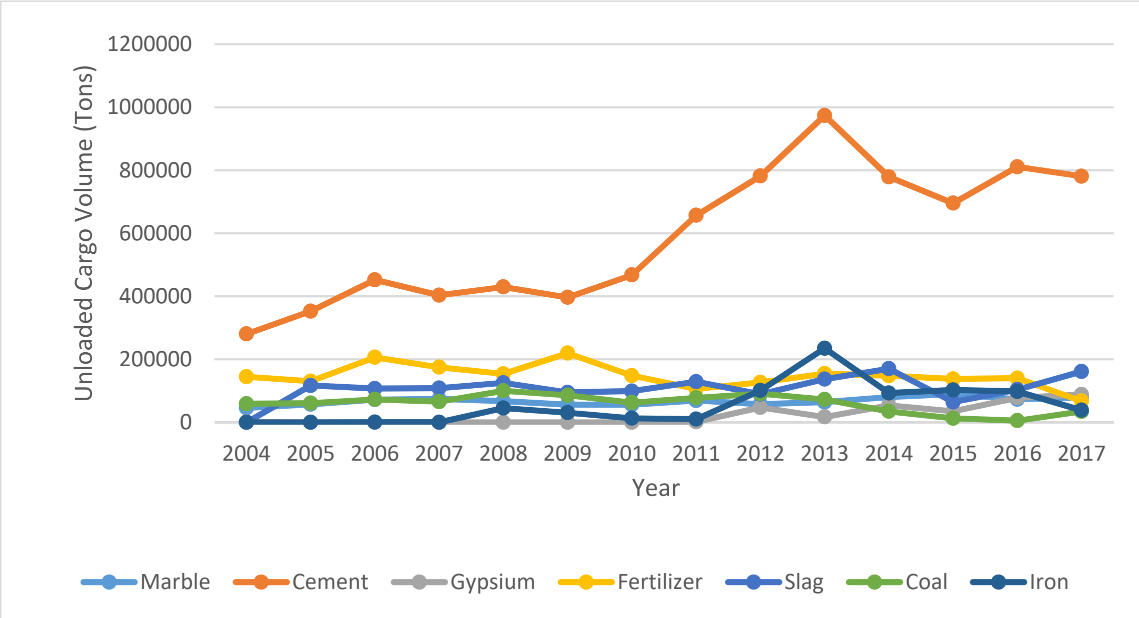
Figure 34. Most Dry Cargo Types and Volumes Loaded at TR83 Region



Source: Compiled from MTI, (2019b) by the Author

TR90, approximately 17,961,303 tonnes of dry cargo had been loaded during the fourteen years. Figure 35 illustrates the most loaded cargo types in the region. Pazar, Fatsa, Giresun, Hopa, Ordu, Rize, Sürmene, Tirebolu, Trabzon, Unye are the considered port authorities in the region. Cement was the most unloaded cargo type in the region and generally shipped from Unye to Rize. Cement Filling and Packaging Plant of Unye Cement located at Rize (Unye Cement, 2019). Fertilizer, slag, and marble are the other most unloaded cargo types in the region. Fertilizer mainly shipped from Gemlik, while slag mainly shipped from Karadeniz Eregli and Zonguldak to Unye and Rize. Marble mainly shipped from Marmara Adası to Unye.

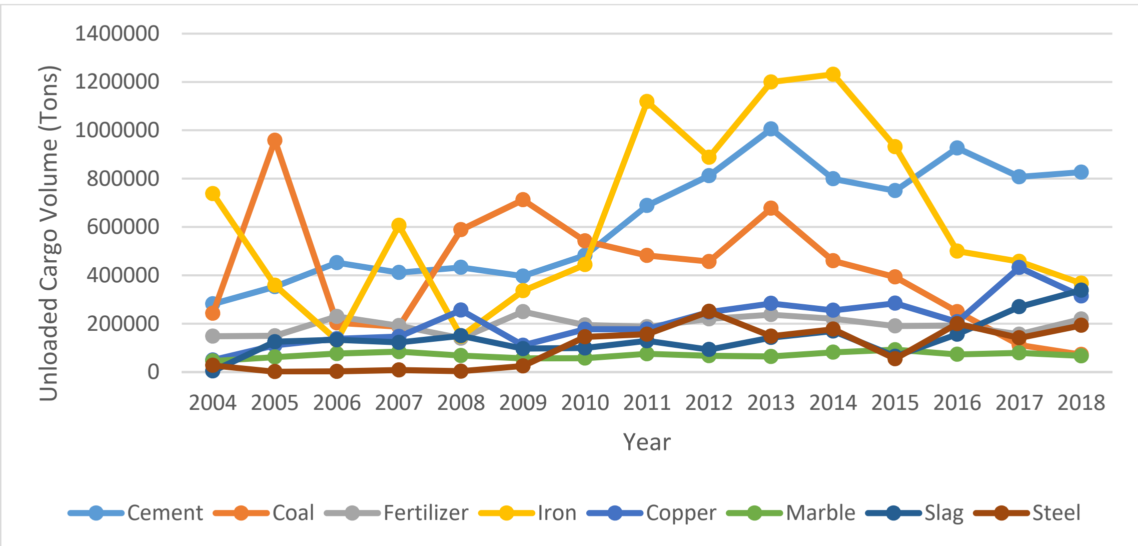
Figure 35: Most Dry Cargo Types and Volumes Loaded at TR90 Region



Source: Compiled from MTI, (2019b) by the Author

In Black Sea Region, approximately 47,083,135 tonnes of dry cargo had been unloaded during the fourteen years. Figure 36 illustrates the most unloaded cargo types in the region. Cement and iron were the most unloaded cargo type in the region. Iron and coal unload showed a decreasing trend in the last years.

Figure 36: Most Dry Cargo Types and Volumes Unloaded at Black Sea Region



Source: Compiled from MTI, (2019b) by the Author

4.3.3.7. Data and Data Collection Tools

Based on the characteristics and usage areas of the dry cargoes that are modeled (cement, slag, copper, steel, and iron) following variables were considered for developing models. In terms of cement demand, Fradinata et al. (2015: 378) pointed out GDP growth, population, number of customer, price, sales, promotion, quality, expectation future price, preference price as demand variables.

There are some steel production and demand forecasting studies. Economic variables are mentioned as the most influencing components of the steel industry. The quantity of steel consumed, the total value of production, rate of growth of GDP (Crompton, 2000: 103), real national income, the consumer price index, money supply, real investment, and steel consumption are considered while developing steel industry forecasting models (Chen et al., 1991: 198).

Table 18 presents the used variables and their definitions, data period and sources. The variables are determined based on the shipping forecast literature, shipping industry characteristics and variables and data characteristics. Cement, slag, copper, steel and iron are used as dependent variables while developing domestic dry cargo shipping demand models. Iron and steel are also employed as the independent variable while developing domestic slag shipping demand. Export, import, IPI, price and exchange rate are used as an independent variable and they are framed as their NACE codes and customs tariff (CTIP) chapters. Besides these variables, BDI is also tried to include while developing models. However, the results of these models present poor forecasting performances.

Table 18. Data and Data Sources

Variables	Definitions	Data Period (MM.YYYY)	Sources
Slag	Loaded Slag Volumes at Black Sea Ports of Turkey	01.2005-12.2018	MTI (2019b)
Export (Slag, copper)	Export by chapters, 1996-2019 (Value: Thousand US $) (Metallic ores, slag and ash)	01.2005-12.2018	TUIK (2019h)
Import (Slag, copper)	Import by chapters, 1996-2019 (Value: Thousand US $) (Metallic ores, slag and ash)	01.2005-12.2018	TUIK (2019h)
IPI (Slag, copper, steel)	Calendar adjusted industrial production index, 2005 – 2019 (Economic activity (Nace Rev. 2-24-Manufacture of basic metals)(2015=100)	01.2005-12.2018	TUIK (2019h)
Sales	Domestic Cement Sales at Black Sea	01.2005-12.2018	TÇMB (2019)
Cement	Loaded Cement Volumes at Black Sea Ports of Turkey	01.2005-12.2018	MTI (2019b)
Iron	Loaded Iron Volumes at Black Sea Ports of Turkey	01.2005-12.2018	MTI (2019b)
Steel	Loaded Steel Volumes at Black Sea Ports of Turkey	01.2005-12.2018	MTI (2019b)
Copper	Loaded Copper Volumes at Black Sea Ports of Turkey	01.2005-12.2018	MTI (2019b)
Price (Copper)	Copper, grade A cathode Monthly Price - US Dollars per Metric Ton	01.2005-12.2018	Indexmundi (2019)
Exchange Rate	(USD) US Dollar (Buying)	01.2005-12.2018	TCMB (2019)
Export (Cement)	Export by chapters, 1996-2019 (Value: Thousand US $) (Articles of stone, of plaster, of cement, of asbestos of mica or similar materials)	01.2005-12.2018	TUIK (2019h)
Import (Cement)	Import by chapters, 1996-2019 (Value: Thousand US $) (Articles of stone, of plaster, of cement, of asbestos of mica or similar materials)	01.2005-12.2018	TUIK (2019h)
IPI (Cement)	Calendar adjusted industrial production index, 2005 – 2019 (Economic activity (Nace Rev. 2-23-Manufacture of other non-metallic mineral products) (2015=100)	01.2005-12.2018	TUIK (2019h)
Export (Steel)	Export by chapters, 1996-2019 (Value: Thousand US $) (Iron and Steel)	01.2005-12.2018	TUIK (2019h)
Import (Steel)	Import by chapters, 1996-2019 (Value: Thousand US $) (Iron and Steel)	01.2005-12.2018	TUIK (2019h)
Price (Steel)	Commodity Metals Price Index, 2005 = 100, includes Copper, Aluminum, Iron Ore, Tin, Nickel, Zinc, Lead, and Uranium Price Indices	01.2005-12.2018	Indexmundi (2019)
CPI	Consumer price index numbers (2003=100)	01.2005-12.2018	TUIK (2019h)
Iprice	Commodity price data Iron ore, cfr spot ($/dmtu)	01.2005-12.2018	World Bank
Crude	Crude oil, average ($/barrel)	01.2005-12.2018	World Bank
Buildings	Calendar adjusted volume index of production buildings	01.2005-12.2018	Eurostat

Source: Author

4.3.3.8. Data Analysis and Data Pre-processing

While developing ANN-based models for forecasting domestic cement shipping, data is pre-processed to develop better accurate forecasting models.

Differencing applied to the cement, sales, IPI, export variables of domestic cement shipping. For domestic slag shipping data, Philips-Perron test results indicate that the variables are stationary apart from the IPI. As to domestic copper shipping demand, Philips-Perron test results indicate that the variables are stationary apart from the IPI and exchange rate. Therefore, differencing is not applied to these variables during model development of slag and copper shipping. For domestic steel shipping data, differencing applied to the exchange rate, IPI ad CPI. However, developed models did not result in good forecasts, and unprocessed data is used. Then data was scaled with min-max scaler with -1 and 1 range. Data were split into three as train, validation and test data. 131 training, 18 validation and 18 test data were used. Keras Deep Learning Package is used (Chollet, 2015) for developing MLP and LSTM models.

NARX model is formed with MATLAB's neural network toolbox (MATLAB, R2018b). Preparets (MATLAB function that prepares data for network simulation or training) fixed the data in the correct format for the NARX and there were ten hidden neurons. The training function is the Levenberg-Marquardt backpropagation. 131 training, 18 validation and 18 test data are employed.

While developing ARIMAX models of cement and steel shipping demand, the logarithmic transformation of the series is used to change units of the data to percentages to provide equality of the characteristics to the data. While developing ARIMAX models of slag and copper shipping demand, square root transformation is applied to the series to ensure the normality assumption. Then, used data have split into two as training and test data. 150 training observations, 18 test observations were used. To obtain optimal hyper-parameters for ARIMAX 'auto_arima' from Pyramid (Pmdarima, 2019) is used which is an API under MIT license based on selecting the model that minimizes the *Akaike information* criterion (AIC). The function selects the differencing terms with a test of stationarity (such as an augmented Dickey-Fuller test) and determines seasonality (such as the Canova-Hansen test) for seasonal models (Pmdarima documentation, 2019). Therefore, non-stationarity affect that is found above is handled with the 'auto_arima' of Phyton library, so any differencing process is not needed.

Within the light of the above-mentioned theoretical model, the hybrid model for the specified sample is developed in this study. After modeling the ARIMAX for the linear relationship, MLP is modeled to reveal any non-linear relationship. According to Moeeni and Bonakdari (2017), this non-linear relationship is highly dependent on the number of neurons. As a result, there is no accurate method to find the most suitable input combination. Because of the limited data, lags have not been considered and input trials are limited to four lags. For this study, the following combinations are identified where Q is the as:

ARMAX-ANN-1: Q_{t-1}, Q_{t-4}

ARMAX-ANN-2: Q_{t-1}, Q_{t-2}

ARMAX-ANN-3: Q_{t-1}, Q_{t-3}

ARMAX-ANN-4: Q_{t-1}, Q_{t-2}, Q_{t-3}

ARMAX-ANN-5: Q_{t-1}, Q_{t-2}, Q_{t-3}, Q_{t-4}

ARMAX-ANN-6: Q_{t-3}, Q_{t-4}

ARMAX-ANN-7: Q_{t-2}, Q_{t-4}

ARMAX-ANN-8: Q_{t-2}, Q_{t-3}, Q_{t-4}

ARMAX-ANN-9: Q_{t-2}, Q_{t-3}

ARMAX-ANN-10: Q_{t-1}, Q_{t-3}, Q_{t-4}

4.3.3.9. Forecasting Domestic Cement Shipping Demand

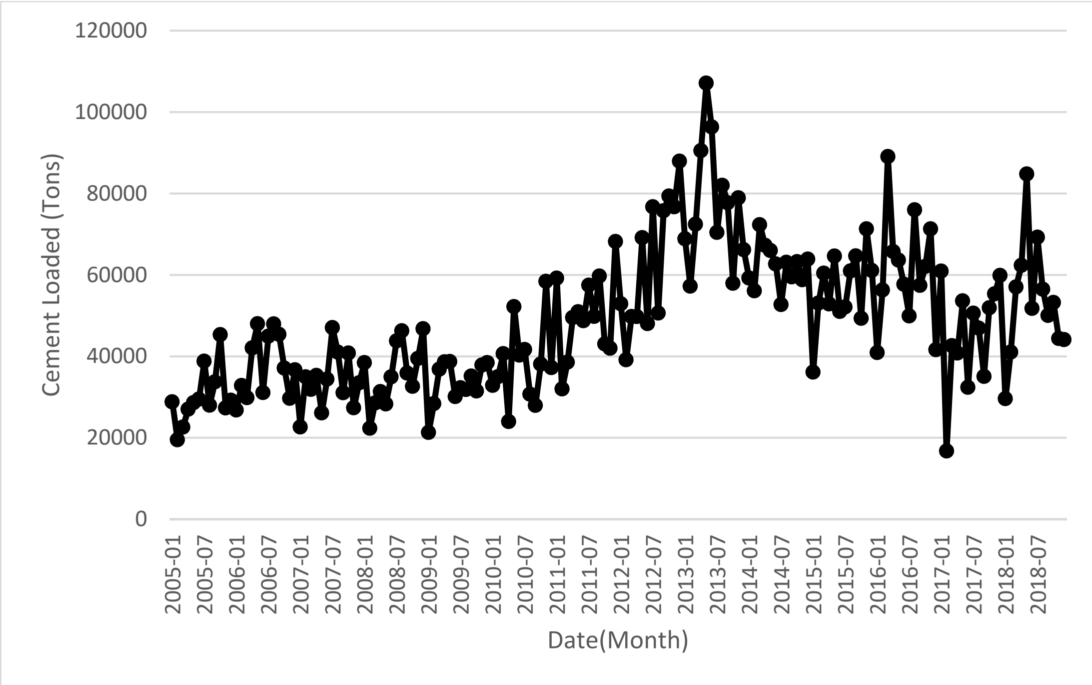
This part consists of the out of sample forecast models of domestic shipping demand based on ARIMA model and ANN models and hybrid model.

4.3.3.9.1. Data Characteristics

The cement industry has seasonal demand and price flexibility is low. The macroeconomic conditions of the country affect the cement industry easily. Transportation costs of the cement impress the cement industry to a considerable extent (Largo, 3001: 67, 71). Moreover, seasons also affect the cement industry as the sales are increasing at the warm weather (TÇMB, 2019). In parallel with the cement industry, the shipping of the cement is affected by seasonality. It is observed that the cement shipping load is increasing during the summer months, while it is decreasing during the winter months (Solak Fışkın and Cerit, 2019: 2).

Peaks generally have been realized in summer and spring while low observations have occurred in winter. As shown in Figure 37, loaded cement volumes are composed of convergent series until 2010, after that series has more spikes and downs.

Figure 37. Domestic Cement Shipping Loaded at Ports of Black Sea (Tons)



Source: Compiled from MTI, (2019b) by the Author

Figure 38 illustrates the distribution of the cement loaded at Black Sea Region. White cement, Portland cement, hydraulic cement, dry cement and other cement are positioned at the CTIP Chapter 25.23. Other cement and portland cement are the most loaded cement types respectively at the region and loaded from Unye. There are also cement loads, mostly Portland cement at Bartın.

Figure 38: Distribution of Cement Loaded at Black Sea Region

Source: Compiled from MTI, (2019b) by the Author

Figure 39 illustrates the distribution of the cement unloaded at Black Sea Region. Other cements and Portland cement are the most unloaded cement types respectively at the region and unloaded from Rize. There is also cement unloads, mostly Portland cement at Trabzon that is generally shipped from Bartın.

Figure 39: Distribution of Cement Unloaded at Black Sea Region

Source: Compiled from MTI, (2019b) by the Author

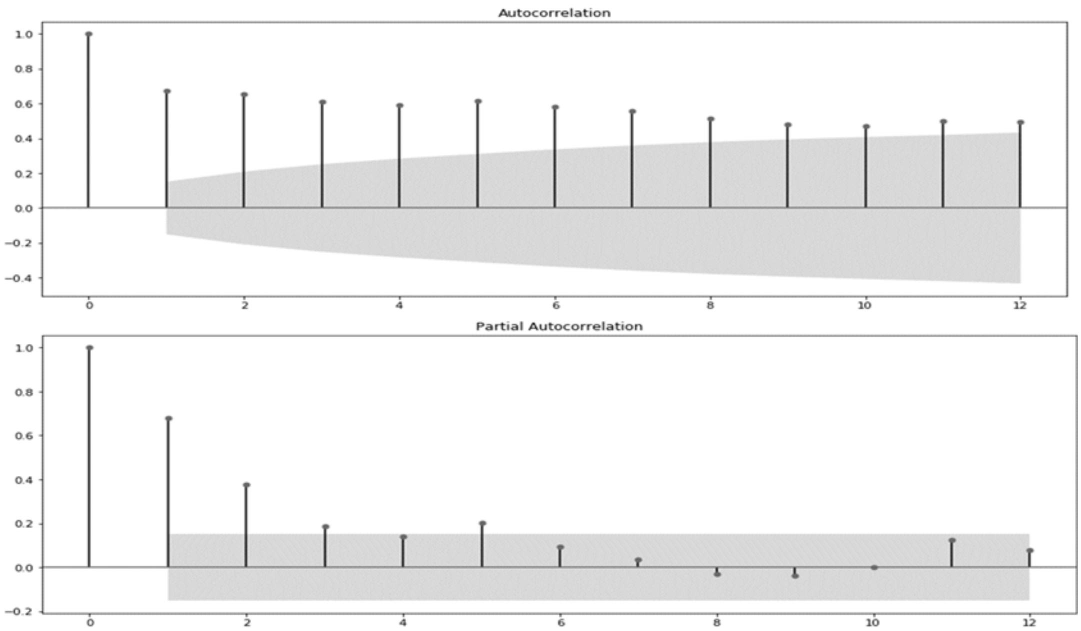
The descriptive statistics of the series are presented in Appendix 7. Total of 168 observations used for the development of the models. Cement, IPI and import variables have positive skewness that shows occurring increases are more probable than decreases. Sales and export have negative skewness that refers to occurring declines are more than probable than occurring increases at the data. All variables are platykurtic that have a flat top near the mean and shorter, thinner tails that refer to low probability for very extreme values.

Various time series methods rely on the assumption that data were sampled from a normal distribution (Machiwal and Jha, 2012:32). Shapiro-Wilk and Jarque-Bera normality tests performed to variables used in the study as presented in Appendix 6. The null hypothesis for the normality tests is normally distributed sample. The null hypothesis for the cement variable is rejected that infers the data was not drawn from a normal distribution. However, the logarithmic transformation of the data was drawn from a normal distribution.

Stationarity is tested with Dickey-Fuller and Philips Perron unit root test. The results are presented in Appendix 8 and reveal that cement, import, sales, IPI and export variables are stationary at the level in terms of P_P test. Cement, sales and IPI and export variables are stationary at their first differences in terms of the ADF Test.

Cement data have severe auto-correlation and presented that loaded series are serially correlated for all 12 lags as shown in Figure 40. PACF plot shows a spike at lag 1, 2, 3 and 5.

Figure 40. ACF and PACF Plot of the Domestic Cement Shipping Data



Source: Statsmodels output

The statistical association between the domestic cement shipping volume and used exogenous variables are searched with a cross-correlations matrix. This is shown in Table 19. As a result, the highest correlation existed between cement and sales variables. Besides, cement is also highly correlated with IPI.

Table 19. Correlation Coefficients of the Used Variables While Modelling Domestic Cement Shipping Demand Forecast

Variables	Cement	Sales	IPI	Export	Import
Cement	1.0	0.6542	0.6211	0.5589	0.3394
Sales	0.6542	1.0	0.7748	0.6899	0.3747
IPI	0.6211	0.7748	1.0	0.6387	0.4815
Export	0.5589	0.6899	0.6387	1.0	0.4262
Import	0.3394	0.3747	0.4815	0.4262	1.0

Source: Created by Author based on Statsmodels outputs

Seasonality is a repeated characteristic of the time series that occur at a fixed time interval (Xie et al., 2017:163). Literature proposed that both the cement industry as the sales are increasing at the warm weather (TÇMB, 2019) and cement shipping (Solak Fışkın and Cerit, 2019: 2). The Canova-Hansen test is applied to detect seasonality in the series. All variables used for the forecasting of the domestic cement shipping showed stable seasonal pattern contrary to the expectations. The reasons are observed in Figure 36. It is observed that there are downs in 2012-08, 2014-07 and peaks at 2010-11, 2011-01 as contrary to the expectations.

4.3.3.9.2. Results of ARMAX Model

Firstly, the ARMAX model with all variables has estimated. To find out the best model, variable selection has applied with eliminating with the highest probability. However, this method did not provide the best accuracy. Therefore, below listed models in Table 20 are tried based on the accuracy errors RMSE and MAPE. The model generated from the dataset is ARMAX (1,0,1). The best model is composed of Sales and IPI variables as consistent with the cross-correlations of the data.

Table 20. Comparison of the ARMAX Forecasts of Domestic Cement Shipping Demand

Model ARMAX (1, 0, 1)		
Variables	**RMSE**	**MAPE**
Sales, IPI	**9300.177**	**12.95**
Sales, IPI, Export	10391.861	13.37
Sales, IPI, Export, Import	10640.272	13.73
Sales, export	14343.725	19.56
Sales, IPI, import	11288.565	14.77
Sales, export, import	14092.812	19.91

Source: Created by Author based on “auto_arima” from Pyramid outputs

The estimated significant parameters are illustrated in the equation (17) and Table 21 as follows:

$$y_t = 1.0503 + 0.0547\text{sales} + 0.7273\text{IPI} + 0.8445Y_{t-1} - 0.5743\varepsilon_{t-1} \quad (17)$$

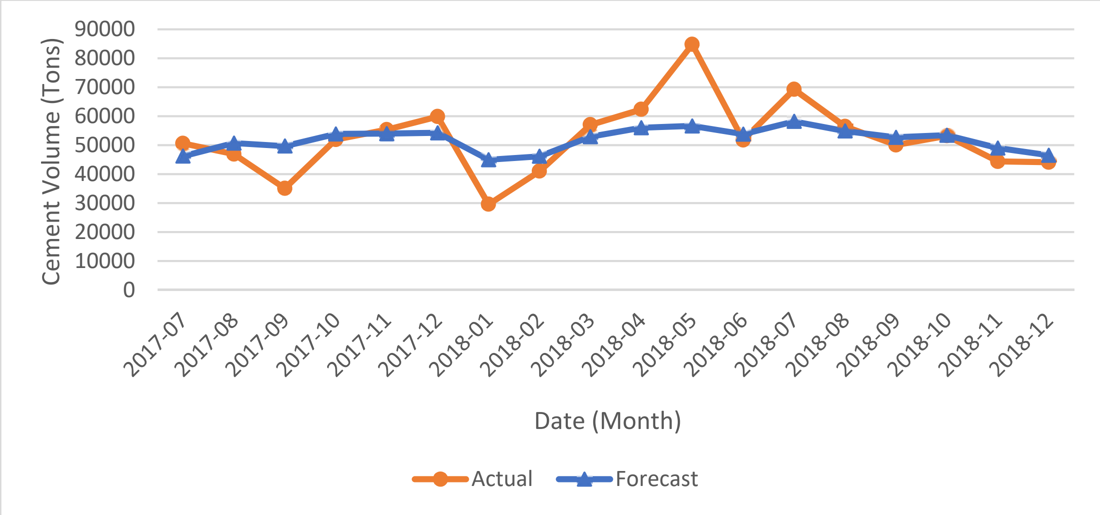
Table 21. Model Estimation of The ARMAX Model for Domestic Cement Shipping Demand

Variable	Coefficient (standard errors)	Z value	P>|z|
C	1.0503 (0.583)	1.802	0.072
Sales	0.0547 (0.049)	1.115	0.265
IPI	0.7273 (0.166)	4.385	0.000
ar.L1	0.8445 (0.091)	9.314	0.000
ma.L1	-0.5743 (0.169)	-3.407	0.001
sigma2	0.0473 (0.004)	11.955	0.000

Source: Created by Author based on “auto_arima” from Pyramid outputs

Figure 41 presents the best forecast which is obtained from the ARMAX model for domestic cement shipping. As shown below, out of sample forecasts of domestic cement shipping can be produced with the ARMAX model and the model is capable of produce effective forecasts. The estimated model is good at forecasting peaks and downs, but it is not good enough to forecast the range of these volatilities.

Figure 41. Results of ARMAX Forecasting for Domestic Cement Shipping



Source: Created by Author based on “auto_arima” from Pyramid outputs

After the model is estimated, ACF and PACF of the residuals were examined to check the adequacy of the model. Ljung–Box *Q* test is adopted to diagnose if the estimated residuals are white noise series or not. As seen in Figure 42, the result of the test indicates that the goodness of fit test of the optimum ARIMA models showed no significant autocorrelations in the residuals of the model. Therefore, it is deduced that the developed ARMAX model established correctly.

Figure 42. ACF and PACF of Residuals for The ARMAX Model of Domestic Cement Shipping

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.122	0.122	0.3158	0.574
		2	0.097	0.084	0.5290	0.768
		3	-0.129	-0.153	0.9272	0.819
		4	-0.165	-0.147	1.6268	0.804
		5	0.154	0.232	2.2833	0.809
		6	-0.270	-0.339	4.4778	0.612
		7	-0.164	-0.200	5.3608	0.616
		8	-0.251	-0.115	7.6329	0.470
		9	-0.045	0.023	7.7136	0.563
		10	0.031	-0.163	7.7580	0.652
		11	-0.028	-0.034	7.7983	0.731
		12	0.043	-0.019	7.9101	0.792

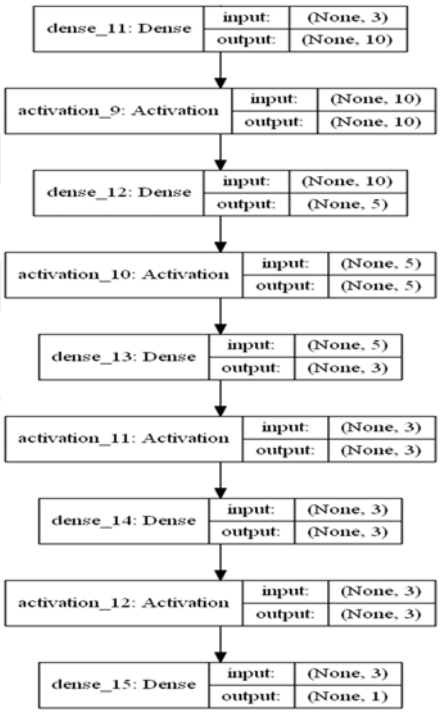
Source: Eviews outputs

4.3.3.9.3. Results of the ANN Models

4.3.3.9.3.1. Results of the MLP Model

Figure 43 illustrates the MLP model graph. MLP architecture is utilized as three input variables, three hidden layers with five, five and three neurons terminating at an output layer with the activation. Hidden layers utilized tanh activation functions and the network epoch was 600.

Figure 43. MLP Model Graph for Domestic Cement Shipping



Source: Keras Deep Learning Package outputs

Table 22 shows the used variable combinations while developing the MLP model. The best model is composed of IPI, export and import variables. Other combinations have insufficient accuracy. The combination of export and import variables has close accuracy to the best combination.

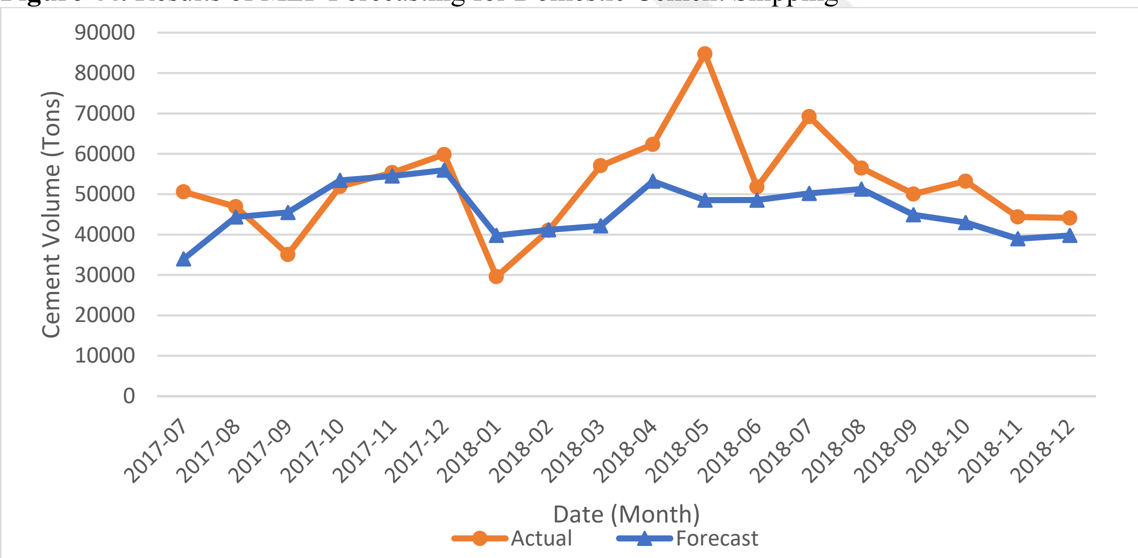
Table 22. Comparison of the MLP Forecasts for Domestic Cement Shipping

	MLP Model	
Variables	**RMSE**	**MAPE**
IPI, export, import	**12258**	**16.17**
IPI, export	29363	49.06
IPI	29321	48.99
Sales, IPI, export, import	23589	34.64
Sales, IPI	24542	40.44
Export, import	12732	18.39

Source: Created by Author based on Keras Deep Learning Package outputs

Figure 44 illustrates the results of the MLP out of forecasts for domestic cement shipping. It is inferred that although the acceptable forecasting accuracy of the model, MLP could not properly model the peaks and downs. Since there were no distinct volatilities, the last five months were forecasted thereabouts to the actual volume.

Figure 44. Results of MLP Forecasting for Domestic Cement Shipping

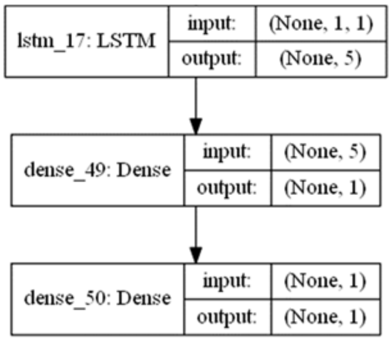


Source: Created by Author based on Keras Deep Learning Package outputs

4.3.3.9.3.2. Results of the LSTM Model

Figure 45 illustrates the LSTM model graph. LSTM architecture is utilized as one input variable, one hidden layer with five, five and three neurons terminating at an output layer with tanh activation. Hidden layers utilized tanh activation functions and the network epoch was 400.

Figure 45: LSTM Model Graph for Domestic Cement Shipping



Source: Keras Deep Learning Package outputs

Table 23 shows the used variable combinations while developing LSTM models. The best model is composed of only import variable. Other combinations have insufficient accuracies. The only combination of export and import variables has close accuracy to the best combination.

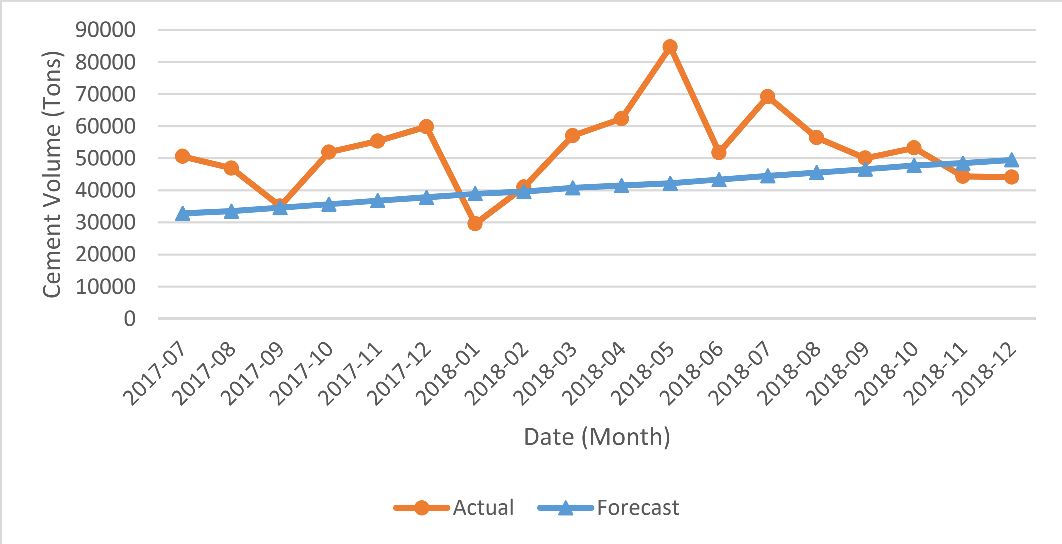
Table 23. Comparison of the LSTM Forecasts for Domestic Cement Shipping

	LSTM Model	
Variables	**RMSE**	**MAPE**
IPI, export, import	22269	34.26
IPI, export	25011	40.93
IPI	27466	45.42
Sales, IPI, export, import	22712	35.03
Sales, IPI	26561	43.70
Export, import	18596	26.59
Import	**16795**	**23.54**

Source: Created by Author based on Keras Deep Learning Package outputs

Figure 46 illustrates the results of the LSTM out of forecasts for domestic cement shipping. It is inferred that LSTM forecasted only the trend line with its best forecast. Although the forecast accuracy was at the reasonable accuracy range according to the MAPE, forecasts were not good at following the pattern.

Figure 46. Results of LSTM Forecasting for Domestic Cement Shipping

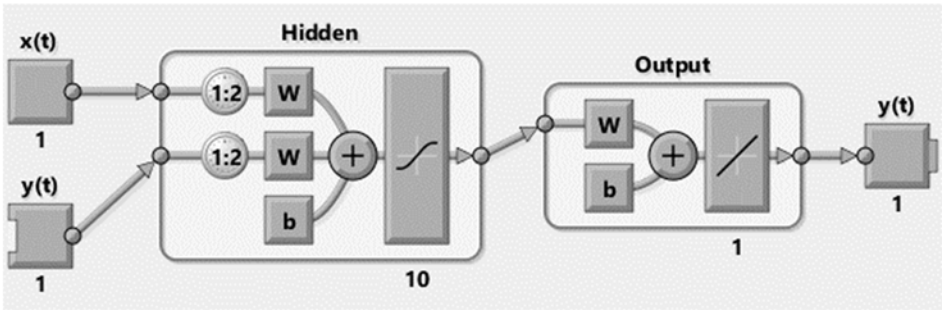


Source: Created by Author based on Keras Deep Learning Package outputs

4.3.3.9.3.3. Results of the NARX Model

Figure 47 illustrates the NARX model graph. The model has two input variables as export and past values of slag, ten hidden layers, and one output layer.

Figure 47: NARX Model Graph for Domestic Cement Shipping



Source: MATLAB neural network toolbox output

Table 24 shows the used variable combinations while developing NARX models. The best model was composed of the only export variable. Other combinations have also similar accuracy results. Only import variable, combination of export and import variable and combination of import and sales variable have also MAPE under 25%.

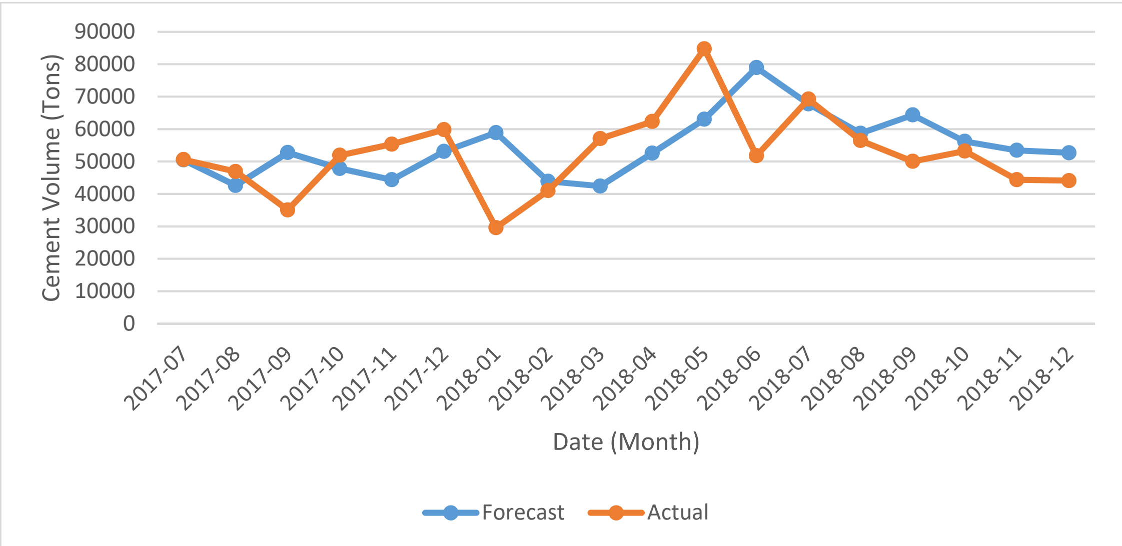
Table 24. Comparison of the NARX Forecasts for Domestic Cement Shipping

	NARX Model	
Variables	**RMSE**	**MAPE**
IPI, export, import	17129	30.86
IPI, export	26752	50.67
IPI	15681	30.20
Import	14741	23.16
Sales, IPI	26561	43.70
Export, import	13356	23.73
Export	**13490**	**22.45**
Export, IPI	26752	50.67
Import, IPI	17366	28.29
Import, sales	14416	25.86
Export, sales	16823	28.93

Source: Created by Author based on MATLAB neural network toolbox output

Figure 48 illustrates the results of the NARX out of forecasts for domestic cement shipping. It is inferred that NARX was quite successful at forecasting the loaded pattern of cement in given out of sample. However, it was not able to catch the peaks and downs.

Figure 48. Results of NARX Forecasting for Domestic Cement Shipping



Source: Created by Author based on MATLAB neural network toolbox output

4.3.3.9.4. Results of Hybrid Model

Firstly, the ARMAX model with sales and IPI variables were estimated. The model generated from the dataset is ARMAX (1,0,1). Then, the MLP model constructed with below-mentioned lags and with two input variables, three hidden layers with five, five and three neurons, one output layer. The activation function was tanh and the epoch was 120.

Table 25 shows the used variable lag combinations while developing hybrid model. Developed models have similar accuracy performances, two different evaluation metrics pointed out different models as accurate models. ARMAX-ANN-1 and ARMAX-ANN-3 were found as the best-performed models.

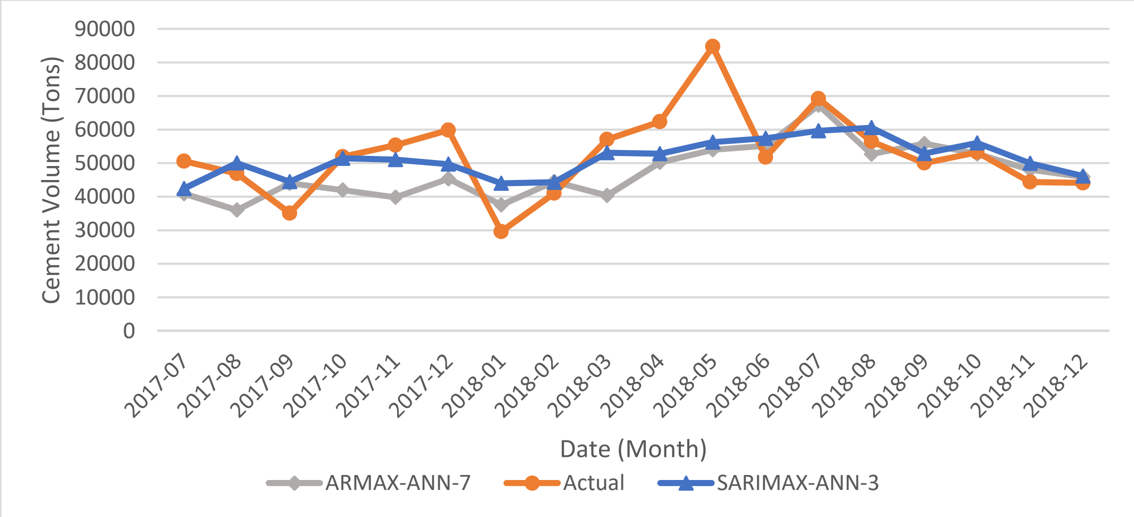
Table 25. Comparison of the Hybrid Forecasts for Domestic Cement Shipping

Hybrid Model		
Variables	**RMSE**	**MAPE**
ARMAX-ANN-1: Qt-1, Qt-4	10194	**13.33**
ARMAX-ANN-2: Qt-1, Qt-2	11115	16.22
ARMAX-ANN-3: Qt-1, Qt-3	**9469**	13.76
ARMAX-ANN-4: Qt-1, Qt-2, Qt-3	10734	14.80
ARMAX-ANN-5: Qt-1, Qt-2, Qt-3, Qt-4	13116	15.95
ARMAX-ANN-6: Qt-3, Qt-4	10968	13.45
ARMAX-ANN-7: Qt-2, Qt-4	11473	16.69
ARMAX-ANN-8: Qt-2, Qt-3, Qt-4	12851	15.92
ARMAX-ANN-9: Qt-2, Qt-3	11396	14.61

Source: Created by Author based on “auto_arima” from Pyramid outputs and Keras Deep Learning Package outputs

Figure 49 illustrates the results of the hybrid model out of forecasts for domestic cement shipping. It is inferred that the hybrid model is capable of produce effective forecasts. The estimated model is good at forecasting peaks and downs, but it is not good enough to forecast the range of these volatilities. However, the last peaks and downs were forecasted accurately.

Figure 49. Results of Hybrid Forecasting of Domestic Cement Shipping



Source: Created by Author based on "auto_arima" from Pyramid outputs and Keras Deep Learning Package outputs

4.3.3.9.5. Comparison of the Results

Table 26 shows that the ARMAX model outperformed than all the other methods. In this scenario, the performance of the LSTM method was considered in inaccurate forecasting with the largest RMSE and MAPE. ARMAX-ANN-4 method forecasted domestic cement shipping volume with good performance as well. Although the ARMAX-ANN model can capture both the linear and nonlinear nature of the data and uses the advantages of both models, it did not present better performance. Therefore, ANN-based models fail to model the volatilities properly, despite the preprocessed data. MLP model presented better performance than NARX and LSTM. Limited data could be the reason for the poor performance of the LSTM.

Variable combinations have differed with the used method. Sales and IPI have resulted as the most accurate combination for ARMAX, while export and import have presented the best combination for the MLP. Import variable used for the LSTM forecasting and export variable used for the NARX forecasting.

Table 26. Accuracy Comparisons of Domestic Cement Shipping Forecast Models

Forecast Model	MLP Model		ARMAX (1,0,1)		LSTM		NARX		ARMAX-ANN-4	
Forecast Error	MAPE	RMSE	MAPE	RMSE	MAPE	RMSE	MAPE	RMSE	MAPE	RMSE
	16.17	12258	12.95	9300	26.59	18596	22.45	13490	13.76	9469

Source: Author

4.3.3.9.6. Significances of the Model Performances

The significance test provides investigating the predictive ability of the models are due to pure chance or statistically significant (Mariano and Preve, 2012: 123). There is a debate on applying significance tests to forecasts. Some claim that the significance test is over-cautious, while others think that poor statistical forecasts cause overestimated results (Geer, 2016: 2). Kostenko and Hyndman (2008: 1) suggest researchers should not emphasize on p-values and should emphasis more on the predictive ability of models.

In this dissertation, DM test and paired t-test have implemented for the significances of the developed models and these tests have implemented via the R software package.

To discuss the developed models in detail, t-tests are conducted to examine the significances of the model performances. T-test results are based on the comparison of MAPE of the residuals. The *p*-value for each t-test presented in Table 27. The tests have resulted at a significance level of 95%, therefore p-values <0.05 indicate models that vary significantly.

The paired t-test between the results of the ARMAX method and the LSTM method also shows that there are significant differences between these two methods with a p-value of less than 0.05. LSTM and MLP, NARX and ARMAX, Hybrid and LSTM, Hybrid and NARX method also show that there are significant differences between these two methods.

Furthermore, Diebold–Mariano test (1995) is adopted to evaluate the statistical significance of performances of developed models in depth. DM test aims to test the null hypothesis of equal accuracy of the two competing models. The null hypothesis of the DM test can be rejected for four of the compared models. LSTM and MLP, LSTM and Hybrid, LSTM and ARMAX indicate different accuracies. According to the DM test, the LSTM model has presented different accuracies. However, when p-values are considered as $p < 0.10$, MLP and ARMAX, MLP and Hybrid, ARMAX and NARX models also considered as having different accuracy. It is obtained that the rest of the developed models have similar forecasting accuracy. As a result of the two of the used significance tests., LSTM and MLP, NARX and ARMAX, Hybrid and LSTM models are found to have different accuracies.

Table 27.T-test and DM Test Results of Domestic Cement Shipping Forecast Models

	MLP	ARMAX	LSTM	NARX	Hybrid
MLP		-1.7491 (0.0983)	-3.6112 (0.0021)	-0.38309 (0.7064)	1.7375 (0.1004)
ARMAX	**-1.2464** **(0.2295)**		-3.3389 (0.0038)	-1.6757 (0.1121)	-0.32387 (0.75)
LSTM	**2.5727** **(0.0197)**	**2.7099** **(0.0148)**		-1.3702 (0.1884)	-3.5165 (0.0026)
NARX	**1.1465** **(0.2675)**	**2.3662** **(0.0301)**	**-0.53834** **(0.5973)**		-1.576 (0.1335)
Hybrid	**-1.0941** **(0.2892)**	**0.62029** **(0.5433)**	**-2.9861** **(0.0082)**	**-2.0834** **(0.0526)**	

* Bold fonts are the results of the t-test

Source: Created by Author based on R Studio outputs

4.3.3.10. Forecasting Domestic Slag Shipping Demand

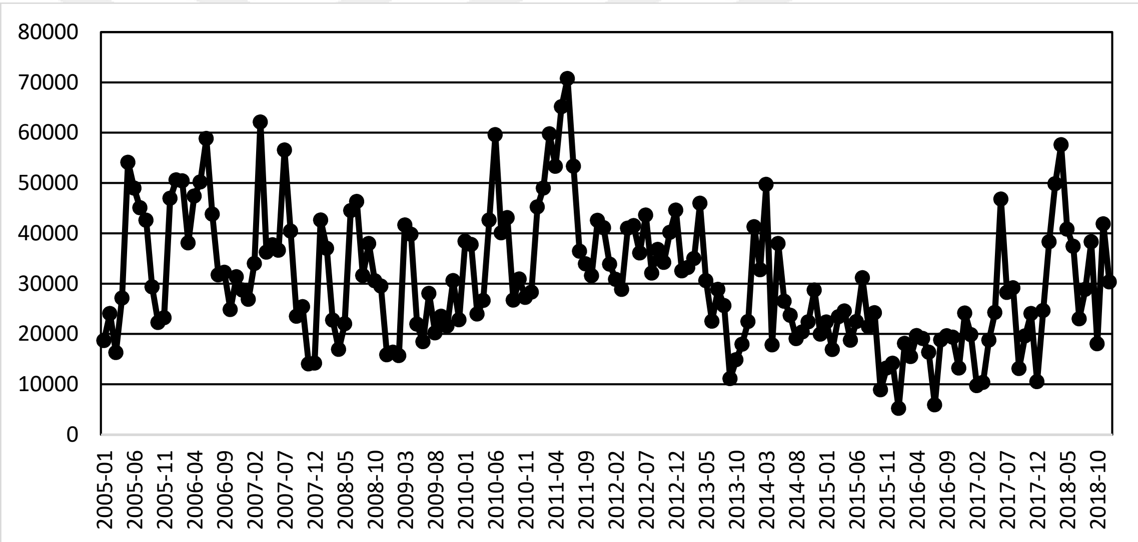
In this part, the out of sample forecast models of domestic slag shipping demand based on the ARIMA model, ANN models and hybrid model are reported.

4.3.3.10.1. Data Characteristics

World Steel Organization suggests the use of slag to contribute material efficiency and achieve zero-waste during the steelmaking process (World Steel Association, 2018:1). used in ready-mixed concrete, concrete products, asphaltic concrete, road bases and surfaces, fill, clinker raw material, railroad ballast, roofing, mineral wool (for use as insulation) and soil conditioner, portland cement production (World Steel Association, 2018:2) and synthetic slag production (aluminium based flux) for iron and steel industry, secondary alumina production (TR Ministry of Environment and Urbanisation, 2016: 42). Uysal and Bahar (2018: 48) proposed that the recovery rate of steelmaking slag should be increased in Turkey. In light of this information, there is still potential to increase the use of slags in Turkey.

Domestic slag shipping depends on the steelmaking, ironmaking and cement industries in Turkey. As shown in Figure 49, the slag shipping volume has increased during the summer months, while has decreased during the winter months. Peaks generally have been realized in summer and spring while low observations have occurred in winter. Slag shipping load volume also observed as very volatile. Slag could have seasonality characteristics in parallel with the cement industry. However, the Canova-Hansen test is used to detect seasonality and resulted that there is no seasonal effect at the sample.

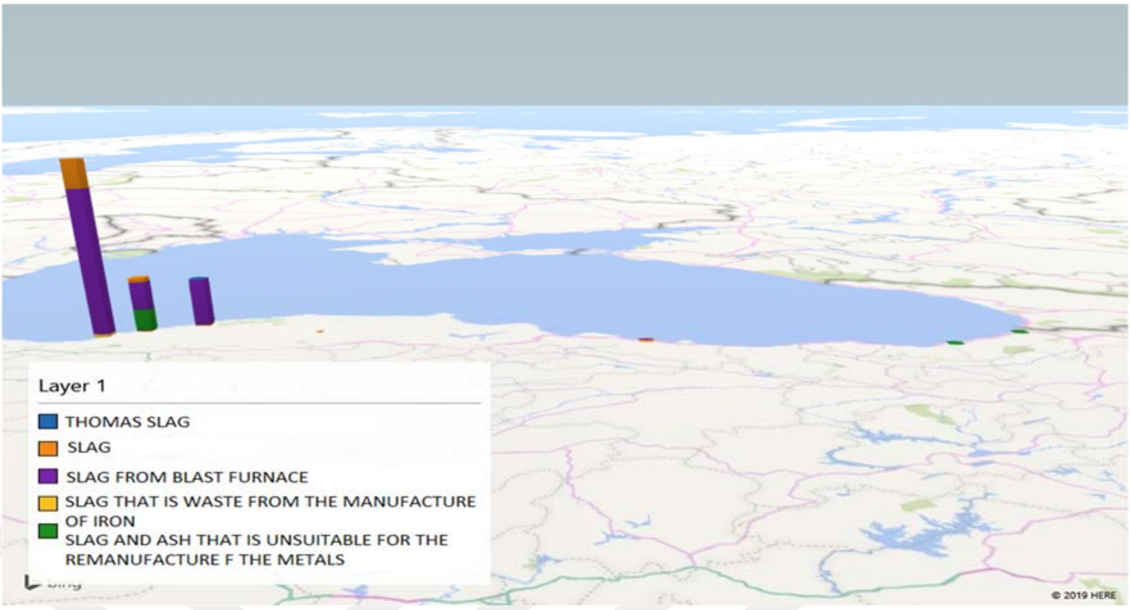
Figure 50. Domestic Slag Shipping Loaded at Ports of Black Sea (Tons)



Source: Compiled from MTI, (2019b) by the Author

Figure 51 illustrates the loaded slag at the ports of the Black Sea. Thomas slag is important phosphoric fertilizer that is positioned CTIP (Customs Tariff Statistics Position) in Chapter 31. Thomas slag loaded approximately 14.000 tons for fourteen years. It constitutes only a little portion of the loaded slag. Slag, slag from the blast furnace, waste from the manufacture of iron, slag and ash that is unsuitable for the remanufacture of the metals are positioned at CTIP in Chapter 26. Slag from blast furnace is the most loaded slag type and most of the slag is loaded from Karadeniz Eregli, Zonguldak and Bartın.

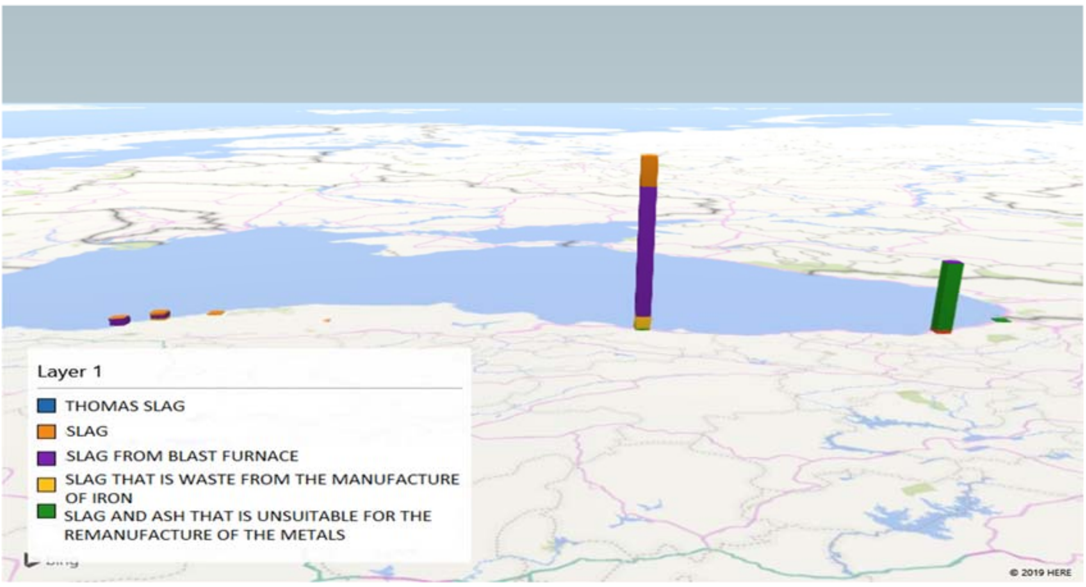
Figure 51. Distribution of The Slag Loaded at Black Sea Region



Source: Compiled from MTI, (2019b) by the Author

Figure 52 illustrates the unloaded slag distribution at the ports of the Black Sea. Slag from the blast furnace is the most loaded slag type and unloaded in Unye. Slag and ash that is unsuitable for the remanufacture of the metals is the second most unloaded slag type at the region and unloaded in Rize.

Figure 52. Distribution of The Slag Unloaded at Black Sea Region



Source: Compiled from MTI, (2019b) by the Author

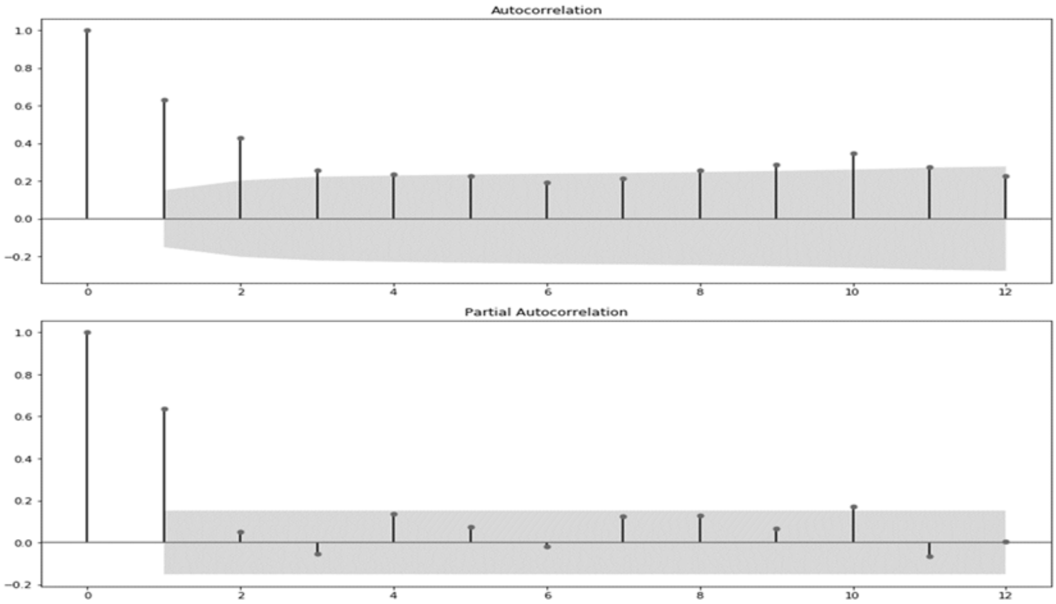
The descriptive statistics of the series are presented in Appendix 7. Total of 168 observations used for the development of the models. Slag, import, iron, steel and cement variables have positive skewness that shows occurring increases are more probable than decreases. Sales, IPI and export have negative skewness that refers to occurring declines are more than probable than occurring increases at the data. Slag, export, IPI, sales, and steel are platykurtic that have a flat top near the mean and shorter, thinner tails that refer to low probability for very extreme values. Imports, cement, and iron have positive kurtosis that leptokurtic distribution referring to fatter tails.

Shapiro-Wilk and Jarque-Bera normality tests performed to variables used in the study as presented in Appendix 6. The null hypothesis for the normality tests is normally distributed sample. The null hypothesis related to normality was rejected for slag, sales and IPI, and cement. However, the square root transformation was drawn to normalize the data.

Stationarity is tested with Dickey-Fuller and Philips Perron unit root test. The results are presented in Appendix 8 and reveal that export and import variables are stationary at the level in terms of P-P and ADF tests. Slag, cement, sales, iron, and steel are stationary at the level in terms of the P-P test and stationary at their first differences in terms of the ADF test. IPI is stationarity at first differences in terms of the P-P test.

Slag data have auto-correlation and presented that the series is serially correlated at lag 1, 2 and as shown in Figure 53. PACF plot shows a spike at lag only 1 and 10.

Figure 53: ACF and PACF Plot of the Domestic Slag Shipping Data



Source: Statsmodels outputs

The statistical association between the domestic slag shipping and used exogenous variables is searched with a cross-correlations matrix. This is shown in Table 28. All variables apart from imports have a negative correlation with the slag. Correlation coefficients indicate the poor correlation between the slag and exogenous variables. As a result, the highest negative correlation existed between slag and IPI and slag and steel variables.

Table 28. Correlation Coefficients of the Used Variables While Modelling Domestic Slag Shipping Demand Forecast

Variables	Slag	Export	Imports	IPI	Cement	Sales	Iron	Steel
Slag	1	-0.0196	0.0107	-0.2168	-0.0730	-0.1176	-0.0209	-0.1703
Export	-0.0196	1	0.4412	0.6022	0.5149	0.5045	0.3318	0.1955
Imports	0.0107	0.4412	1	0.3493	0.3420	0.3279	0.2160	0.0246
IPI	-0.2168	0.6022	0.3493	1	0.6376	0.6746	0.3233	0.3041
Cement	-0.0730	0.5149	0.3420	0.6376	1	0.6542	0.4082	0.2567
Sales	-0.1176	0.5045	0.3279	0.6746	0.6542	1	0.2860	0.2589
Iron	-0.0209	0.3318	0.2160	0.3233	0.4082	0.2860	1	0.3629
Steel	-0.1703	0.1955	0.0246	0.3041	0.2567	0.2589	0.3629	1

Source: Created by Author based on Statsmodels outputs

The Canova-Hansen test is applied to detect seasonality in the series. All variables used for the forecasting of the domestic cement shipping showed stable seasonal pattern contrary to the expectations. The reasons for this can be explained by Figure 49. It is observed that there are several contrary movements to the seasonality.

4.3.3.10.2. Results of the ARIMAX Model

Firstly, ARMAX model with all variables has estimated. To find out the best model, variable selection has applied to eliminate the highest probability. Nevertheless, below listed models in Table 29 are tried to base on the accuracy errors. The model generated from the dataset is ARIMAX (0,1,3). Unit root test results also indicated the necessity of the differencing. The best model is composed of import, cement, sales, iron and steel variables. This is consistent with the findings of "4.3.3.5. Current Domestic Dry Cargo Shipping Market Demand (Loaded Cargo)" part which points out slag loads are following a similar pattern with cement and steel loads.

Table 29. Comparison of The ARIMAX Forecast of Domestic Slag Shipping Demand

Model ARIMAX (0, 1, 3)		
Variables	**RMSE**	**MAPE**
Export, IPI	16772.84	39.44
Sales, IPI	16627.52	39.05
Export, Import	16647.59	38.60
Export, Import, Cement	16672.40	38.49
Cement	16445.85	37.81
Import, Cement, Sales	16299.58	37.61
Import, Cement, Sales, Iron	16312.55	37.36
Export, Import, IPI, Sales, Cement, Iron, Steel	16142.57	36.69
Export, Import, Sales, Cement, Iron, Steel	16324.58	37.29
Cement, Sales, Iron, Steel	16029.05	36.38
Sales, Iron, Steel	16056.14	36.49
Cement, Iron, Steel	16101	36.52
Steel	15903.52	36.63
Import, Cement, Sales, Iron, Steel	**15893.93**	**36.22**

Source: Created by Author based on auto_arima' from Pyramid outputs

The estimated significant parameters are illustrated in equation (18) and Table 30 as follows:

$$Y_t = -0.2911 - 0.0193 \text{ Import} + 0.1460 \text{ Cement} - 0.0026 \text{ Sales} + 0.0364 \text{ Iron} - 0.0883 \text{ Steel} - 0.3909\, \varepsilon_{t-1} - 0.1772\, \varepsilon_{t-2} - 0.2692\, \varepsilon_{t-3} \tag{18}$$

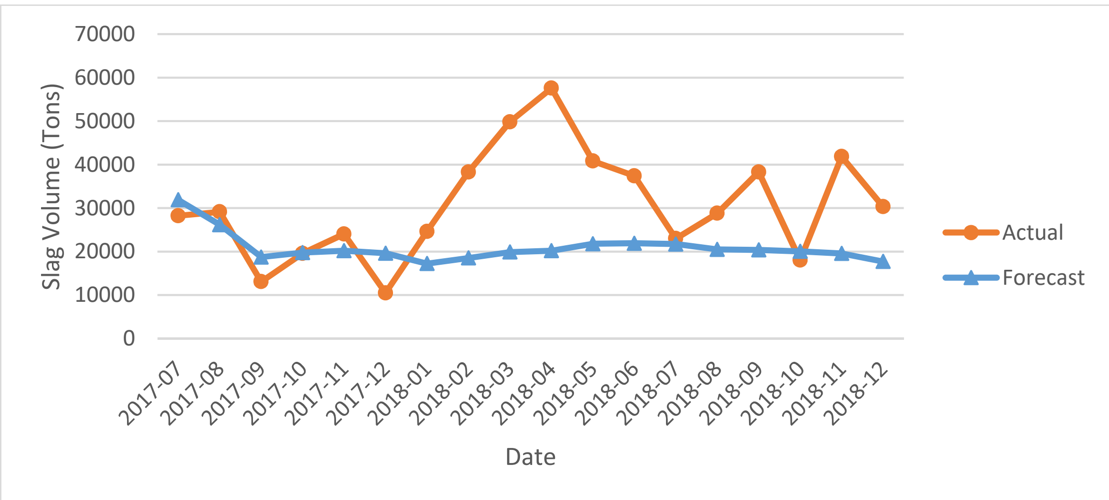
Table 30. Model Estimation of The ARIMAX Model for Domestic Slag Shipping Demand

Variable	Coefficient (standard errors)	Z value	P>|z|
C	-0.2911 (0.436)	-0.667	0.505
Import	-0.0193 (0.035)	-0.554	0.580
Cement	0.1460 (0.096)	1.521	0.128
Sales	-0.0026 (0.017)	-0.157	0.876
Iron	0.0364 (0.032)	1.153	0.249
Steel	-0.0883 (0.064)	-1.376	0.169
ma.	-0.3909 (0.095)	-4.104	0.000
ma.L2	-0.1772 (0.097)	-1.829	0.067
ma.L3	-0.2692 (0.096)	-2.795	0.005
sigma2	746.9399 (89.685)	8.328	0.000

Source: Created by Author based on auto_arima' from Pyramid outputs

Figure 53 presents the forecast of domestic shipping loaded at ports of the Black Sea that is obtained from the ARIMAX model. As shown below, the developed model did not present satisfactory forecasts. The estimated model is poor at forecasting peaks and it is not good enough to follow the increasing trend.

Figure 54: Results of The ARIMAX Forecasting for Domestic Slag Shipping Demand



Source: Created by Author based on auto_arima' from Pyramid outputs

After the model is estimated, to check the adequacy of the model ACF and PACF of the residuals were examined. Ljung–Box Q test is adopted to diagnose if the estimated residuals are white noise series or not. As seen in Figure 55, the result of the test indicates the goodness of fit test of the optimum ARIMA models showed non-significant autocorrelations in the residuals of the model. Therefore, it is deduced that the developed ARIMAX model established correctly.

Figure 55. ACF and PACF of Residuals for The ARIMAX Model of Domestic Slag Shipping

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.484	0.484	4.9512	0.026
		2	0.315	0.106	7.1884	0.027
		3	0.033	-0.205	7.2139	0.065
		4	-0.279	-0.353	9.2109	0.056
		5	-0.140	0.224	9.7538	0.083
		6	-0.292	-0.195	12.306	0.055
		7	-0.161	-0.024	13.154	0.068
		8	-0.140	-0.121	13.860	0.085
		9	-0.133	0.021	14.573	0.103
		10	0.057	0.061	14.720	0.143
		11	-0.088	-0.209	15.116	0.177
		12	-0.002	-0.046	15.116	0.235

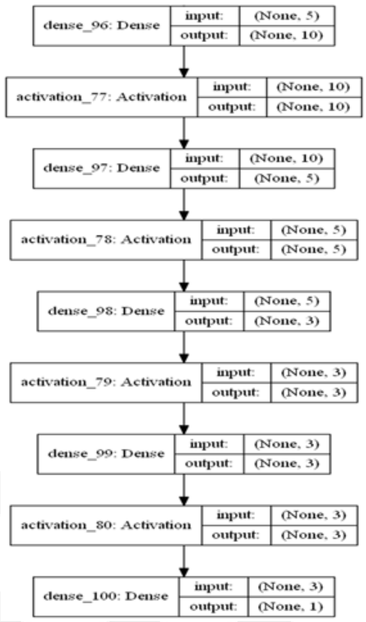
Source: Eviews outputs

4.3.3.10.3. Results of the ANN Models

4.3.3.10.3.1. Results of the MLP Model

Figure 56 illustrates the MLP model graph. MLP architecture is utilized as five input variables, three hidden layers with five, five and three neurons terminating at an output layer with tanh activation. Hidden layers utilized tanh activation functions and the network epoch was 800.

Figure 56. MLP Model Graph for Domestic Slag Shipping



Source: Keras Deep Learning Package outputs

Table 31 shows the used variable combinations while developing the MLP model. The best model is composed of import, cement, sales, iron and steel. The best combination includes the same variables with the ARIMAX model. If the RMSE is considered as an accuracy method MLP is outperformed than the ARIMAX method. However, ARIMAX performed better in terms of MAPE results.

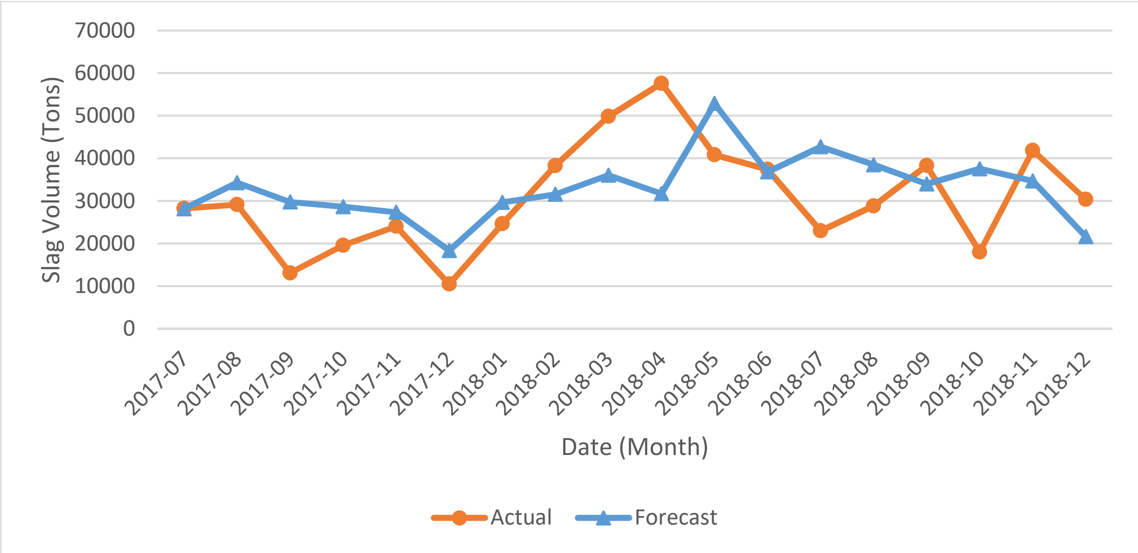
Table 31. Comparison of the MLP Forecasts of Domestic Slag Shipping Demand

MLP Model		
Variables	**RMSE**	**MAPE**
IPI, Export	17961.49	40.43
Sales, IPI, Export, Import, Cement, Iron, Steel	16391.32	40.97
Import, Cement, Sales, Iron, Steel	**11891.36**	**39.23**
Import, Cement, Iron, Steel	12548.55	49.01
Cement	12786.57	43.15
Cement, Steel	12341.09	42.83
Export, Cement, Steel	13818.48	47.84
Cement, Iron, Steel	12660.75	40.62
IPI, Import, Cement, Iron, Steel	18451.67	44.31

Source: Created by Author based on Keras Deep Learning Package outputs

Figure 57 illustrates the results of the MLP out of forecasts for domestic slag shipping loaded at Ports of the Black Sea. Forecasting errors are very high at 2017-09, 2018-03, 2018-04, 2018-07, 2018-10. Apart from these dates, this developed MLP model is good at following the peaks and downs at the data.

Figure 57: Results of MLP Forecasting for Domestic Slag Shipping

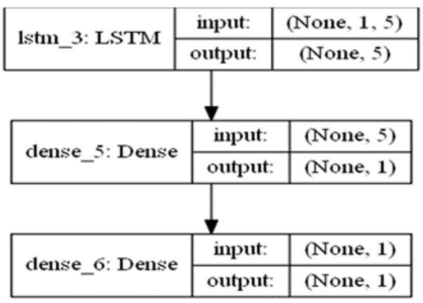


Source: Created by Author based on Keras Deep Learning Package outputs

4.3.3.10.3.2. Results of the LSTM Model

Figure 58 illustrates the LSTM model graph. LSTM architecture is utilized as five input variables, one hidden layer with five, five and three neurons terminating at an output layer with tanh activation. Hidden layers utilized tanh activation functions and the network epoch was 2800.

Figure 58: LSTM Model Graph for Domestic Slag Shipping



Source: Keras Deep Learning Package outputs

Table 32 shows the used variable combinations while developing the LSTM model of slag volume. If the RMSE is considered as accuracy method, the best model is composed of import, cement, sales, iron, and steel. This combination includes the same variables with the ARIMAX model and the MLP model. However, the best model is only composed of import variable in terms of MAPE. The LSTM model of the slag volume outperformed than both ARIMAX and MLP models.

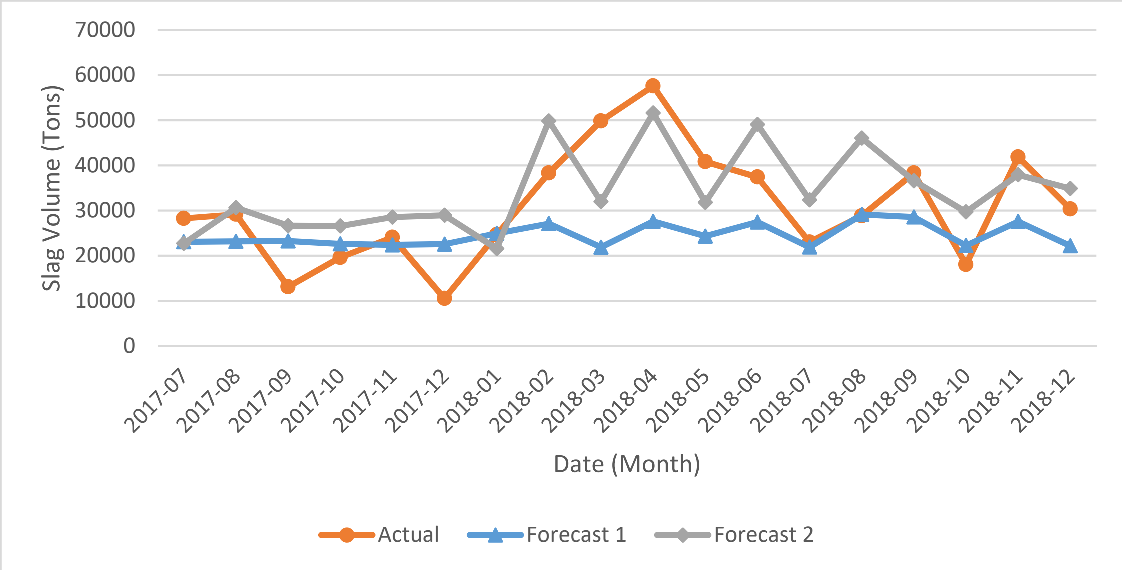
Table 32. Comparison of the LSTM Forecasts for Domestic Slag Shipping

MLP Model		
Variables	**RMSE**	**MAPE**
Import	12668.34	**31.93**
Import, Cement, Sales, Iron, Steel	**10278.66**	38.57
IPI, Export	13516.36	36.32
Sales, IPI, Export, Import, Cement, Iron, Steel	18286.04	53.25
Import, Cement, Iron, Steel	12610.35	44.53
Cement	13331.72	50.91
Cement, Steel	13706.06	47.90
Export, Cement, Steel	11908.86	43.33
Cement, Iron, Steel	14140.02	47.61
IPI, Import, Cement, Iron, Steel	16638.18	37.11
Sales, Cement, Iron, Steel	12542.8	45.45

Source: Created by Author based on Keras Deep Learning Package outputs

Figure 59 illustrates the results of the LSTM out of forecasts for domestic slag shipping loaded at Ports of the Black Sea. Forecasting errors of the second forecast are very high at 2017-09, 2018-03, 2018-08 while forecasting errors of the first forecast are high at 2017-12, 2018-03, 2018-04, 2018-05, 2018-11. The first forecast forecasted limited volume and poor at forecasting the volatility. However, the second forecast is good at forecasting volumes, especially in the last months.

Figure 59. Results of LSTM Forecasting for Domestic Slag Shipping

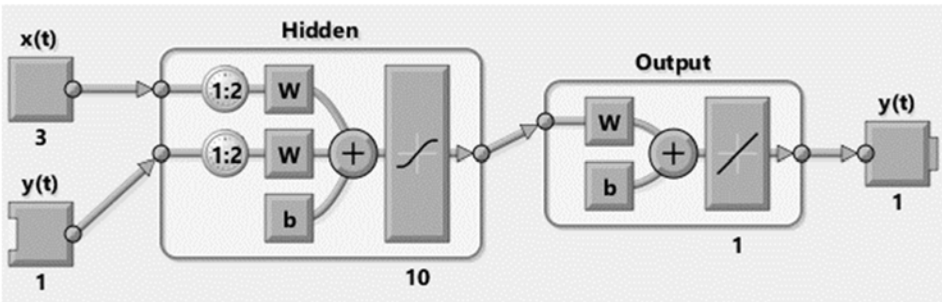


Source: Created by Author based on Keras Deep Learning Package outputs

4.3.3.10.3.3. Results of the NARX model

Figure 60 illustrates the model graph of the NARX. The model has four input variables as iron, cement, steel and past values of slag, ten hidden layers and one output layer.

Figure 60. NARX Model Graph for Domestic Slag Shipping



Source: MATLAB neural network toolbox output

Table 33 shows the used variable combinations while developing NARX model. In terms of RMSE best model is composed of sales, iron, cement and steel variables, while cement, iron, steel is the best model in terms of MAPE. However, both models have close RMSE results. Therefore, best model is considered as cement, iron and steel combination.

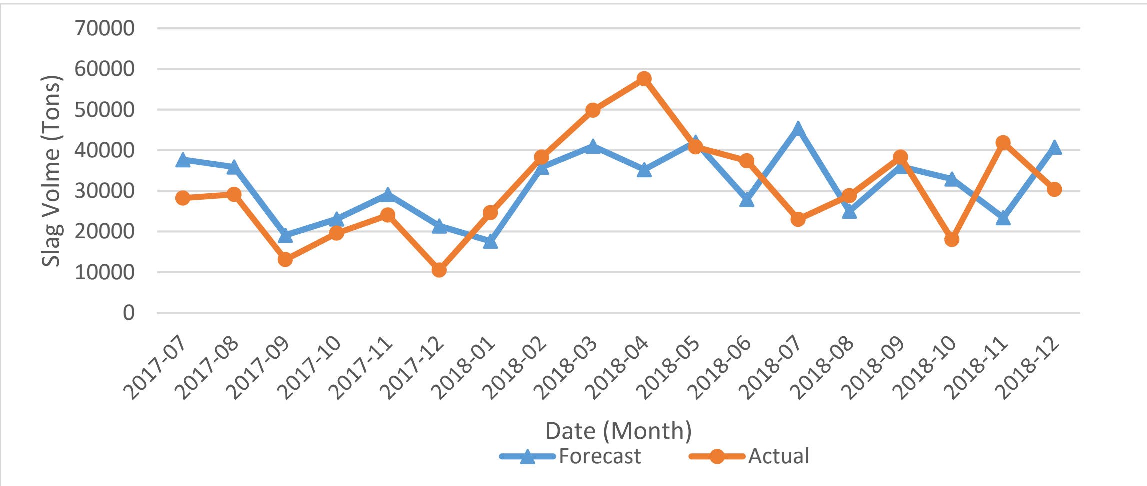
Table 33. Comparison of the NARX Forecasts for Domestic Slag Shipping

NARX Model		
Variables	**RMSE**	**MAPE**
Import	12739.42	39.73
Import, Cement, Sales, Iron, Steel	11144.11	41.80
IPI, Export	13192.51	49.42
Sales, IPI, Export, Import, Cement, Iron, Steel	15245.72	48.62
Import, Cement, Iron, Steel	11886.72	43.29
Cement	13024.81	44.00
Cement, Steel	13119.6	46.51
Export, Cement, Steel	16182.73	55.04
Cement, Iron, Steel	11173.92	**35.71**
IPI, Import, Cement, Iron, Steel	11638.63	40.47
Sales, Cement, Iron, Steel	**11128.23**	40.79

Source: Created by Author based on MATLAB neural network toolbox output

Figure 61 illustrates the results of the NARX out of forecasts for domestic slag shipping loaded at Ports of Black Sea. At first months, NARX presents relatively good forecasts and follows the same pattern with the series until 2018-02. However, forecasting errors are very high at last month's especially 2018-04, 2018-07, 2018-10, 2018-11.

Figure 61. Results of NARX Forecasting of Domestic Slag Shipping



Source: Created by Author based on MATLAB neural network toolbox output

4.3.3.10.4. Results of the Hybrid model

Firstly, the ARIMAX model with import, cement, sales, iron, steel variables were estimated. The model generated from the dataset is ARMAX (0,1,3). Then, the MLP model constructed with the below-mentioned lags and best model composed of two input variables, three hidden layers with five, five and three neurons, one output layer. The activation function was tanh. Epoch was tried as 120 for all lags at first, then the epoch of the ARIMAX-ANN-7 and ARIMAX-ANN-8 models were specified as 500 and 1000 respectively.

Table 34 shows the used variable lag combinations while developing a hybrid model. The results are not good enough in terms of accuracy performances. ARIMAX-ANN-7 and ARIMAX-ANN-8 were found as the best-performed models.

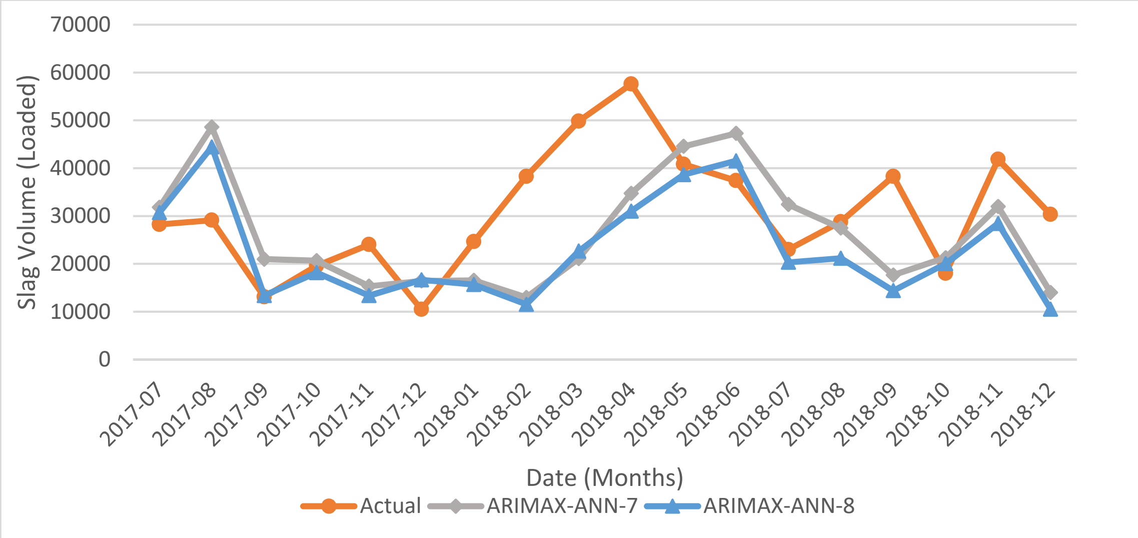
Table 34. Comparison of The Hybrid Forecasts for Domestic Slag Shipping

Hybrid Model		
Variables	**RMSE**	**MAPE**
ARIMAX-ANN-1: Qt-1, Qt-4	18675.25	66.63
ARIMAX-ANN-2: Qt-1, Qt-2	16559.38	57.03
ARIMAX-ANN-3: Qt-1, Qt-3	17614.11	62.01
ARIMAX-ANN-4: Qt-1, Qt-2, Qt-3	17498.98	62.22
ARIMAX-ANN-5: Qt-1, Qt-2, Qt-3, Qt-4	16196.29	58.00
ARIMAX-ANN-6: Qt-3, Qt-4	17153	42.34
ARIMAX-ANN-7: Qt-2, Qt-4	**14184.64**	36.91
ARIMAX-ANN-8: Qt-2, Qt-3, Qt-4	14661.8	**33.67**
ARIMAX-ANN-9: Qt-2, Qt-3	14784.79	41.07
ARIMAX-ANN-10: Qt-1, Qt-2, Qt-4	18979.68	68.07

Source: Created by Author based on “auto_arima” from Pyramid outputs and Keras Deep Learning Package outputs

Figure 62 illustrates the results of the hybrid model out of forecasts for domestic slag shipping loaded at Ports of the Black Sea. It is inferred that hybrid model forecasts are not good enough. The estimated model is relatively good at forecasting peaks and downs, but it is not good enough to forecast the range of these volatilities.

Figure 62. Results of Hybrid Forecasting for Domestic Slag Shipping



Source: Created by Author based on "auto_arima" from Pyramid outputs and Keras Deep Learning Package outputs

4.3.3.10.5. Comparison of the Results

Table 35 shows that the LSTM model outperformed all the other methods. In this scenario, the MAPE and RSME accuracy metric pointed out different accuracies. According to the results of MAPE, NARX and MLP have the worst performances, while RMSE indicated ARIMAX and Hybrid models. Although the ARIMAX-ANN model can capture both the linear and nonlinear nature of the data and uses the advantages of both models, it did not present better performance. Therefore, artificial neural network-based models are good at modeling the volatilities properly. Non-normal distribution of the data could be the reason for the good performance of the LSTM rather than the other developed methods.

Similar variable combinations were used in forecasting domestic slag shipping. Import, cement, sales, iron, and steel were the resulted as the most accurate combination for ARMAX, MLP, LSTM while cement, sales, iron, and steel were presented best combination for the NARX. This result is consistent with the current domestic slag shipping demand that is related to the cement, iron and steel productions and shipping loads in the region.

Table 35. Accuracy Comparisons of Domestic Slag Shipping Forecast Models

Forecast Model	MLP Model		ARMAX (1,0,1)		LSTM		NARX		ARIMAX-ANN-7 and ARIMAX-ANN-8	
Forecast Error	**MAPE**	**RMSE**	**MAPE**	**RMSE**	**MAPE**	**RMSE**	**MAPE**	**RMSE**	**MAPE**	**RMSE**
	39.23	11891	36.22	5893	**31.93**	12668	35.71	1173	36.91	14184
					38.57	**10278**	40.79	1128	33.67	14661

Source: Author

4.3.3.10.6. Significances of the Model Performances

To discuss the developed models in detail, t-tests are conducted to examine the significances of the model performances. T-test results are based on the comparison of MAPE of the residuals. The *p*-value for each t-test presented in Table 36. The tests have resulted at a significance level of 95%, therefore p-values <0.05 indicate models that vary significantly. The paired t-test showed that none of the developed models have significant differences with a p-value of less than 0.05.

Furthermore, Diebold–Mariano test (1995) is adopted to evaluate the statistical significance of performances of developed models in depth. DM test aims to test the null hypothesis of equal accuracy of the two competing models. In this paper, the null hypothesis of the DM test cannot be rejected for the compared models. All p-values are presented with high values than 0.05. Therefore, it is obtained that developed models' have equal forecasting accuracy.

Table 36. T-test and DM Test Results of Domestic Slag Shipping Forecast Models

	MLP	ARIMAX	LSTM	NARX	Hybrid
MLP		1.4977 (0.1525)	-0.74102 (0.4688)	0.55469 (0.5863)	-1.0423 (0.3119)
ARIMAX	**0.29276 (0.7732)**			1.6118 (0.1254)	0.64439 (0.5279)
LSTM	**-0.084372 (0.9337)**	**0.25016 (0.8055)**		-0.38955 (0.7017)	1.5451 (0.1407)
NARX	**-0.54447 (0.5932)**	**-0.057723 (0.9546)**	**-0.36506 (0.7196)**		1.2374 (0.2328)
Hybrid	**-0.47192 (0.643)**	**-0.45293 (0.6563)**	**-0.41415 (0.6839)**	**-0.21124 (0.8352)**	

*** Bold fonts are the results of the t-test**

Source: Created by Author based on R Studio outputs

4.3.3.11. Forecasting Domestic Copper Shipping Demand

In this part, the out of sample forecast models of domestic copper shipping demand based on the ARIMA model, ANN models, and hybrid model are reported.

4.3.3.11.1. Data Characteristics

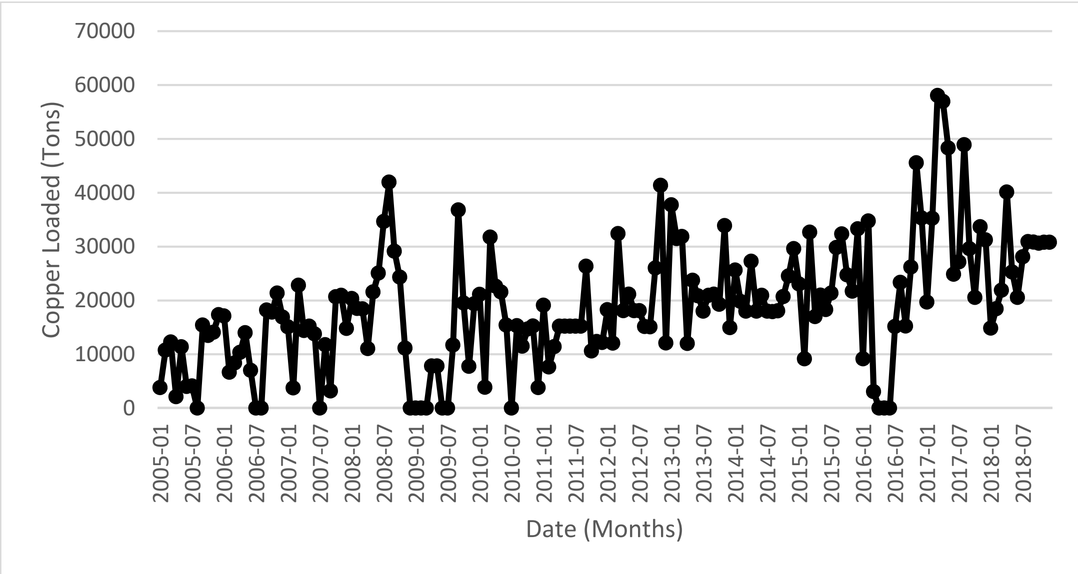
Demand to copper is expected to continue due to the needs of modern technological society, infrastructure developments, need to cleaner energy and sustainability for economic activity. Copper demand is expected to grow despite the slowdown in world economic growth (ISGC, 2019: 1).

75% of the world's copper demand is supplied from primary sources (copper ores) and 25% from secondary sources (scrap, dust, and waste). Copper reserve in terms of copper metal content is around 690 million tons in the world. 190 million tons (about 28%) of this reserve is in Chile. USA (33 million tons), China (30 million tons), Peru (90 million tons), Poland (26 million tons), Australia (86 million tons) and Indonesia are the other countries that have the largest copper reserves (TR Ministry of Development, 2015: 75).

In developed countries, annual copper consumption per capita is around 10 kg, while this amount is 3 kg in Turkey (TR Ministry of Development, 2015: 85). In terms of industries copper mostly used in electric electronic industry, construction industry, transportation industry, industrial hardware, military and other industries, chemical industry, jewellery, etc. (MTA, 2016: 20). The world copper resources in terms of metal content are valued at 550 million tons, while the metal content of known sources in Turkey was determined to be about 1.7 million tons. Turkey's annual copper metal consumption is around 200,000 tons. There are five major active copper mines in Turkey. These are Murgul, Küre, Çayeli, Lahonos and Siirt-Madenköy. Although the production to existing copper mines need a smelting capacity of over 100 thousand tonnes, Turkey's only active copper smelting plant is located in Samsun (TR Ministry of Development, 2015: 86).

The volatile characteristics of the domestic copper loads are observed from Figure 63. Copper prices had been decreased at 2008-12,2009-01, and 2009-02, while there was no domestic copper load between 2008-12 and 2009-03. Moreover, there was a decreasing trend at copper prices on 2016-04, 2016-05 and 2016-06, while there were no copper loads again. There were also no copper loads on 2005-08, 2006-07, 2006-08, 2007-07 and 2010-07.

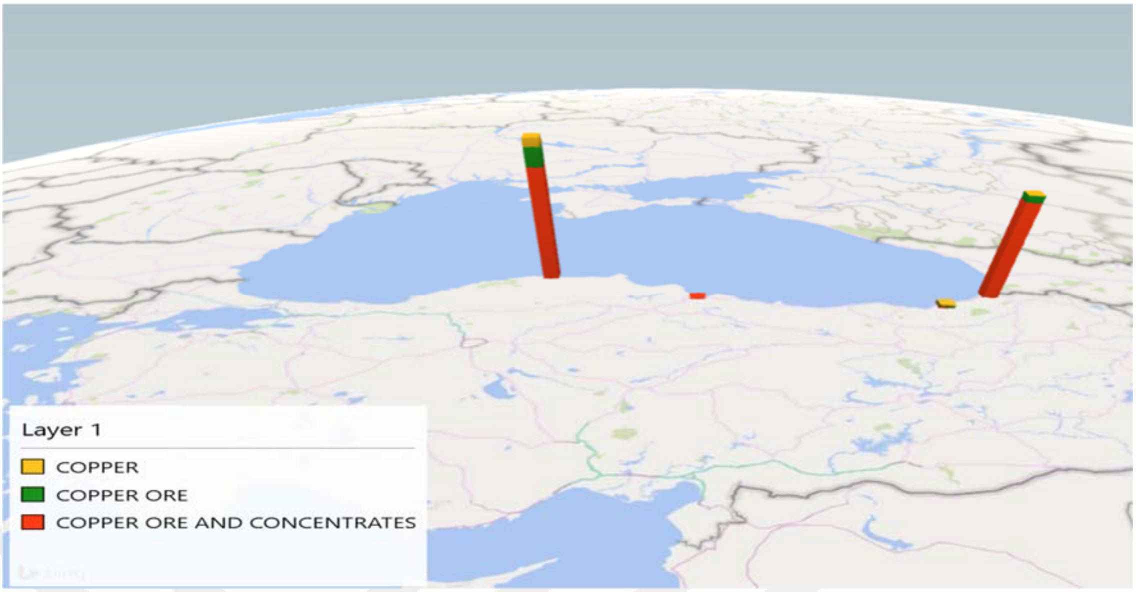
Figure 63: Domestic Copper Shipping Loaded at Ports of Black Sea (Tons)



Source: Compiled from MTI, (2019b) by the Author

Figure 64 illustrates the loaded copper at the ports of the Black Sea. Copper ore and concentrates are the most loaded copper type in the region. Copper ore, copper ore, and concentrates belong to CTIP Chapter 26: Ores, slag and ash. There are also related chapters: CTIP Chapter 74: Copper and articles thereof. Copper, copper ore and copper ore and concentrates are loaded from Inebolu.

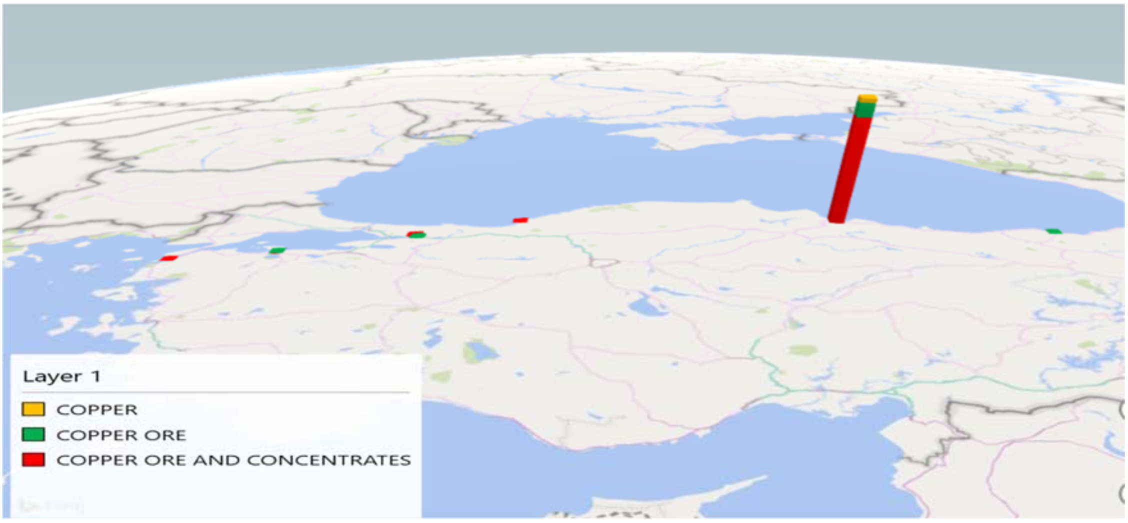
Figure 64. Distribution of the Copper Loaded at Black Sea Region



Source: Compiled from MTI, (2019b) by the Author

Figure 65 illustrates the copper unloaded at the ports of the Black Sea. Copper ore and concentrates are the most unloaded copper type at the ports of the Black Sea. It is unloaded in the Samsun which has the copper smelter and electrolysis plant.

Figure 65. Distribution of The Copper Unloaded at Black Sea Region



Source: Compiled from MTI, (2019b) by the Author

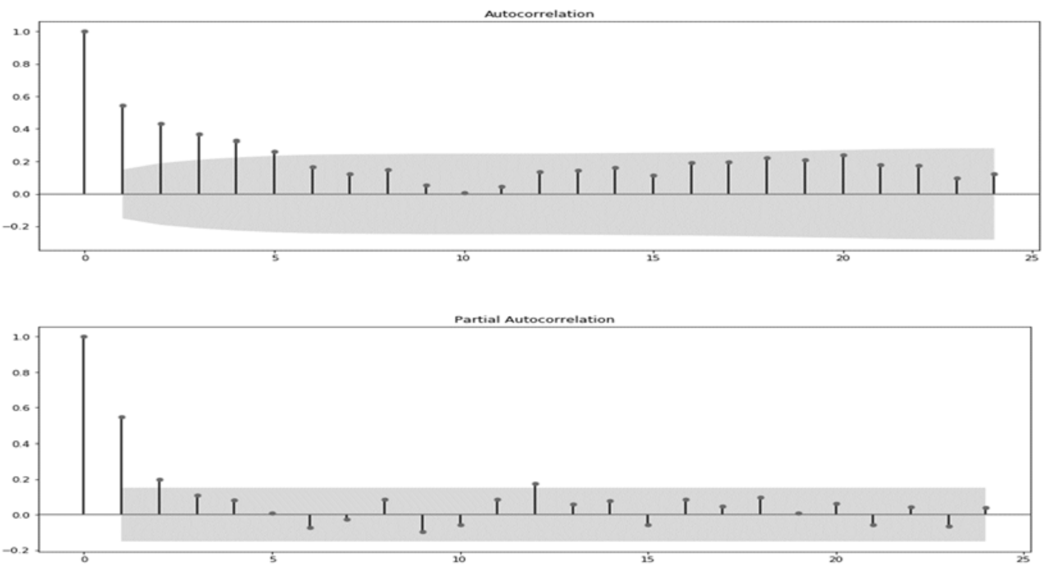
The descriptive statistics of the series are presented in Appendix 7. Total of 168 observations used for the development of the models. Import and exchange rate variables have positive skewness that shows occurring increases are more probable than decreases. Copper, price, IPI, and export have negative skewness that refers to occurring declines are more than probable than occurring increases at the data. All variables apart from the exchange rate are platykurtic that have a flat top near the mean and shorter, thinner tails that refer to low probability for very extreme values. Kurtosis of the exchange rate is close to 3 which refers to mesokurtic (normal) distribution.

Shapiro-Wilk and Jarque-Bera normality tests performed to variables used in the study as presented in Appendix 6. The null hypothesis for the normality tests is normally distributed sample. The null hypothesis related to normality was rejected for copper. Therefore, sample data is not normally distributed. Square root transformation of the data was drawn from a normal distribution.

Stationarity is tested with Dickey-Fuller and Philips Perron unit root test. The results are presented in Appendix 8 and reveal that copper, price, import, and export are stationary. The exchange rate is stationary at its first differences.

Copper data have auto-correlation and presented that the series is serially correlated at lag 1, 2,3,4 and as shown in Figure 66. PACF plot shows a spike at lag only 1, 2 and 13.

Figure 66. ACF and PACF Plot of The Domestic Copper Shipping Data



Source: Statsmodels output

The statistical association between the domestic copper shipping volume and the used exogenous variables are searched with a cross-correlations matrix. This is shown in Table 37. The price and exchange rate have a negative correlation with the copper. The highest correlation existed between copper and export variables.

Table 37. Correlation Coefficients of the Used Variables While Modelling Domestic Copper Shipping Demand Forecast

Variables	**Copper**	**Price**	**Exchange**	**IPI**	**Export**	**Import**
Copper	1	0.1663	0.4638	0.5309	0.5159	0.2113
Price	0.1663	1	-0.1600	0.2598	0.5817	0.3127
Exchange	0.4638	-0.1600	1	0.6721	0.2664	0.2232
IPI	0.5309	0.2598	0.6721	1	0.6023	0.3493
Export	0.5159	0.5817	0.2664	0.6023	1	0.4413
Import	0.2113	0.3127	0.2232	0.3493	0.4413	1

Source: Created by Author based on Statsmodels outputs

The Canova-Hansen test is applied to detect seasonality in the series. All variables used for the forecasting of the domestic copper shipping showed stable seasonal pattern contrary to the expectations. The reasons for this can be explained by Figure 62. It is observed that there are several contrary movements to the seasonality.

4.3.3.11.2. Results of the ARX Model

Firstly, the ARX model with all variables is estimated. To find out the best model, variable selection is applied to eliminating the highest probability. Nevertheless, below listed models in Table 38 are tried to base on the accuracy errors. The model generated from the dataset is ARX (2,0,0). Two models are estimated and resulted in similar accuracy rates. In terms of MAPE, the best model is composed of and import, cement, sales, iron, and steel variables while exchange rate, IPI, export variables are presented the best model in terms of RMSE.

Table 38. Comparison of The ARX Forecast of Domestic Copper Shipping Demand

Model ARX (2,0,0)		
Variables	**RMSE**	**MAPE**
Price, exchange, IPI, export, imports	8329.95	**21.27**
Exchange, IPI, export, imports	8030.39	23.08
IPI, export, imports	9562.03	26.44
IPI, export	9406.79	25.82
Price, export, imports	11131.79	28.77
Exchange, IPI, export	**8003.27**	23.41
Export	11906.55	31.38
Export, import	12109.34	32.07
Price, exchange	13040.08	44.87

Source: Created by Author based on "auto_arima" from Pyramid outputs

The estimated significant parameters are illustrated in equation (19) and Table 39 as follows:

$$y_t = -4.2043 + 0.4053price + 36.8212exchange$$
$$-1.6621IPI + 0.2604export - 0.0422import + 0.3523Y_{t-1} + 0.0664Y_{t-2} \quad (19)$$

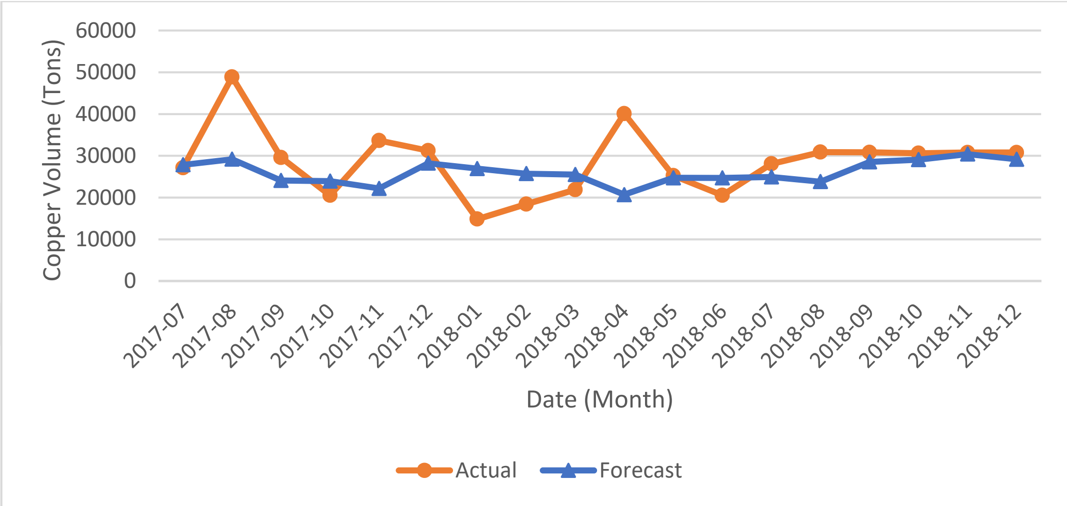
Table 39. Model Estimation of the ARX Model for Domestic Copper Shipping Demand

Variable	**Coefficient (standart errors)**	**Z value**	**P>|z|**
C	-4.2043 (45.586)	-0.092	0.927
Price	0.4053 (0.781)	0.519	0.604
Exchange Rate	36.8212 (47.236)	0.78	0.436
IPI	-1.6621 (13.862)	-0.12	0.905
Export	0.2604 (0.087)	3.007	0.003
Import	-0.0422 (0.047)	-0.9	0.368
ar.L1	0.3523 (0.072)	4.927	0
ar.L2	0.0664 (0.077)	0.859	0.39
sigma2	1664.7296 (202.762)	8.21	0

Source: Created by Author based on "auto_arima" from Pyramid outputs

Forecast of domestic shipping loaded at ports of Black Sea that is obtained from the ARX model is presented in Figure 67: As shown below, the developed model presents adequate forecasts. The estimated model is poor at forecasting high peaks and downs. However, it is good enough to follow the cargo volume trend, especially in the last months.

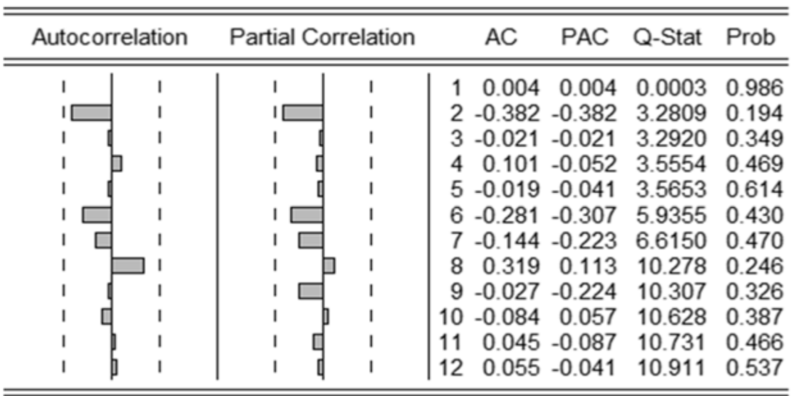
Figure 67: Results of ARX Forecasting for Domestic Copper Shipping Loaded



Source: Created by Author based on "auto_arima" from Pyramid outputs

After the model is estimated, to check the adequacy of the model ACF and PACF of the residuals were examined. Ljung–Box *Q* test is adopted to diagnose if the estimated residuals are white noise series or not. As seen in Figure 68 the result of the test indicates that the residuals of the estimated model are white noise and do not have a serial correlation. Therefore, it is deduced that the developed ARX model established correctly.

Figure 68: ACF and PACF of Residuals for The ARX Model of Domestic Copper Shipping



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.004	0.004	0.0003	0.986
		2	-0.382	-0.382	3.2809	0.194
		3	-0.021	-0.021	3.2920	0.349
		4	0.101	-0.052	3.5554	0.469
		5	-0.019	-0.041	3.5653	0.614
		6	-0.281	-0.307	5.9355	0.430
		7	-0.144	-0.223	6.6150	0.470
		8	0.319	0.113	10.278	0.246
		9	-0.027	-0.224	10.307	0.326
		10	-0.084	0.057	10.628	0.387
		11	0.045	-0.087	10.731	0.466
		12	0.055	-0.041	10.911	0.537

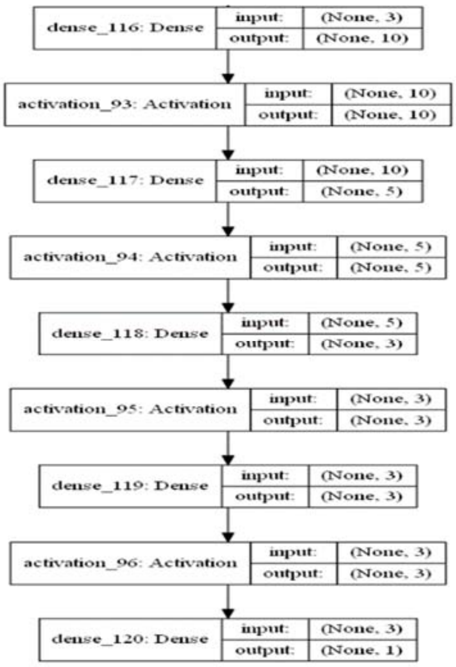
Source: Eviews outputs

4.3.3.11.3. Results of the ANN models

4.3.3.11.3.1. Results of the MLP model

Figure 69 illustrates the MLP model graph. MLP architecture is utilized as three input variables, three hidden layers with five, five and three neurons terminating at an output layer with tanh activation. Hidden layers utilized tanh activation functions and the network epoch was 800.

Figure 69: MLP Model Graph for Domestic Copper Shipping



Source: Keras Deep Learning Package output

Table 40 shows the used variable combinations while developing the MLP model. Five models resulted in similar accuracy rates. In terms of MAPE, the best model is composed of the exchange rate, IPI, export variables, while IPI and export variables are presented the best model in terms of RMSE.

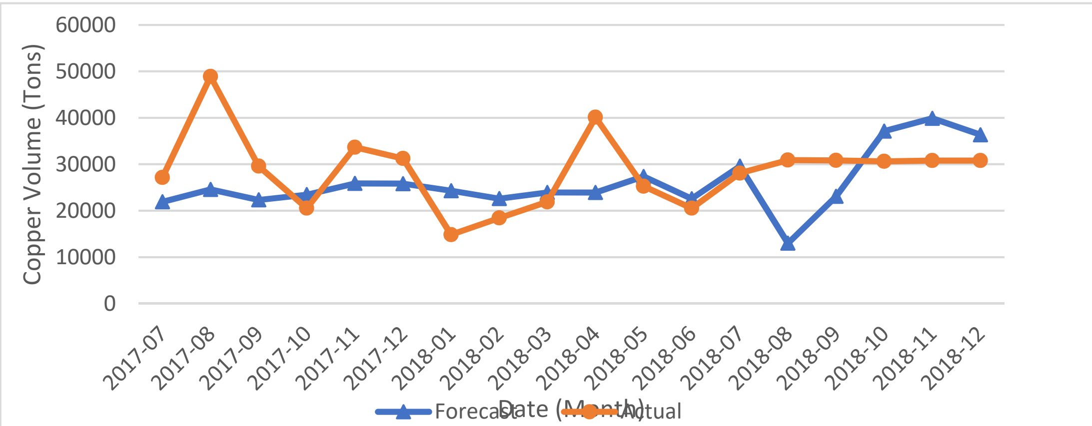
Table 40. Comparison of the MLP Forecasts of Domestic Copper Shipping Demand

MLP Model		
Variables	**RMSE**	**MAPE**
Price, exchange rate, IPI, export, import	10827.5	28.58
Exchange rate, export, import, IPI	15095.84	39.10
Export, import, IPI	9617.60	25.77
IPI, export	**9551.97**	25.68
Exchange rate, export, import	22402.46	85.02
Exchange rate, IPI, export	9683.07	**25.42**
Export	11719.29	32.17
Export, import	11018.78	30.30
Price, exchange rate	19819.71	74.06
Price, export, import	10601.3	27.66
Price, exchange, export, IPI	15145.19	57.43

Source: Created by Author based on Keras Deep Learning Package outputs

Figure 70 illustrates the results of the MLP out of forecasts for domestic copper shipping loaded at Ports of the Black Sea. As similar to the ARX model, the developed MLP model presents adequate forecasts. The estimated model is poor at forecasting high peaks and downs.

Figure 70. Results of MLP Forecasting for Domestic Copper Shipping

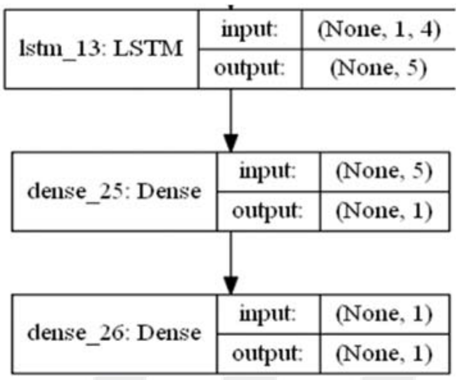


Source: Created by Author based on Keras Deep Learning Package outputs

4.3.3.11.3.2. Results of the LSTM model

Figure 71 illustrates the LSTM model graph. LSTM architecture is utilized as four input variables, one hidden layers with five, five and three neurons terminating at an output layer with tanh activation. Hidden layers utilized tanh activation functions and the network epoch was 3200.

Figure 71: LSTM Model Graph for Domestic Copper Shipping



Source: Keras Deep Learning Package output

Table 41 shows the used variable combinations while developing the LSTM model. The best model was composed of price, exchange rate, export, and IPI variables.

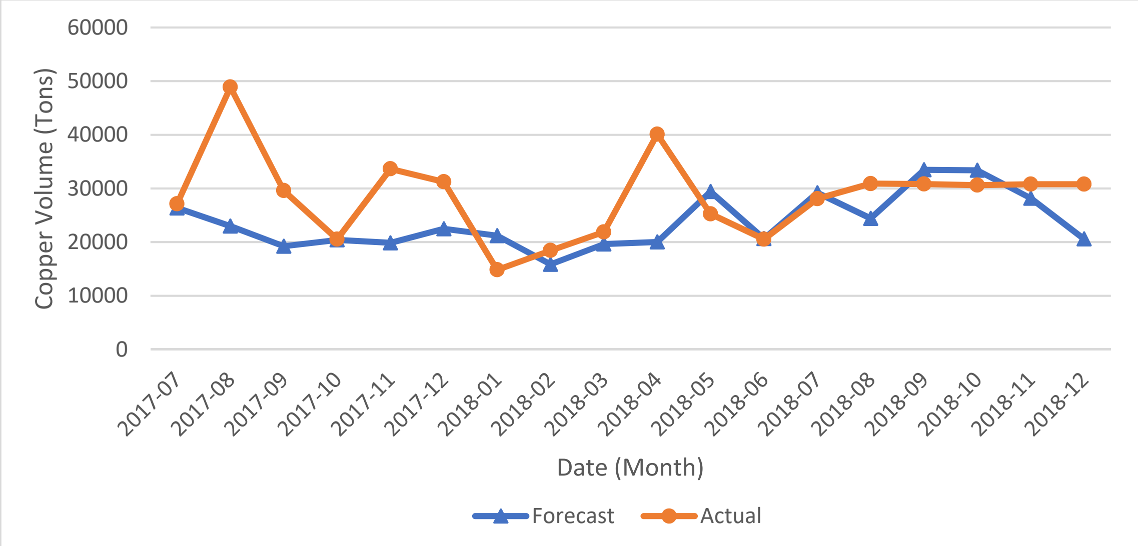
Table 41. Comparison of the LSTM Forecasts for Domestic Copper Shipping

MLP Model		
Variables	**RMSE**	**MAPE**
Price, exchange rate, IPI, export, import	10037.15	23.25
Exchange rate, export, import, IPI	19556.40	59.99
Export, import, IPI	12457.97	39.86
IPI, export	9714.86	22.23
Exchange rate, export, import	23563.65	87.59
Exchange rate, IPI, export	18020.55	50.33
Export	11712.88	32.04
Export, import	11916.10	30.82
Price, Exchange rate	19035.54	73.57
Price, export, import	12048.31	32.49
Price, exchange rate, export, IPI	**9685.34**	**21.04**
IPI, export, import	23705.77	88.17

Source: Created by Author based on Keras Deep Learning Package outputs

Figure 72 illustrates the results of the LSTM out of forecasts for domestic copper shipping loaded at Ports of the Black Sea. The forecast accuracy was at the good accuracy range according to the MAPE, forecasts were good at following the pattern.

Figure 72. Results of LSTM Forecasting for Domestic Copper Shipping

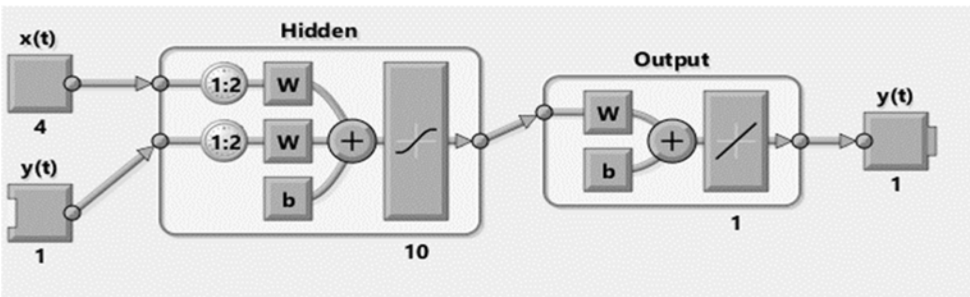


Source: Created by Author based on Keras Deep Learning Package outputs

4.3.3.11.3.3. Results of the NARX model

Figure 73 illustrates the model graph of the NARX. The model has five input variables as exchange rate, price, export, IPI and past values of copper, ten hidden layers and one output layer.

Figure 73: NARX Model Graph for Domestic Copper Shipping



Source: MATLAB neural network toolbox output

Table 42 shows the used variable combinations while developing the NARX model. The best model was composed of price, exchange rate, export, and IPI variables. Different forecasting accuracies are collected with NARX while developing models.

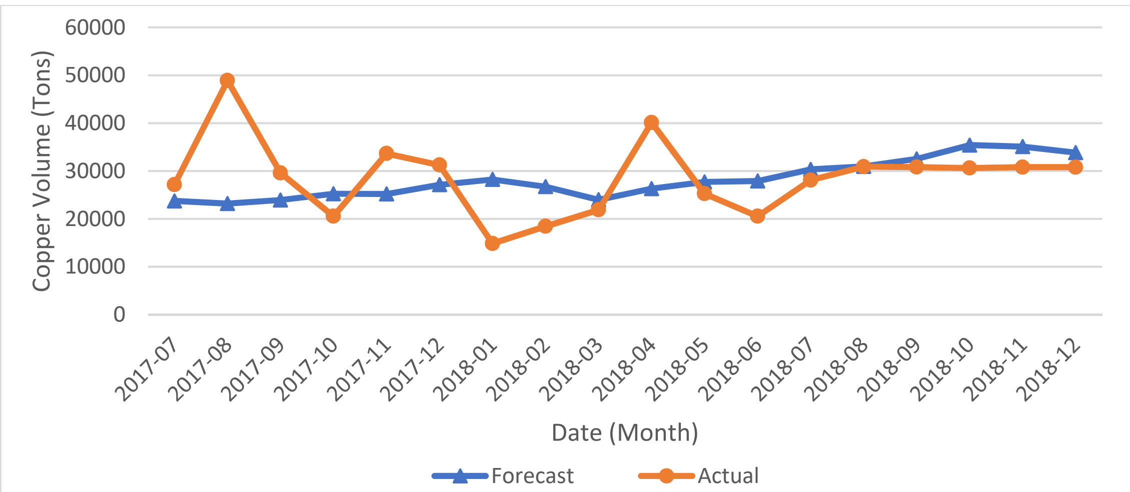
Table 42. Comparison of the NARX Forecasts for Domestic Copper Shipping

NARX Model		
Variables	**RMSE**	**MAPE**
Price, exchange rate, IPI, export, import	35919.77	119.59
Exchange rate, export, import, IPI	8971.61	28.72
Export, import, IPI	13349.41	46.01
IPI, export	9665.8	27.26
Exchange rate, export, import	9080.53	30.70
Exchange rate, IPI, export	15780.46	52.04
Export	9405.17	25.70
Export, import	12040.23	32.64
Price, Exchange rate	20144.64	65.99
Price, export, import	11452.85	33.27
Price, exchange rate, export, IPI	**8745.19**	**23.51**
IPI, export, import	13868.62	38.23

Source: Created by Author based on MATLAB neural network toolbox output

Figure 74 illustrates the results of the NARX out of forecasts for domestic copper shipping loaded at Ports of the Black Sea. As consistent with the models that are established with LSTM, price, exchange rate, export, and IPI variables form the best model with NARX. It is quite successful at forecasting the loaded pattern of copper in given out of sample. However, it was not able to catch the peaks and downs.

Figure 74. Results of NARX Forecasting of Domestic Copper Shipping



Source: Created by Author based on MATLAB neural network toolbox output

4.3.3.11.4. Results of the Hybrid model

Firstly, the ARX model with price, exchange rate, IPI, export, import variables were estimated. The model generated from the dataset is ARX (2,0). Then, the MLP model constructed with the below-mentioned lags and best model composed of three input variables, three hidden layers with five, five and three neurons, one output layer. The activation function was tanh. Epoch was tried as 120 for all lags.

Table 43 shows the used variable lag combinations while developing a hybrid model. The results are not good enough in terms of accuracy performances. ARIMAX-ANN-10 is found as the best-performed model.

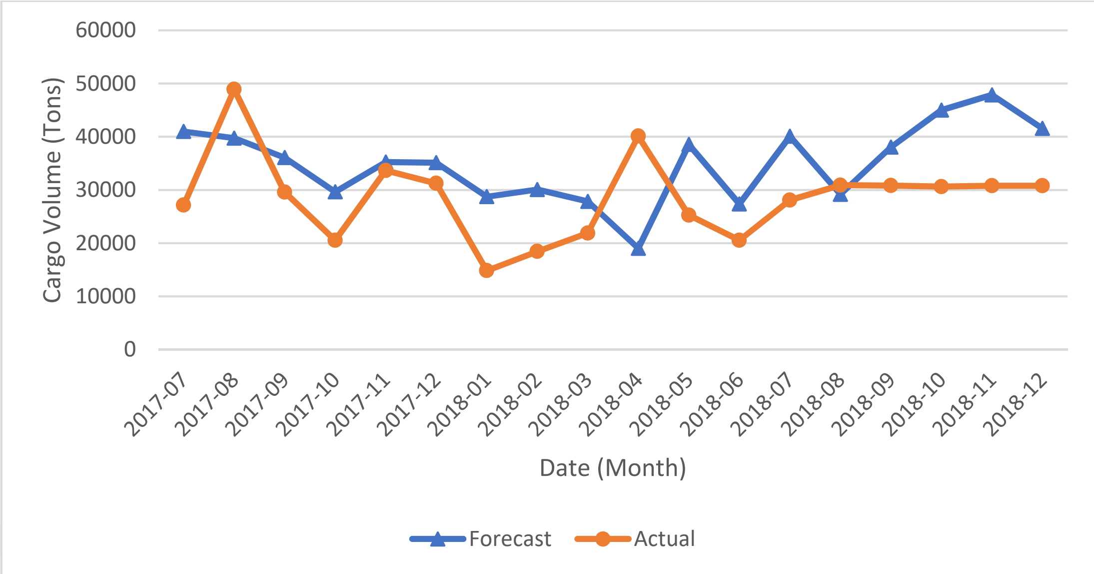
Table 43. Comparison of the Hybrid Forecasts for Domestic Copper Shipping

Hybrid Model		
Variables	**RMSE**	**MAPE**
ARIMAX-ANN-1: Qt-1, Qt-4	12672.84	46.03
ARIMAX-ANN-2: Qt-1, Qt-2	11723.96	41.98
ARIMAX-ANN-3: Qt-1, Qt-3	15133.88	48.56
ARIMAX-ANN-4: Qt-1, Qt-2, Qt-3	12741.66	45.50
ARIMAX-ANN-5: Qt-1, Qt-2, Qt-3, Qt-4	18558.04	60.89
ARIMAX-ANN-6: Qt-3, Qt-4	14135.59	50.49
ARIMAX-ANN-7: Qt-2, Qt-4	18171.67	59.27
ARIMAX-ANN-8: Qt-2, Qt-3, Qt-4	17878.82	58.10
ARIMAX-ANN-9: Qt-2, Qt-3	14080.38	48.21
ARIMAX-ANN-10: Qt-1, Qt-2, Qt-4	18168.51	59.24
ARIMAX-ANN-10: Qt-1, Qt-3, Qt-4	11210.66	38.00

Source: Created by Author based on “auto_arima” from Pyramid outputs and Keras Deep Learning Package outputs

Figure 75 illustrates the results of the hybrid model out of forecasts for domestic copper shipping loaded at Ports of the Black Sea. It is inferred that hybrid model forecasts are not good enough. The estimated model is relatively good at forecasting peaks and downs in the first months. However, it is not good enough to forecast the range of these volatilities.

Figure 75: Results of Hybrid Forecasting for Domestic Copper Shipping



Source: Created by Author based on "auto_arima" from Pyramid outputs and Keras Deep Learning Package outputs

4.3.3.11.5. Comparison of the Results

Table 44 shows that LSTM and ARX models outperformed than the other methods. According to the results, the hybrid model has the worst performances. Although the ARX-ANN model can capture both the linear and nonlinear nature of the data and uses the advantages of both models, it did not present better performance. Therefore, artificial neural network-based models are good at modeling the volatilities properly. Non-normal distribution of the data could be the reason for the good performance of the LSTM rather than the other developed methods.

Similar variable combinations are used in forecasting domestic copper shipping. Price, exchange rate, export, IPI were the resulted as the most accurate combination for LSTM and NARX while price, exchange rate, IPI, export, import are presented best combination for the ARX. Exchange rate, IPI, and export is the most accurate combination in terms of MAPE for MLP.

Table 44. Accuracy Comparisons of Domestic Slag Shipping Forecast Models

Forecast Model	MLP Model		ARX (2,0)		LSTM		NARX		ARIMAX-ANN-10	
Forecast Error	MAPE	RMSE	MAPE	RMSE	MAPE	RMSE	MAPE	RMSE	MAPE	RMSE
	25.42	9683	21.27	8329	21.04	9685	23.51	8745	38.00	11210

Source: Author

4.3.3.11.6. Significances of the Model Performances

To discuss the developed models in detail, t-tests are conducted to examine the significances of the model performances. T-test results are based on the comparison of MAPE of the residuals. The *p*-value for each t-test presented in Table 45. The tests have resulted at a significance level of 95%, therefore p-values <0.05 indicate models that vary significantly.

The paired t-test showed that the hybrid model and other developed models have significant differences with a p-value of less than 0.05.

Furthermore, Diebold–Mariano test (1995) is adopted to evaluate the statistical significance of performances of developed models in depth. DM test aims to test the null hypothesis of equal accuracy of the two competing models. In this paper, the null hypothesis of the DM test cannot be rejected for the compared models apart from the ARX and hybrid models. All p-values are presented with high values than 0.05. Therefore, it is obtained that developed models' have equal forecasting accuracy.

Table 45. T-test and DM Test Results of Domestic Copper Shipping Forecast Models

	MLP	ARX	LSTM	NARX	Hybrid
MLP		-1.1463 (0.2676)	-0.0060005 (0.9953)	0.84782 (0.4083)	0.73947 (0.4697)
ARX	**1.1872 (0.2515)**		-1.294 (0.213)	-0.36059 (0.7228)	-1.7934 (0.09071)
LSTM	**-1.265 (0.2229)**	**-0.059741 (0.9531)**		0.95063 (0.3551)	-0.70343 (0.4913)
NARX	**0.45429 (0.6554)**	**-0.92951 (0.3656)**	**-0.51572 (0.6127)**		-1.1394 (0.2703)
Hybrid	**2.0176 (0.0597)**	**2.9156 (0.009639)**	**2.4084 (0.02765)**	**2.9434 (0.009086)**	

*** Bold fonts are the results of the t-test**

Source: Created by Author based on R Studio outputs

4.3.3.12. Forecasting Domestic Steel Shipping Demand

This part consists of the out of sample forecast models of domestic steel shipping demand based on the ARIMA model and ANN models and hybrid model.

4.3.3.12.1. Data Characteristics

China accounted for about 80% of the 1 billion ton/year increase in global steel production capacity in 2005-2015. Supply and demand developments in China, which also has a large domestic market, have become the determinants of steel prices.

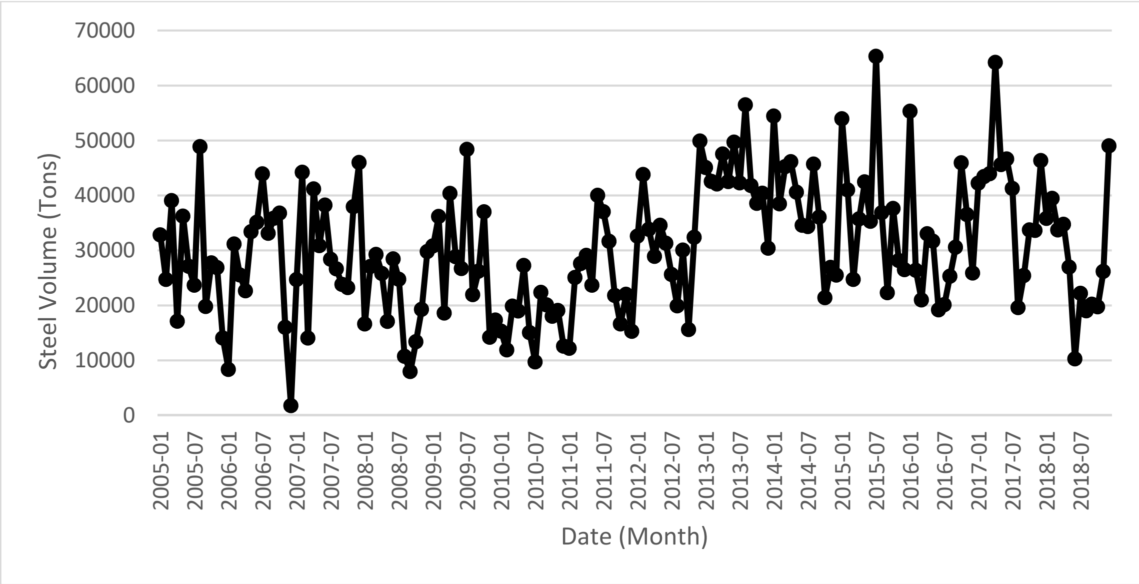
The high capacity utilization rate in the sector, which was between 81-89% between 2000-2007, declined rapidly to 72% due to the impact of the 2008 crisis. With the recovery in demand after the global crisis, the increase in the capacity of developing countries, especially China, decreased the global capacity utilization rate. Therefore, there is a surplus of capacity in global steel production, which lowers the price level and thus the profitability.

Flat products manufactured and processed in Ereğli are used in the automotive sector as a shock absorber, seat, vehicle body, in-door support, in-vehicle support, chassis construction. It is also used refrigerator, aspirator, oven, aspirator deep freezer, water heater, air conditioner, radiator and furniture, machinery, steel goods, tankers, vehicle trailers, and steel construction. Most of the sales are made to the Marmara and Aegean regions in the domestic market, while sales to the foreign market are directed to the EU countries, Russian Federation, Middle East and North Africa (Sevsay et al, 2019: 13,14).

Due to the limited domestic demand, voluminous markets can only be accessed through exporting to the outside the region, which leads to high logistics costs. Since both rolling mills and steel service centers are low value-added sectors and logistics costs are important, thus this limits the competitiveness. In the near future, the launching of Filyos port and establishing a railway connection between the port and Karabük will contribute to the reduction of the logistics costs of both KARDEMİR and the rolling mills in Karabük (Sevsay et al., 2019:19).

As shown in Figure 76, loaded steel volume present volatile series. The sharp peaks and downs are observed. However, this volatility cannot have explained by seasonality.

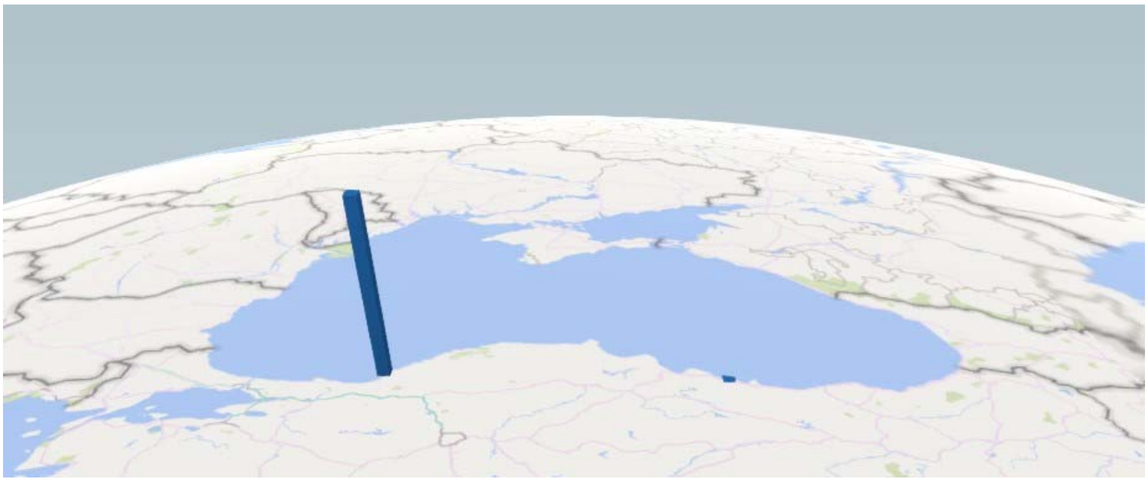
Figure 76. Domestic Steel Shipping Loaded at Ports of Black Sea (Tons)



Source: Compiled from MTI, (2019b) by the Author

Figure 77 illustrates the distribution of the steel loaded at Black Sea Region. Most of the loaded steel type is steel roll. The steel plate and steel sheet are the other loaded steel types. Karadeniz Eregli is the origin of the loaded steel volume.

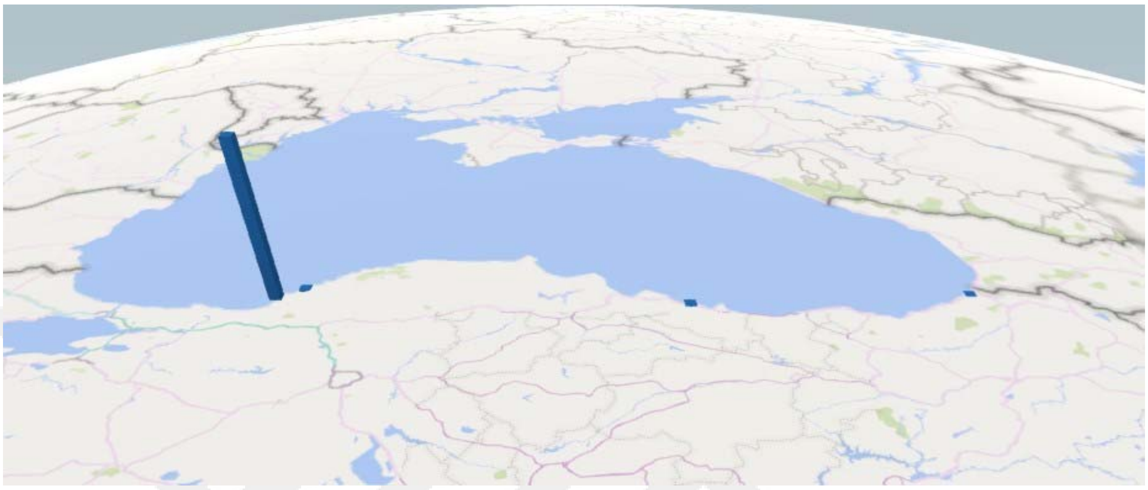
Figure 77. Distribution of the Steel Loaded at Black Sea Region



Source: Compiled from MTI, (2019b) by the Author

Figure 78 illustrates the distribution of the steel unloaded at the ports of the Black Sea Region. Most of the loaded steel type is steel roll and unloaded in Karadeniz Eregli. The steel sheet is also unloaded in the region and especially in Unye.

Figure 78: Distribution of the Steel Unloaded at Black Sea Region



Source: Compiled from MTI, (2019b) by the Author

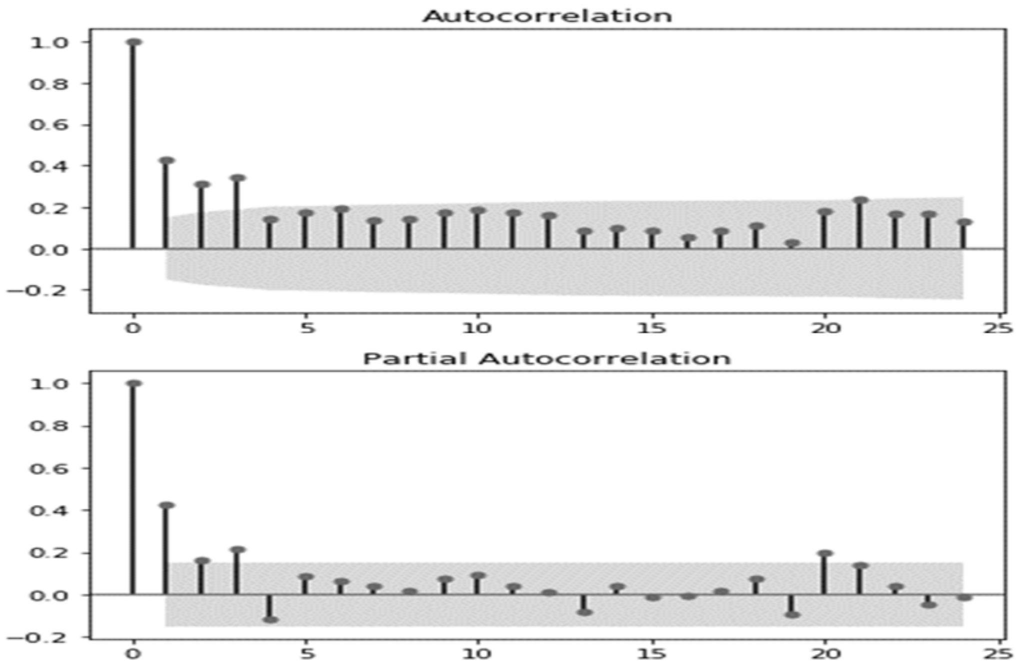
The descriptive statistics of the series are presented in Appendix 7. Total of 168 observations used for the development of the models. Steel, export, import, Iron, Iprice, crude, and CPI have positive skewness that shows occurring increases are more probable than decreases. IPI has negative skewness that refers to occurring declines are more probable. Export, import, exchange rate, Iron has positive kurtosis that indicates leptokurtic distribution referring to fatter tails. Steel, price, CPI, Iprice and crude have negative kurtosis that indicates playkurtic distribution, a flat top near the mean and shorter, thinner tails, referring to low probability for extreme values.

Shapiro Wilk and Jarque-Bera normality tests performed to variables used in the study as presented in Appendix 6. The null hypothesis for the normality test is normally distributed sample. The null hypothesis for the steel variable is rejected that infers the data is not drawn from the normal distribution. However, the logarithmic transformation of the data is used.

Stationarity is tested with Dickey-Fuller and Philips-Perron unit root test. The results are presented in Appendix 8 and reveal that steel, export, import, price, crude and iron variables are stationary at level. Exchange rate, IPI, Iprice and CPI variables are stationary at their first differences.

Steel data have autocorrelation at first, second and third lags as shown in Figure 79. PACF plot shows a spike at lag first, second, third and twentieth lags.

Figure 79. ACF and PACF Plot of the Domestic Steel Shipping Data



Source: Statsmodels output

The statistical association between the domestic steel shipping and used exogenous variables are searched with a cross-correlation matrix. This is shown in Table 46. As a result, the highest correlation existed between steel and Iron and IPI, CPI variables

The Canova-Hansen test is applied to detect seasonality in the series. All variables used for the forecasting of the domestic steel shipping did not show a seasonal pattern.

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Table 46. Correlation Coefficients of the Used Variables While Modelling Domestic Steel Shipping Demand Forecast

	Steel	Export	Import	Exchange	IPI	Price	CPI	Iron	Iprice	Crude
Steel	1									
Export	-0.1106	1								
Import	-0.0469	0.7279	1							
Exchange	0.1666	0.0350	0.1403	1						
IPI	0.3041	0.2442	0.4664	0.6718	1					
Price	-0.1498	0.5667	0.4229	-0.3339	0.0426	1				
CPI	0.2387	0.1133	0.2966	0.9424	0.8140	-0.2528	1			
Iron	0.3629	0.1664	0.3326	0.1186	0.3233	-0.0583	0.25132	1		
Iprice	-0.1371	0.5894	0.4788	-0.4508	-0.0769	0.82542	-0.3182	0.1092	1	
Crude	-0.0191	0.6707	0.6429	-0.3213	0.1326	0.7279	-0.1688	0.3352	0.8137	1

Source: Created by Author based on Statsmodels outputs

4.3.3.12.2. Results of the ARMAX model

Firstly, the ARMAX model with all variables is estimated. To find out the best model, variable selection is applied with eliminating with the highest probability. However, this method did not provide the best accuracy. Therefore, below listed models in Table 47 are tried on the accuracy errors RMSE and MAPE. The model generated from the dataset is ARMAX (2,0,2). The best model is composed of export and import variables. It is deduced that the forecast model of ARMAX resulted in a reasonable prediction with 33.80 % MAPE.

Table 47. Comparison of The ARMAX Forecast of Domestic Steel Shipping Demand

Model ARMAX (2,0,2)		
Variables	**RMSE**	**MAPE**
Export, imports, exchange, IPI, price, CPI	13033.6	52.58
CPI	18673.66	76.24
Price, CPI	14739.07	59.94
IPI, price, CPI	16350.33	66.41
Export, import, IPI, price, CPI	26489.39	108.67
Export, import, price, CPI	25039.53	100.91
Exchange, CPI	15487.62	62.87
Export, import	9971.68	36.27
Export, import, CPI	29265.49	117.93
Export, import, CPI	12502.94	49.65
IPI	10609.21	39.72
IPI, export	13340.29	54.12
IPI, import	16232.42	66.39
Import, export, exchange	35143.59	134.36
Import, export, price	10019.19	36.96
Export	10251.72	35.47
Import	10072.16	35.38
IPI, price	11326.71	44.21
IPI, price, import	13430.07	53.99
IPI, price, export	14220.23	57.95
Export, imports, exchange, IPI, price, CPI, ironload, Iprice, crude	19850.08	82.04
Export, imports, IPI, price, ironload, Iprice, crude	17168.54	70.99
Imports, exchange, IPI, price, ironload, Iprice, crude	18347.61	75.94
Export, imports, ironload, Iprice, crude	**9298.18**	**33.80**
Imports, ironload, Iprice, crude	9717.55	34.25
Export, imports, ironload, Iprice	9921.78	37.16
Export, imports, price, ironload, Iprice	10798.6	41.76
Export, imports, price, ironload, Iprice, crude	9816.18	36.66
Export, imports, ironload	10019.19	36.96
Export, imports, ironload, crude	10094.73	35.92

Source: Created by Author based on “auto_arima” from Pyramid outputs

The estimated significant parameters are illustrated in equation (20) and Table 48 as follows:

$$Y_t = 2.4564 + 0.1698\text{export} - 0.3290\text{import} + 0.0195\text{Iron} + 0.3680\text{Iprice} - 0.6346\text{crude} + 0.2731Y_{t-1} + 0.5440Y_{t-2} + 0.2472\varepsilon_{t-1} - 0.4756\varepsilon_{t-2} \quad (20)$$

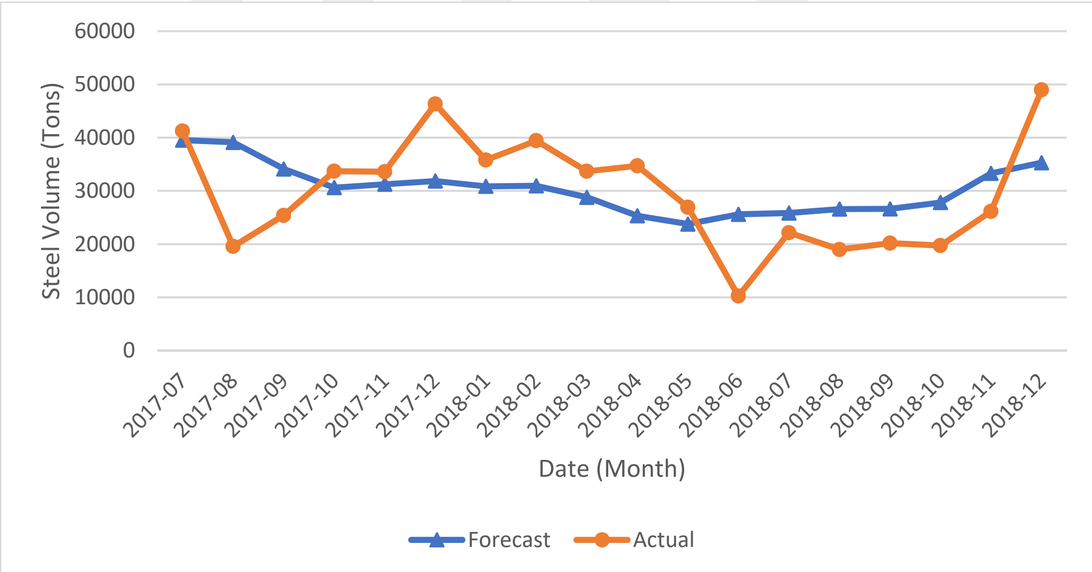
Table 48. Model Estimation of The ARMAX Model for Domestic Steel Shipping Demand

Variable	Coefficient (standard errors)	Z value	P>|z|
C	2.4564 (2.469)	0.995	0.320
Export	0.1698 (0.217)	0.781	0.435
Import	-0.3290 (0.175)	-1.884	0.060
Iron	0.0195 (0.017)	1.164	0.244
Iprice	0.3680 (0.365)	1.008	0.314
Icrude	-0.6346 (0.435)	-1.457	0.145
ar.L1	0.2731 (0.317)	0.862	0.389
ar.L2	0.5440 (0.234)	2.321	0.020
ma.L1	0.2472 (0.305)	0.811	0.418
ma.L2	-0.4756 (0.129)	-3.691	0.000
sigma2	0.1690 (0.015)	11.198	0.000

Source: Created by Author based on “auto_arima” from Pyramid outputs

Forecast of domestic steel shipping loaded at ports of Black Sea that is obtained from the ARMAX model is presented in Figure 80. As shown below, out of sample forecasts did not capable of produce effective forecasts.

Figure 80. Results of ARMAX Forecasting for Domestic Steel Shipping



Source: Created by Author based on “auto_arima” from Pyramid outputs

After the model is estimated, to check the adequacy of the model ACF and PACF of the residuals were examined. Ljung–Box *Q* test is adopted to diagnose if the estimated residuals are white noise series or not. As seen in Figure 81 the result of the test indicates that the goodness of fit test of the optimum ARMAX model showed non-significant autocorrelations in the residuals of the model.

Figure 81. ACF and PACF of Residuals for The ARMAX Model of Domestic Steel Shipping

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.104	0.104	0.2308	0.631
		2	0.012	0.001	0.2341	0.890
		3	0.100	0.100	0.4747	0.924
		4	0.017	-0.004	0.4822	0.975
		5	0.057	0.056	0.5713	0.989
		6	-0.389	-0.421	5.1102	0.530
		7	-0.101	-0.010	5.4430	0.606
		8	-0.155	-0.200	6.3040	0.613
		9	-0.041	0.120	6.3713	0.702
		10	0.096	0.108	6.7872	0.745
		11	-0.210	-0.151	9.0476	0.617
		12	0.028	-0.103	9.0948	0.695

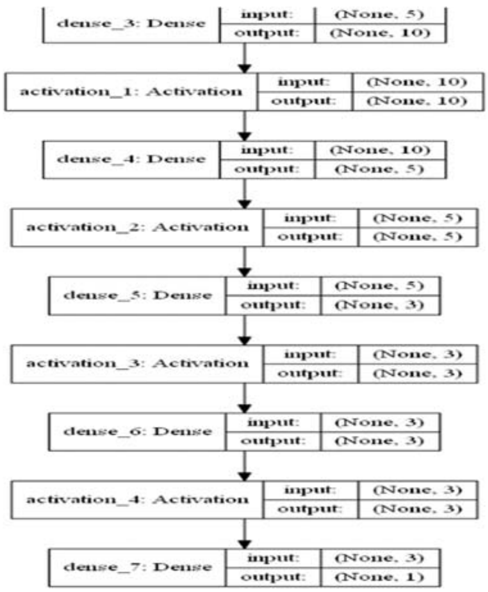
Source: Eviews outputs

4.3.3.12.3. Results of the ANN models

4.3.3.12.3.1. Results of the MLP model

Figure 82 illustrates the model graph of the MLP. MLP architecture is utilized as four input variables, three hidden layers with five, five and three neurons terminating at an output layer with tanh activation. Hidden layers utilized tanh activation functions and the network epoch was 1000.

Figure 82: MLP Model Graph for Domestic Steel Shipping



Source: Keras Deep Learning Package outputs

Table 49 shows the used variable combinations while developing the MLP model. The best model is composed of export, imports, iron, crude variables. Several combinations were tried to find out an accurate model.

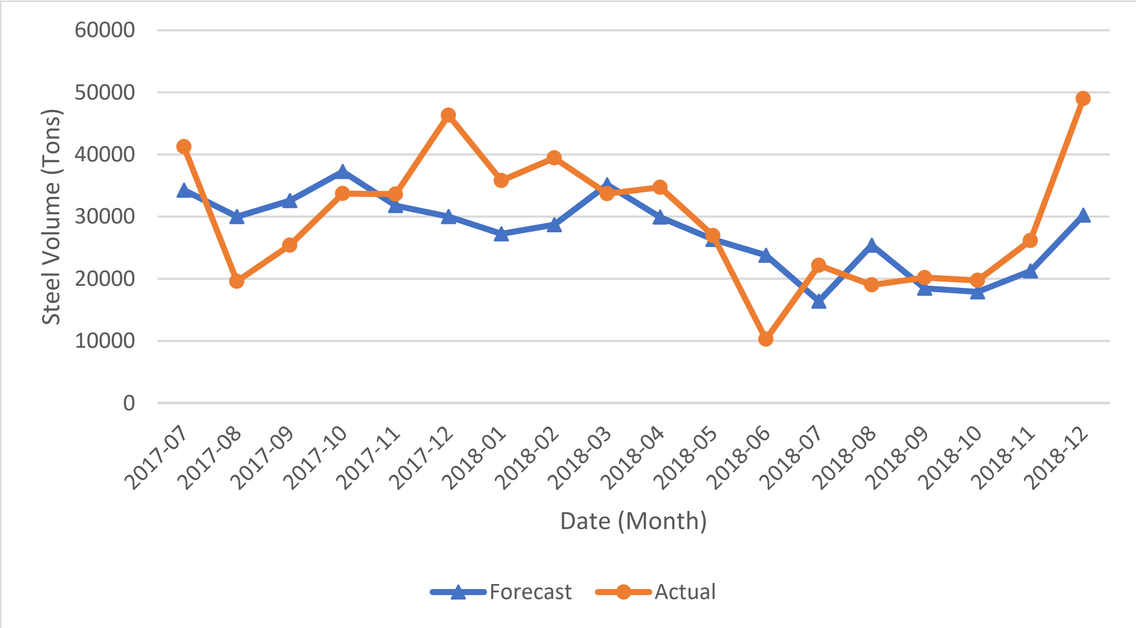
Table 49. Comparison of the MLP Forecasts for Domestic Steel Shipping

Variables	RMSE	MAPE
Export, imports, exchange, IPI, price, CPI	25190.6	104.35
Export	12429.17	50.23
Price, export	12391.6	50.25
Import, price, export	13842.37	47.69
Exchange, IPI, import, price, export	22136.68	91.28
Exchange, IPI, price, export	14061.03	57.18
CPI, export	13997.7	57.33
Export, import	12647.72	49.50
Export, import, CPI	15932.93	63.02
Export, import, IPI	11078.28	39.49
IPI	11443.59	44.66
IPI, import	15349.98	60.20
Import, export, exchange	22995.19	94.36
Import	11019.25	41.96
IPI, price	12165.77	48.70
IPI, price, import	11913.74	47.85
IPI, price, export	12446.55	50.28
CPI	21118.62	58.24
Price, CPI	25724.93	106.66
IPI, price, CPI	10473.16	35.33
Export, import, IPI, iprice, CPI	11519.96	42.95
Export, import, price, CPI	12446.84	49.27
Exchange, CPI	15276.06	39.968
Export, imports, exchange, IPI , price, CPI, iron, iprice, crude	28191.51	112.58
Export, imports, IPI, price, iron, iprice, crude	13037.81	36.73
Imports, exchange, IPI, iron, iprice, crude	25361.47	92.66
Import, export, iron, iprice, crude	11689.22	44.69
Imports, iron, iprice, crude	10155.01	38.67
Export, imports, iron, iprice	10210.53	37.91
Export, imports, price, iron, iprice	10749.1	37.66
Export, imports, price, iron, iprice, crude	11874.94	40.64
Export, imports, iron	10351.09	36.10
Export, imports, iron, crude	**8645.38**	**27.08**

Source: Created by Author based on Keras Deep Learning Package outputs

Figure 83 illustrates the results of the MLP out of forecasts for domestic steel sipping loaded at ports of the Black Sea Region. Reasonable prediction accuracy is obtained with the MLP model. Some dates as 2017-10, 2017-11, 2018-03, 2018-05, 2018-09 and 2018-10 are achieved good forecasts with the best model of MLP.

Figure 83. Results of MLP Forecasting for Domestic Steel Shipping

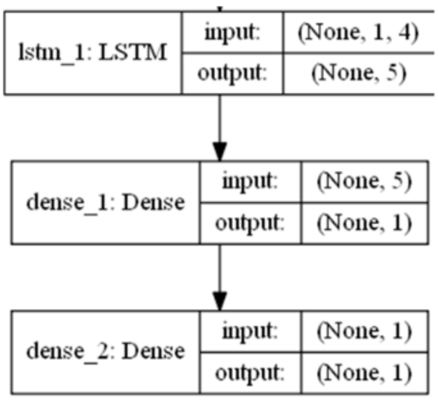


Source: Created by Author based on Keras Deep Learning Package outputs

4.3.3.12.3.2. Results of the LSTM model

Figure 84 illustrates the model graph of the LSTM. LSTM architecture is utilized as four input variables, three hidden layers with five, five and three neurons terminating at an output layer with tanh activation. Hidden layers utilized tanh activation functions and the network epoch was 1500.

Figure 84: LSTM Model Graph for Domestic Steel Shipping



Source: Keras Deep Learning Package outputs

Table 50 shows the used variable combinations while developing the LSTM model. The best model is composed of the export variable when the RMSE is considered as an accuracy metric. Export, import, ironload, and crude form the best model when MAPE is considered as an accuracy metric.

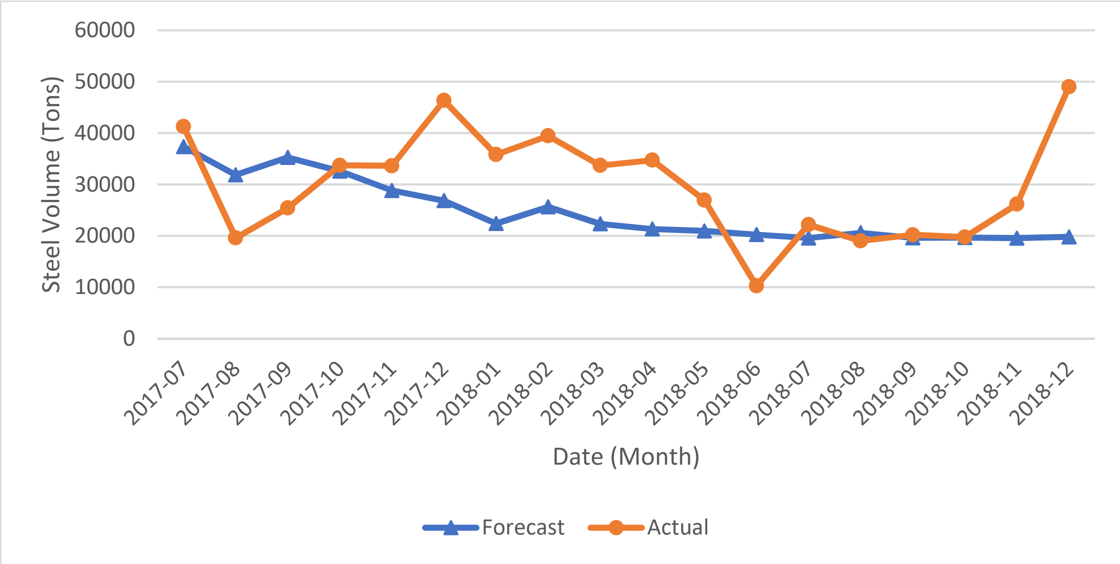
Table 50. Comparison of the LSTM Forecasts for Domestic Steel Shipping

Variables	RMSE	MAPE
Export, imports, exchange, IPI, price, CPI	15733.73	59.76
Export	**10159.78**	35.64
Price, export	10320.53	36.80
Import, price, export	11760.81	42.02
Exchange, IPI, import, price, export	11558.19	44.30
Exchange, IPI, price, export	10564.30	33.60
CPI, export	17099.47	70.03
Export, import	10389.03	35.96
Export, import, CPI	29171.18	121.35
Export, import, IPI	12745.57	50.34
IPI	12795.29	50.96
IPI, import	13295.39	54.20
Import, export, exchange	25723.46	106.02
Import	10306.09	38.75
IPI, price	12912.32	52.38
IPI, price, import	13190.03	53.77
IPI, price, export	12118.74	45.70
CPI	15712.59	64.25
Price, CPI	14451.76	59.27
IPI, price, CPI	10627.91	39.35
Export, import, IPI, iprice, CPI	27568.07	115.19
Export, import, price, CPI	17771.33	68.22
Exchange, CPI	18877.01	77.85
Export, imports, exchange, IPI ,price, CPI, iron, iprice, crude	21680.69	83.75
Export, imports, IPI, price, iron, iprice, crude	25708.37	106.70
Imports, exchange, IPI, iron, iprice, crude	18644.69	74.75
Import, export, iron, iprice, crude	11815.19	39.86
Imports, iron, iprice, crude	10425.65	36.11
Export, imports, iron, iprice	10095.54	36.17
Export, imports, price, iron, iprice	10155.15	33.62
Export, imports, price, iron, iprice, crude	15093.07	38.94
Export, imports, iron	11343.86	32.35
Export, imports, iron, crude	11520.43	**30.17**

Source: Created by Author based on Keras Deep Learning Package outputs

Figure 85 illustrates the results of the LSTM out of forecasts for domestic steel shipping loaded at ports of the Black Sea. Forecasting errors of the forecast are very low at 2017-07, 2017-10, 2018-08, 2018-09, 2018-10. It is observed that reasonable forecasts are achieved in terms of MAPE. However, the forecast line points out the poor forecasting results.

Figure 85. Results of LSTM Forecasting for Domestic Steel Shipping

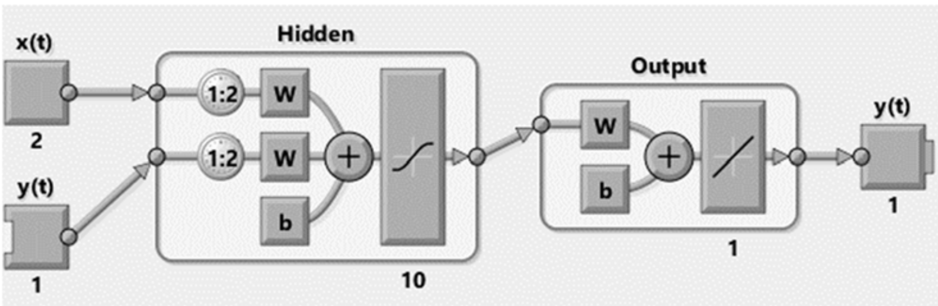


Source: Created by Author based on Keras Deep Learning Package outputs

4.3.3.12.3.3. Results of the NARX model

Figure 86 illustrates the model graph of the NARX. The model has three input variables as export, import and past values of steel, ten hidden layers and one output layer.

Figure 86. NARX Model Graph for Domestic Steel Shipping



Source: MATLAB neural network toolbox output

Table 51 shows the used variable combinations while developing the NARX model. In terms of RMSE, the best model is composed of export and import variables. The export variable is the best model in terms of MAPE. However, both models have close MAPE results. Therefore, the best model is considered as an export and import combination.

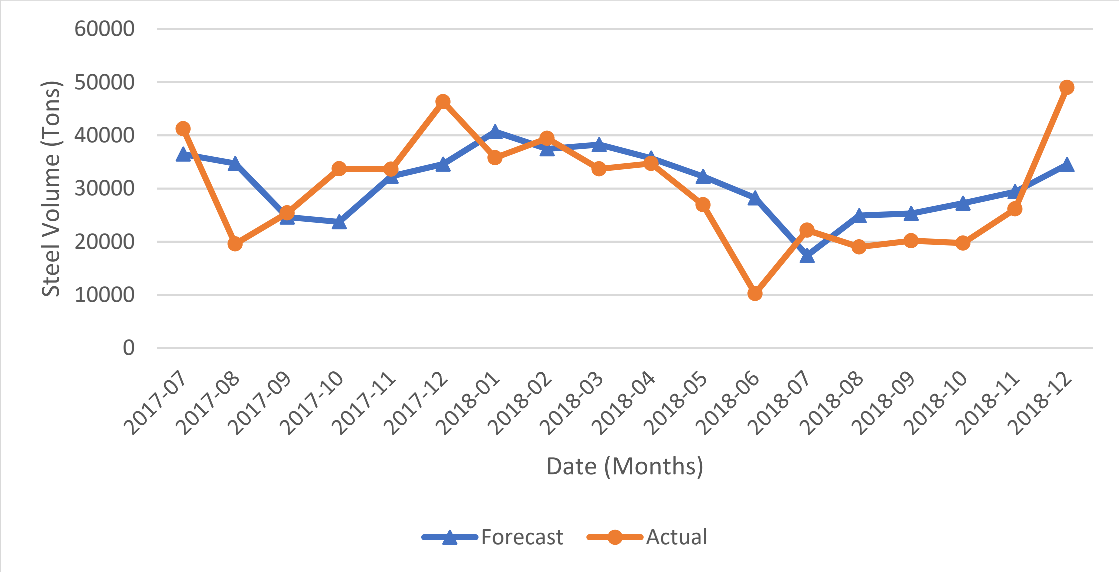
Table 51. Comparison of the NARX Forecasts for Domestic Steel Shipping

NARX Model		
Variables	**RMSE**	**MAPE**
Export, imports, exchange, IPI, price, CPI	21091.73	86.02
Export	9044.36	28.30
Price, export	10292.04	37.15
Import, price, export	10571.42	36.81
Exchange, IPI, import, price, export	19306.17	79.10
Exchange, IPI, price, export	17601.92	54.83
CPI, export	12803.27	51.68
Export, import	**8345.61**	**29.94**
Export, import, CPI	11609.57	44.48
Export, import, IPI	21332.25	83.05
IPI	21978.29	84.46
IPI, import	10660.93	35.99
Import, export, exchange	35788.86	132.38
Import	9524.53	32.23
IPI, price	13662.44	50.85
IPI, price, import	14634.33	60.41
IPI, price, export	16000.66	64.50
CPI	19175.60	71.09
Price, CPI	10047.39	39.78
IPI, price, CPI	17723.68	63.49
Export, import, IPI, iprice, CPI	17894.87	65.71
Export, import, price, CPI	13632.64	55.47
Exchange, CPI	43982.15	138.45
Export, imports, exchange, IPI, price, CPI, iron, iprice, crude	14617.87	60.40
Export, imports, IPI, price, iron, iprice, crude	25720.29	104.54
Imports, exchange, IPI, iron, iprice, crude	11638.85	42.46
Import, export, iron, iprice, crude	11573.29	40.21
Imports, iron, iprice, crude	11056.32	42.20
Export, imports, iron, iprice	13135.26	54.03
Export, imports, price, iron, iprice	10419.89	35.58
Export, imports, price, iron, iprice, crude	11624.47	42.56
Export, imports, iron	11577.20	33.67
Export, imports, iron, crude	10661.74	31.81

Source: Created by Author based on MATLAB neural network toolbox output

Figure 87 illustrates the results of the NARX out of forecasts for domestic steel shipping loaded at Ports of the Black Sea. In the first months, NARX achieved good forecasts on 2017-09, 2017-12, 2018-02 and 2018-04.

Figure 87. Results of NARX Forecasting for Domestic Steel Shipping



Source: Created by Author based on MATLAB neural network toolbox output

4.3.3.12.4. Results of the Hybrid model

Firstly, the ARMAX model with export, imports, ironload, Iprice, crude variables were estimated. The model generated from the dataset is SARIMAX (0, 0, 1) x (0, 0, 1, 12). Then, the MLP model constructed with the below-mentioned lags and best model composed of three input variables, three hidden layers with five, five and three neurons, one output layer. The activation function was tanh. Epoch was tried as 120 for all lags, and the best model was specified with 400 epochs.

Table 52 shows the used variable lag combinations while developing a hybrid model. The results are not good enough in terms of accuracy performances. ARIMAX-ANN-3 is found as the best-performed models.

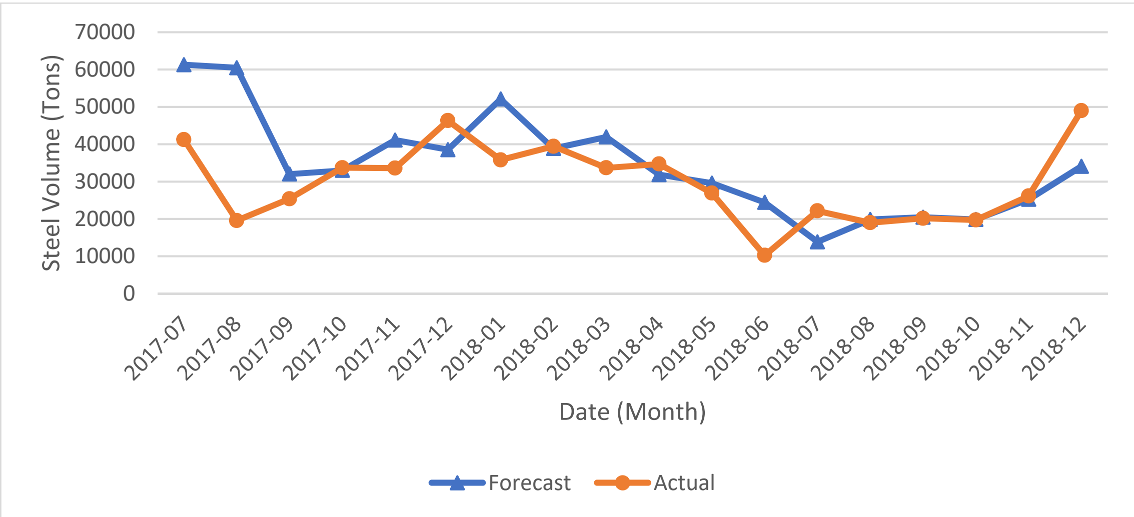
Table 52. Comparison of the Hybrid Forecasts for Domestic Steel Shipping

Variables	RMSE	MAPE
ARIMAX-ANN-1: Qt-1, Qt-4	11851.2	44.72
ARIMAX-ANN-2: Qt-1, Qt-2	11977.26	42.14
ARIMAX-ANN-3: Qt-1, Qt-3	13080.85	34.99
ARIMAX-ANN-4: Qt-1, Qt-2, Qt-3	13854.8	37.83
ARIMAX-ANN-5: Qt-1, Qt-2, Qt-3, Qt-4	17305.91	50.65
ARIMAX-ANN-6: Qt-3, Qt-4	15038.06	59.33
ARIMAX-ANN-7: Qt-2, Qt-4	16788.66	47.86
ARIMAX-ANN-8: Qt-2, Qt-3, Qt-4	16664.03	48.43
ARIMAX-ANN-9: Qt-2, Qt-3	14631.65	54.61
ARIMAX-ANN-10: Qt-1, Qt-2, Qt-4	16340.2	47.61
ARIMAX-ANN-11: Qt-1, Qt-3, Qt-4	11693.08	36.59

Source: Created by Author based on "auto_arima" from Pyramid outputs and Keras Deep Learning Package outputs

Figure 88 illustrates the results of the hybrid model out of forecasts for domestic steel shipping loaded at Ports of the Black Sea. It is inferred that hybrid model forecasts are not good enough. Estimated model is relatively good at forecasting 2017-10, 2018-02, 2018-04, 2018-05, 2018-08, 201809, 2018-10 and 2018-11. The forecasting performance of the first three months has resulted in very poor.

Figure 88. Results of Hybrid Forecasting for Domestic Steel Shipping



Source: Created by Author based on "auto_arima" from Pyramid outputs and Keras Deep Learning Package outputs

4.3.3.12.5. Comparison of the Results

Table 53 shows that MLP and NARX models outperformed than other methods. MLP model presented the best MAPE accuracy rate, while NARX presented the best RMSE accuracy rate. According to the results, the hybrid model has the worst performances. Although the ARMAX-ANN model can capture both the linear and nonlinear nature of the data and uses the advantages of both models, it did not present better performance.

Similar variable combinations are used in forecasting domestic steel shipping. Export, imports, iron, Iprice, crude resulted as the most accurate combination for ARMAX, while export, imports, iron, and crude combination resulted in the best accuracy rate for MLP and LSTM. The best model for the NARX is export and import variables' combination.

Table 53. Accuracy Comparisons of Domestic Steel Shipping Forecast Models

Forecast Model	**MLP Model**		**ARMAX (2,0,2)**		**LSTM**		**NARX**		**SARIMAX-ANN-3**	
Forecast Error	**MAPE**	**RMSE**	**MAPE**	**RMSE**	**MAPE**	**RMSE**	**MAPE**	**RMSE**	**MAPE**	**RMSE**
	27.08	8645	33.81	9298	30.17	11520	29.93	**8345**	34.99	13080

Source: Author

4.3.3.12.6. Significances of the Model Performances

To discuss the developed models in detail, t-tests are conducted to examine the significances of the model performances. T-test results are based on the comparison of MAPE of the residuals. The *p*-value for each t-test presented in Table 54. The tests have resulted at a significance level of 95%, therefore p-values <0.05 indicate models that vary significantly.

The paired t-test showed that only the ARIMAX model and MLP model have significant differences with a p-value of less than 0.10.

Furthermore, Diebold–Mariano test (1995) is adopted to evaluate the statistical significance of performances of developed models in depth. DM test aims to test the null hypothesis of equal accuracy of the two competing models. In this paper, the null hypothesis of the DM test cannot be rejected for the compared models apart from the MLP and LSTM model. They have a p-value of less than 0.10. All p-values are presented with high values than 0.05. Therefore, it is obtained that developed models' have equal forecasting accuracy.

Table 54. T-test and DM Test Results of Domestic Steel Shipping Forecast Models

	MLP	ARMAX (2,0,2)	LSTM	NARX	Hybrid
MLP		0.58161 (0.5685)	1.9235 (0.0713)	-0.27949 (0.7832)	1.0598 (0.3041)
ARX	**1.803 (0.0891)**		-1.0669 (0.301)	1.1905 (0.250)	-1.0992 (0.287)
LSTM	**-0.76063 (0.4573)**	**0.63642 (0.533)**			0.38464 (0.7053)
NARX	**-0.65492 (0.5213)**	**1.114 (0.2808)**	**0.032526 (0.9744)**		1.2101 (0.2428)
Hybrid	**0.82967 (0.4182)**	**0.14315 (0.8879)**	**0.49321 (0.6282)**	**0.55348 (0.5871)**	

*** Bold fonts are the results of the t-test**

Source: Created by Author based on R Studio outputs

4.3.3.13. Forecasting Domestic Iron Shipping Demand

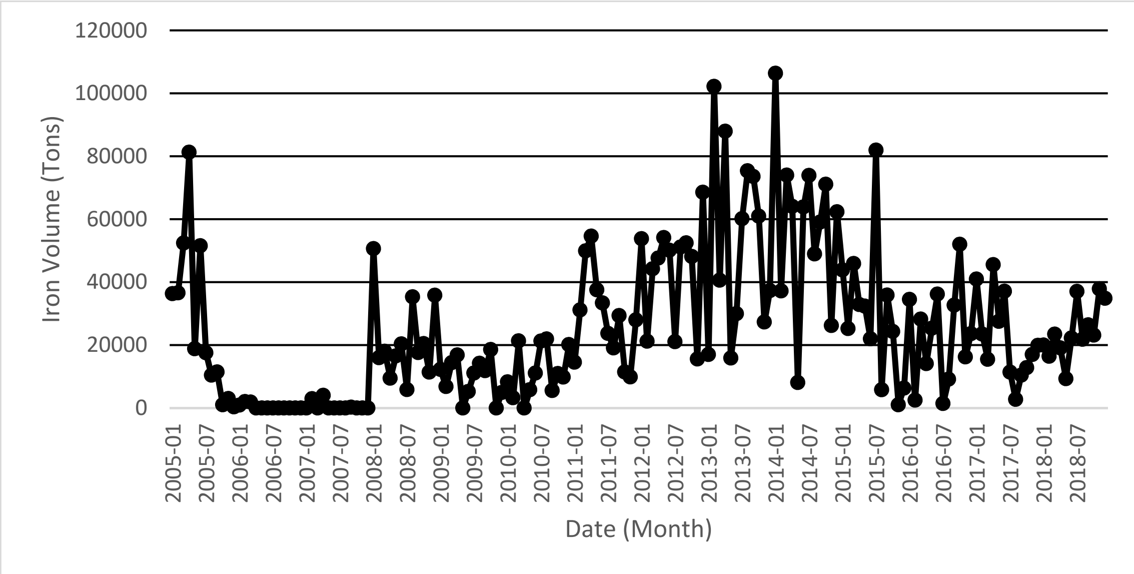
The out of sample forecast models of domestic shipping demand of iron based on the ARIMA model, ANN models, and hybrid model are investigated in this part.

4.3.3.13.1. Data Characteristics

Raw material constitutes 75% -80% of the total product cost of the iron and steel industry (Çevik, 2017: 20). According to estimates of the MTA, 125 million tons of iron ore reserves exist in Turkey (MTA, 2017: 15). Known domestic iron ore resources are insufficient in quality and quantity. Therefore, half of the domestic iron ore demand is supplied by imports (Çevik, 2017: 20). 11th Development Plan also points out that issue and gives attention to securing inputs of the industry. The Plan also gives importance to the other issues that could affect on demand for domestic iron shipping. Expanding export markets of iron and steel industries, embarking on the non-standard poor quality product import, developing domestic supply chain of quality steel types for using strategic areas as railways, defense industry, mega projects, and nuclear power plant are also mentioned (SBB, 2019: 87)

As shown in Figure 89, loaded iron volume present volatile series. The sharp peaks and downs are observed. It is observed from Figure 88 that downs are more frequent than peaks. Between 2005 and 2008, there was no demand for domestic iron shipping at ports of the Black Sea.

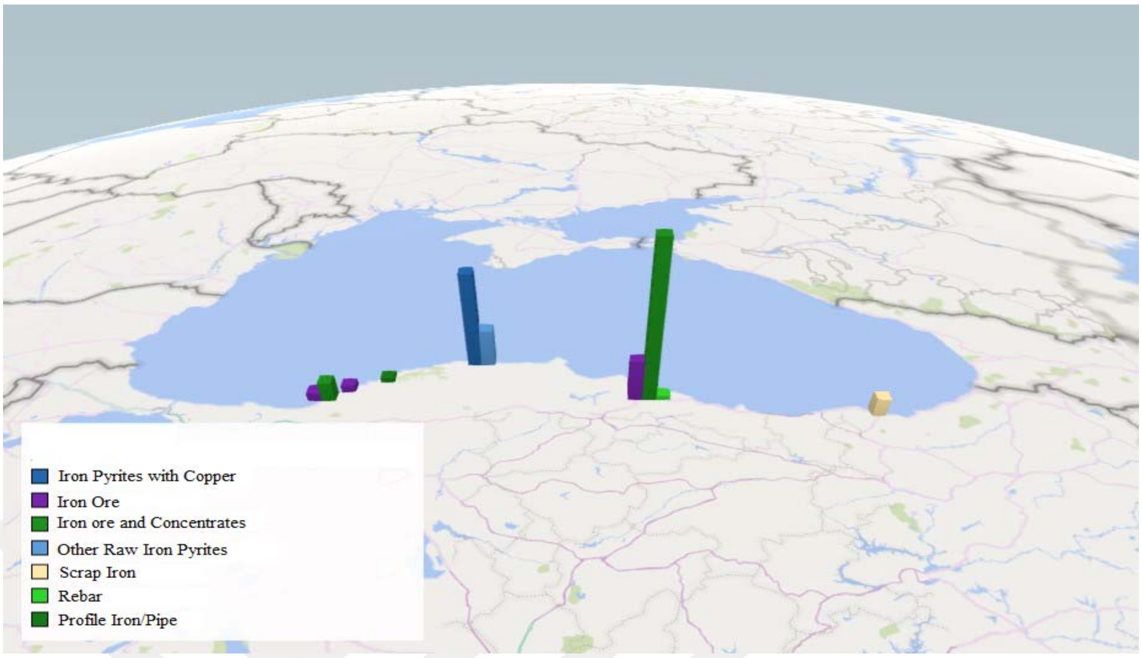
Figure 89. Domestic Iron Shipping Loaded at Ports of Black Sea (Tons)



Source: Compiled from MTI, (2019b) by the Author

Figure 90 illustrates the distribution of the iron loaded at Black Sea Region. Most of the loaded iron type is iron ore and concentrates. Iron ore and concentrates are loaded at Samsun. Samsun has Sivas Divriği in its hinterland and Divriği has the iron deposits that are one of the most important deposits of Turkey. The percentage of iron in these ironstones are %60-70. These ironstones are processed at Karabük and Ereğli Demir Çelik facilities (MTA, 2017:7). Iron pyrites with copper are the second most loaded type that is loaded at Inebolu that have the copper facilities in its hinterland.

Figure 90. Distribution of the Iron Loaded at Black Sea Region



Source: Compiled from MTI, (2019b) by the Author

Figure 91 illustrates the distribution of the iron unloaded at the ports of the Black Sea Region. Most of the loaded iron type is iron ore and unloaded at Karadeniz Eregli that has iron and steel facilities in its hinterland.

Figure 91. Distribution of the Iron Unloaded at Black Sea Region

Source: Compiled from MTI, (2019b) by the Author

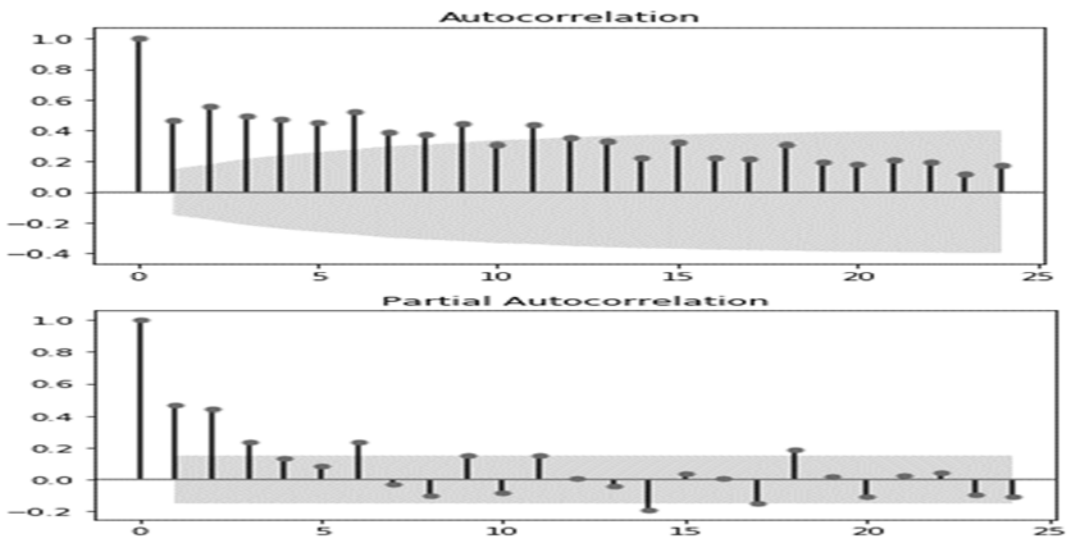
The descriptive statistics of the series are presented in Appendix 7. Total of 168 observations used for the development of the models. Iron, steel, export, import, Iprice, crude, price, CPI and sales have positive skewness that shows occurring increases are more probable than decreases. Buildings have negative skewness that refers to occurring declines are more probable. Export, import, iron have positive kurtosis that indicates leptokurtic distribution refers to fatter tails. Iprice, crude, CPI, steel, price, buildings, sales have negative kurtosis that indicates playkurtic distribution, a flat top near the mean and shorter, thinner tails, referring to low probability for extreme values.

Shapiro Wilk and Jarque-Bera normality tests performed to variables used in the study as presented in Appendix 6. The null hypothesis for the normality test is normally distributed sample. The null hypothesis for the iron variable is accepted that infers the data is drawn from the normal distribution.

Stationarity is tested with Dickey-Fuller and Philips-Perron unit root test. The results are presented in Appendix 8 and reveal that steel, export, import, price, crude, sales, and iron variables are stationary. Iprice and CPI variables are stationary at their first differences.

Iron data have auto-correlation and presented that the series is serially correlated at lag 1, 2,3,4,5,6,7,8,9 and 11 as shown in Figure 92. PACF plot shows a spike at lag only 1, 2, 6, 14 and 18.

Figure 92. ACF and PACF Plot of the Domestic Iron Shipping Data



Source: Statsmodels output

The statistical association between the domestic iron shipping and the used exogenous variables is searched with a cross-correlations matrix. This is shown in Table 55, price and building have a negative correlation with the iron. The highest positive correlation existed between iron and steel variables.

Table 55. Correlation Coefficients of the Used Variables While Modelling Domestic Iron Shipping Demand Forecast

	Iron	Iprice	Crude	Export	Import	CPI	Steel	Price	Building	Sales
Iron	1									
Iprice	0.1092	1								
Crude	0.3352	0.8137	1							
Export	0.1664	0.5894	0.6707	1						
Import	0.3326	0.4788	0.6429	0.7279	1					
CPI	0.2513	-0.3182	-0.1688	0.1133	0.2966	1				
Steel	0.3629	-0.1371	-0.0191	-0.1106	-0.0469	0.2387	1			
Price	-0.0583	0.8254	0.7279	0.5667	0.4229	-0.2528	-0.1498	1		
Building	-0.3872	-0.0585	-0.1271	0.1097	-0.1134	-0.1623	-0.2497	0.1249	1	
Sales	0.2860	-0.0349	0.1829	0.1453	0.3886	0.4934	0.2589	-0.0201	-0.0414	1

Source: Created by Author based on Statsmodels outputs

The Canova-Hansen test is applied to detect seasonality in the series. All variables used for the forecasting of the domestic copper shipping showed stable seasonal pattern contrary to the expectations.

4.3.3.13.2. Results of the ARMAX Model

Firstly, the ARMAX model with all variables is estimated. To find out the best model, variable selection is applied with eliminating with the highest probability. However, this method did not provide the best accuracy. Therefore, below listed models in Table 56 are tried on the accuracy errors RMSE and MAPE. The model generated from the dataset is ARMAX (1,0,1). The best model is composed of export, steel, price and cement variables. It is deduced that the forecast model of ARMAX resulted in reasonable forecasting with 28.90 % MAPE.

Table 56. Comparison of the ARMAX Forecast of Domestic Iron Shipping Demand

Model ARMAX (1,0,1)		
Variables	**RMSE**	**MAPE**
Iprice, crude, export, import, CPI, steel, price, building	10327.44	52.60
Iprice, imports, CPI, price	20303.21	104.73
Iprice, crudeoil, import, building	15780.53	114.50
Irnprice, crude, export, steel, building	10523.15	60.55
Iprice, crude, export, import, CPI, price, building	23523.03	86.42
Steel	13782.69	71.96
Export, import	10985.93	80.22
Buildings	14957.78	104.44
Iprice, crude, export, import, CPI, steel, price	12700.20	54.43
Price	13409.65	79.57
CPI	32591.98	218.04
Iprice, crude, export, import, steel, price	16828.31	66.09
Crude	13571.98	91.29
Iprice, export, import, steel, price	17125.69	71.44
Iprice, export, import, steel, price, CPI	15110.22	61.89
Iprice, export, import, steel, price, buildings	17199.56	73.59
Iprice, import, steel, price	18084.50	78.81
Iprice, crude, export, import, CPI, steel, price, building, sales	17611.11	64.38
Iprice, crude, export, import, CPI, steel, price, sales	21089.51	69.34
Iprice, crude, export, import, steel, price, sales	13816.24	56.71
Iprice, ,export, import, steel, sales	9944.71	57.44
Iprice, import, steel, sales	13587.92	72.17
Export, CPI, steel, price	66725.31	184.95
Crude, price, building, sales	13321.75	61.38
Price, building, sales	14278.75	83.43
Steel, price, building, sales	14625.85	71.31
Iprice, steel, price, building, sales	16901.64	83.86
Iprice	13466.24	90.97
Export	9981.34	73.31
Import	13768.55	95.52
Export, steel	10631.98	58.15
Cement	12738.92	83.13
Export, import, price	7737.51	34.58
Export, import, price, sales	**7710.24**	**28.91**
Iprice, import, price, sales	11452.37	50.39

Source: Created by Author based on “auto_arima” from Pyramid outputs

The estimated significant parameters are illustrated in equation (21) and Table 57 as follows:

$$Y_t = -0.1502 + 2.1915\text{export} + 0.5318\text{steel} - 3.9651\text{price} - 0.3680\text{price} - 0.4640\text{cement} + 0.9400Y_{t-1} - 0.5920\varepsilon_{t-1} \quad (21)$$

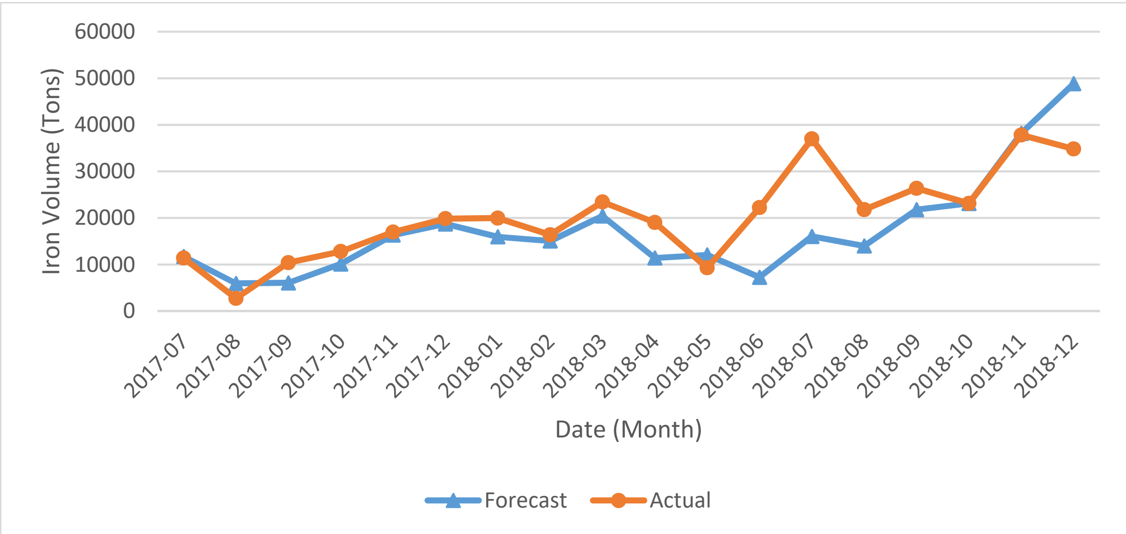
Table 57: Model Estimation of The ARMAX Model for Domestic Iron Shipping Demand

Variable	Coefficient (standard errors)	Z value	P>|z|
C	-0.1502 (0.956)	-0.157	0.875
Export	2.1915 (1.163)	1.884	0.060
Steel	0.5318 (0.390)	1.365	0.172
Price	-3.9651 (2.636)	-1.504	0.133
Cement	-0.4640 (0.340)	-1.365	0.172
ar.L1	0.9400 (0.041)	22.673	0.000
ma.L1	-0.5920 (0.070)	-8.408	0.000
sigma2	5.0235 (0.538)	9.343	0.000

Source: Created by Author based on "auto_arima" from Pyramid outputs

Forecast of domestic steel shipping loaded at ports of Black Sea that is obtained from the ARMAX model is presented in Figure 93. As shown below, out of sample forecasts is capable of produce effective forecasts. Only high peaks and downs are the reasons for the poor forecasting points as 2017-08, 2018-06, 2018-07, 2018-12.

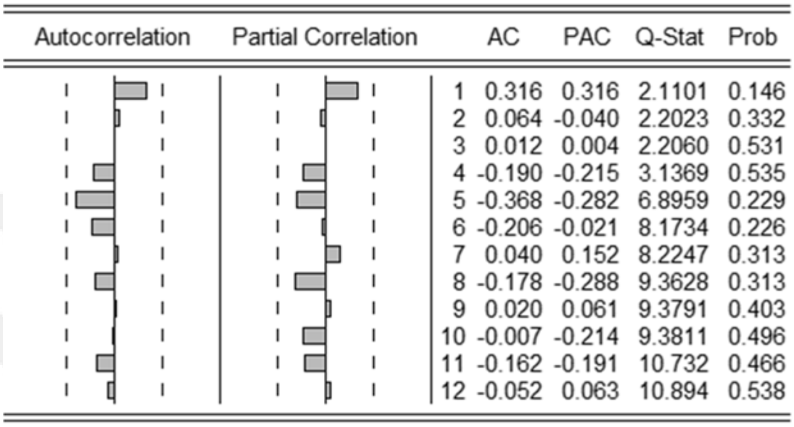
Figure 93: Results of ARMAX Forecasting for Domestic Iron Shipping



Source: Created by Author based on "auto_arima" from Pyramid outputs

After the model is estimated, to check the adequacy of the model ACF and PACF of the residuals were examined. Ljung–Box *Q* test is adopted to diagnose if the estimated residuals are white noise series or not. As seen in Figure 94 the result of the test indicates that the goodness of fit test of the optimum ARMAX model showed non-significant autocorrelations in the residuals of the model.

Figure 94. ACF And PACF Of Residuals for The ARMAX Model of Domestic Iron Shipping



	AC	PAC	Q-Stat	Prob
1	0.316	0.316	2.1101	0.146
2	0.064	-0.040	2.2023	0.332
3	0.012	0.004	2.2060	0.531
4	-0.190	-0.215	3.1369	0.535
5	-0.368	-0.282	6.8959	0.229
6	-0.206	-0.021	8.1734	0.226
7	0.040	0.152	8.2247	0.313
8	-0.178	-0.288	9.3628	0.313
9	0.020	0.061	9.3791	0.403
10	-0.007	-0.214	9.3811	0.496
11	-0.162	-0.191	10.732	0.466
12	-0.052	0.063	10.894	0.538

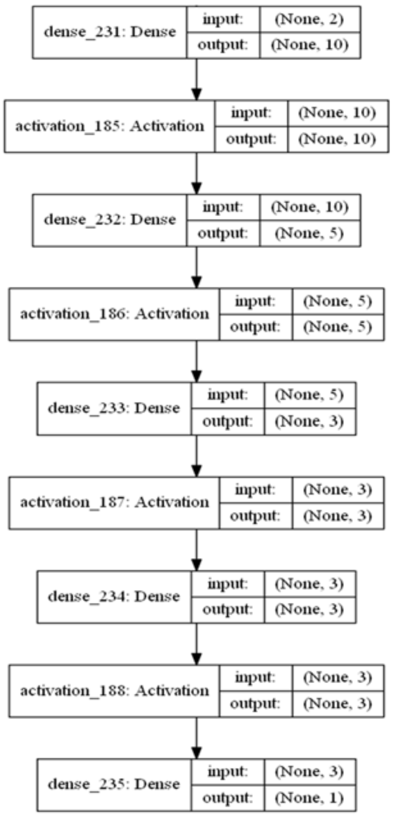
Source: Eviews output

4.3.3.13.3. Results of the ANN models

4.3.3.13.3.1. Results of the MLP model

Figure 95 illustrates the model graph of the MLP. MLP architecture is utilized as two input variables, three hidden layers with five, five and three neurons terminating at an output layer with tanh activation. Hidden layers utilized tanh activation functions and the network epoch was 20.

Figure 95: MLP Model Graph for Domestic Iron Shipping



Source: Keras Deep Learning Package outputs

Table 58 shows the used variable combinations while developing the MLP model. The best model is composed of Iprice and crude variables. Several combinations were tried to find out an accurate model. However, results indicated inaccurate forecasts with developed models.

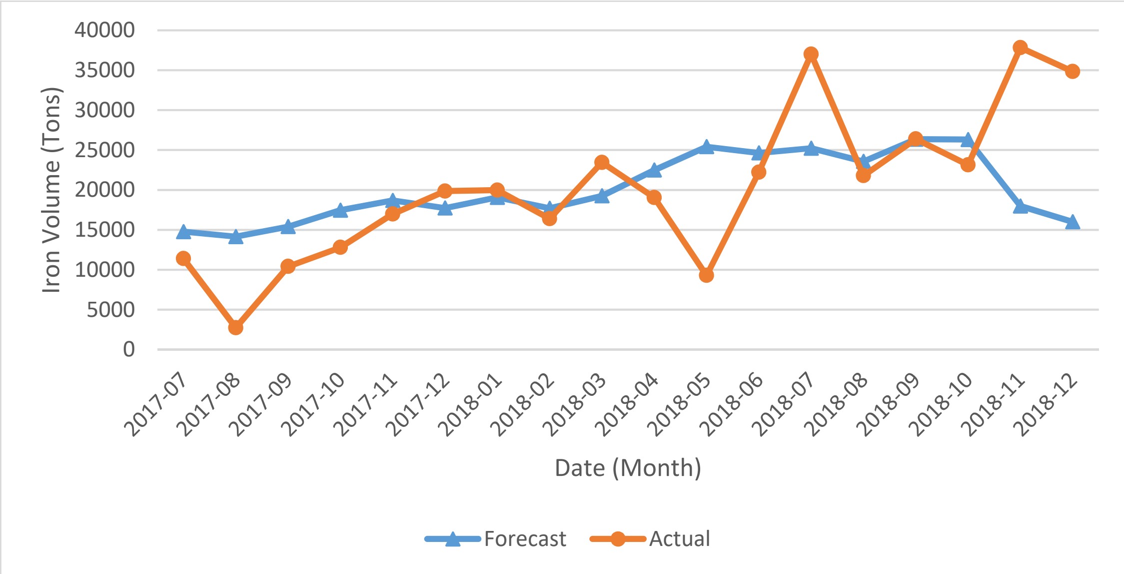
Table 58. Comparison of the MLP Forecasts for Domestic Iron Shipping

Variables	RMSE	MAPE
Iprice, crude, export, import, CPI, steel, price, building, sales	14752.24	113.15
crude, sales, CPI, export	42194.85	304.29
Iprice, imports, CPI, price	26233.50	204.71
Iprice, crude, export, import, CPI, steel, price, building	14051.71	98.62
Iprice, imports, CPI, price	26121.85	203.85
Iprice, crude, import, building	14318.64	99.66
Iprice, crude, export, steel, building	11978.08	65.88
Iprice, crude, export, import, CPI, price, building	15646.58	120.96
Steel	17377.44	134.97
Export, import	29477.72	221.82
Buildings	14819.51	125.88
Iprice, crude, export, import, CPI, steel, price	14841.71	104.37
Price	15620.36	140.81
CPI	27374.74	230.28
Iprice, crude, export, import, steel, price	11568.85	62.29
Crude	9586.63	55.96
Iprice, export, import, steel, price	21099.91	143.20
Iprice, export, import, steel, price, CPI	20655.58	144.21
Iprice, export, import, steel, price, buildings	17046.76	122.78
Iprice, import, steel, price	13588.33	95.24
Iprice, crude, export, import, CPI, steel, price, building, cement	15910.03	128.44
Iprice, crude, export, import, CPI, steel, price, cement	18388.55	130.72
Iprice, crude, export, import, steel, price, cement	11786.58	66.71
Iprice, export, import, steel, cement	23321.43	174.14
Iprice, import, steel, cement	19499.95	145.23
Export, CPI, steel, price	47612.21	325.61
Crude, price, building, cement	10699.62	62.78
Price, building, cement	18310.94	167.67
Steel, price, building, cement	14306.31	118.90
Iprice, steel, price, building, cement	14607.88	121.38
Iprice	11840.31	108.69
Export	18350.74	162.38
Import	19427.16	157.27
Export, steel	17052.70	127.34
Cement	20783.50	186.85
Export, import, price	31528.94	226.77
Export, import, price, cement	26371.34	202.61
Iprice, export, import, price, cement	21664.51	171.71
Iprice, crude	**8807.37**	**52.48**
crude, export	13965.16	61.65
crude, steel, building	10834.49	54.61
Iprice, crude, export, steel, building, cement	11322.06	75.99
Crude, sales, export	12691.30	63.27
Crude, sales, export, steel, building	12811.65	76.52

Source: Created by Author based on Keras Deep Learning Package outputs

Figure 95 illustrates the results of the MLP out of forecasts for domestic iron shipping loaded at ports of the Black Sea Region. Inaccurate prediction accuracy is obtained with the MLP model. Some dates as 2017-08, 2018-05, 2018-07, 2018-11 and 2018-12 2018-10 are presented very poor forecasts.

Figure 96. Results of MLP Forecasting for Domestic Iron Shipping

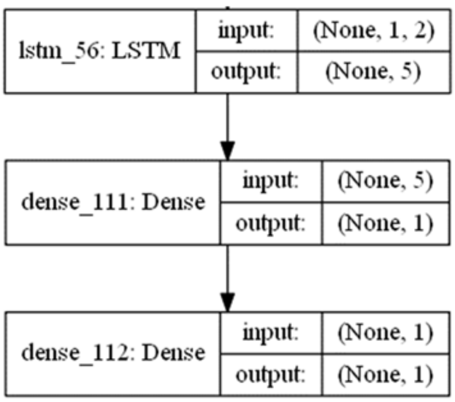


Source: Created by Author based on Keras Deep Learning Package outputs

4.3.3.13.3.2. Results of the LSTM model

Figure 97 illustrates the model graph of the LSTM. LSTM architecture is utilized as two input variables, one hidden layer with five, five and three neurons terminating at an output layer with tanh activation. Hidden layers utilized tanh activation functions and the network epoch was 20.

Figure 97: LSTM Model Graph for Domestic Iron Shipping



Source: Keras Deep Learning Package output

Table 59 shows the used variable combinations while developing the LSTM model. The best model is composed of Iprice and crude variables when the RMSE is considered as an accuracy metric. Crude and export variables form the best model when MAPE is considered as an accuracy metric. Developed out of sample forecasts is capable of produce effective forecasts.

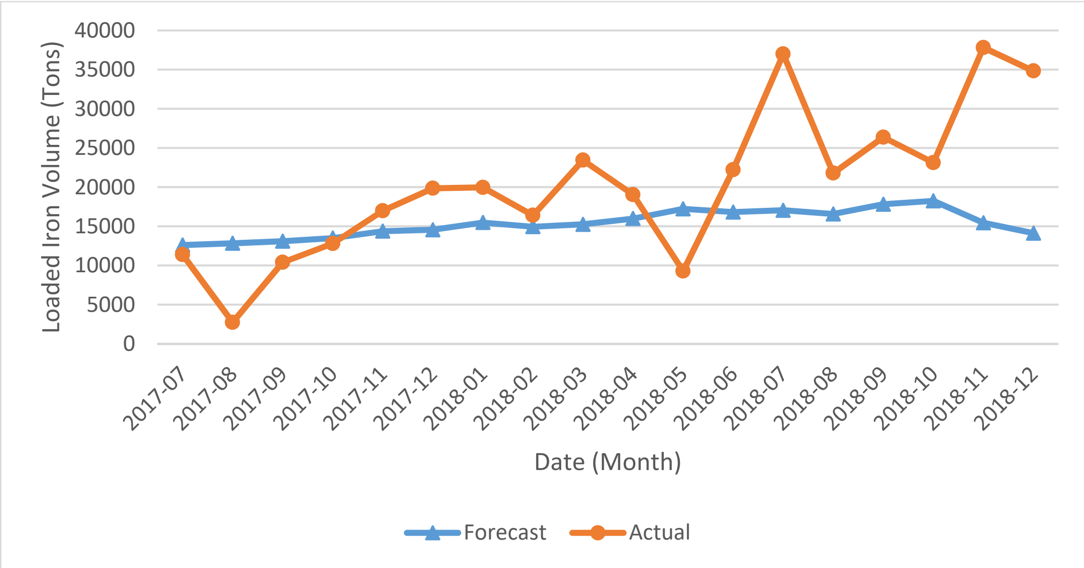
Table 59. Comparison of The LSTM Forecasts for Domestic Iron Shipping

Variables	RMSE	MAPE
Iprice, crude, export, import, CPI, steel, price, building, sales	12021.29	90.50
crude, sales, CPI, export	13652.37	113.71
Iprice, imports, CPI, price	16774.51	142.14
Iprice, crude, export, import, CPI, steel, price, building	10235.82	73.46
Iprice, imports, CPI, price	16772.43	142.12
Iprice, crude, import, building	11586.30	67.42
Iprice, crude, export, steel, building	11588.60	54.57
Iprice, crude, export, import, CPI, price, building	9752.98	69.51
Steel	11674.47	93.88
Export, import	13110.95	109.91
Buildings	12155.88	98.76
Iprice, crude, export, import, CPI, steel, price	11722.97	88.72
Price	10935.47	99.29
CPI	16119.00	142.78
Iprice, crude, export, import, steel, price	9126.86	56.83
Crude	9550.64	51.91
Iprice, export, import, steel, price	14366.50	104.68
Iprice, export, import, steel, price, CPI	16381.86	121.53
Iprice, export, import, steel, price, buildings	13612.17	95.27
Iprice, import, steel, price	14409.30	107.22
Iprice, crude, export, import, CPI, steel, price, building, cement	12021.10	90.50
Iprice, crude, export, import, CPI, steel, price, cement	14707.00	111.58
Iprice, crude, export, import, steel, price, cement	10779.45	71.10
Iprice, export, import, steel, cement	18144.24	130.37
Iprice, import, steel, cement	18402.83	133.04
Export, CPI, steel, price	17617.19	144.06
Crude, price, building, cement	11829.30	60.39
Price, building, cement	15379.99	140.00
Steel, price, building, cement	14599.00	122.37
Iprice, steel, price, building, cement	13383.63	101.77
Iprice	9629.39	80.00
Export	10213.58	91.65
Import	12302.84	103.64
Export, steel	11683.22	93.81
Cement	15084.85	134.70
Export, import, price	15188.21	127.52
Export, import, price, cement	22943.31	187.92
Iprice, export, import, price, cement	17971.94	148.27
Iprice, crude	9283.75	50.43
Crude, export	**9966.49**	**49.59**
Crude, steel, building	12170.63	55.49
Iprice, crude, export, steel, building, cement	11743.87	58.04
Crude, sales, export	9990.73	57.31
Crude, sales, export, steel, building	11992.32	63.79
CPI, import, steel, building	14692.09	115.30

Source: Created by Author based on Keras Deep Learning Package outputs

Figure 98 illustrates the results of the LSTM out of forecasts for domestic iron shipping loaded at ports of the Black Sea. The forecast line points out the poor forecasting results.

Figure 98. Results of LSTM Forecasting for Domestic Iron Shipping

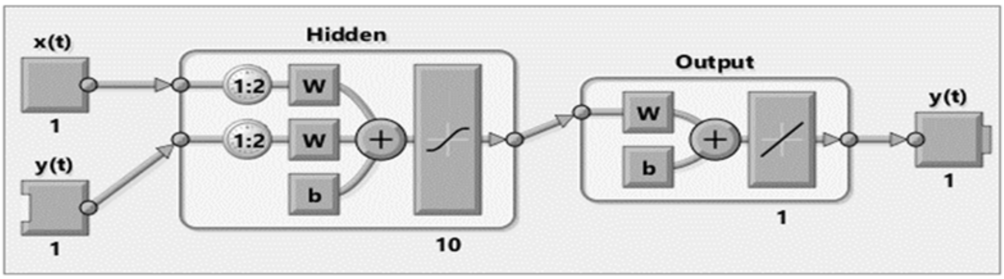


Source: Created by Author based on Keras Deep Learning Package outputs

4.3.3.13.3.3. Results of the NARX model

Figure 99 illustrates the model graph of the NARX. The model has two input variables as crude and past values of iron, ten hidden layers and one output layer.

Figure 99. NARX Model Graph for Domestic Iron Shipping



Source: Source: MATLAB neural network toolbox output

Table 60 shows the used variable combinations while developing the NARX model. The best model is composed of the crude variable.

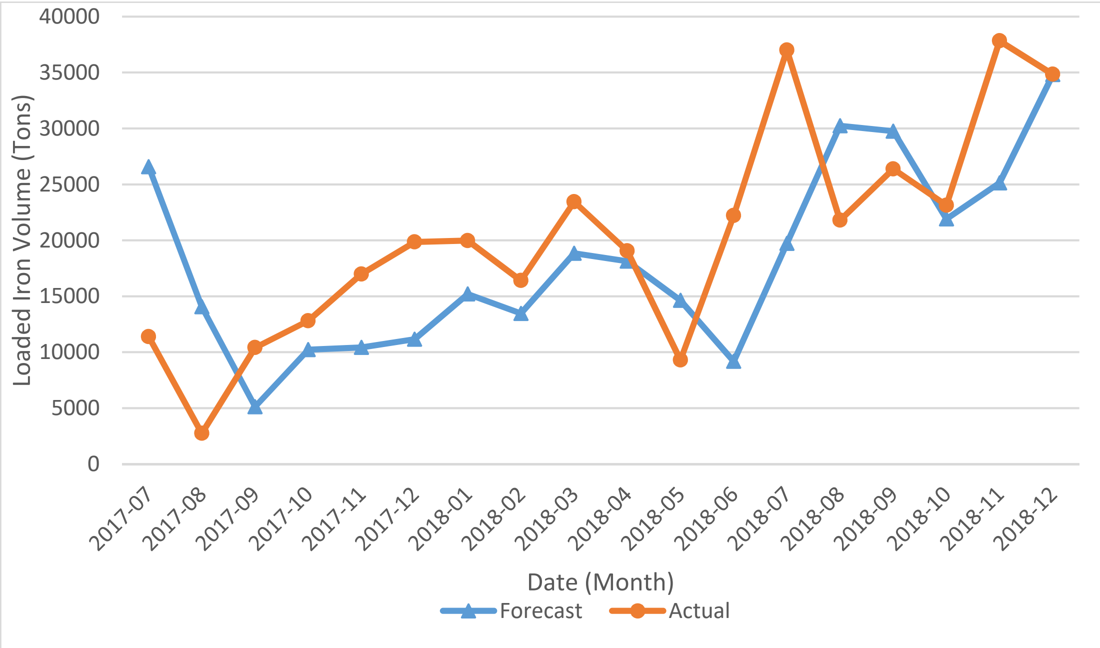
Table 60. Comparison of the NARX Forecasts for Domestic Iron Shipping

Variables	RMSE	MAPE
Iprice, crude, export, import, CPI, steel, price, building, sales	9121.76	65.31
Crude, sales, CPI, export	23045.58	200.05
Iprice, imprts, CPI, price	61037.34	443.00
Iprice, crude, export, import, CPI, steel, price, building	29171.98	227.04
Iprice, imports, CPI, price	13080.91	118.50
Iprice, crude, import, building	12672.93	81.73
Iprice, crude, export, steel, building	13482.21	90.03
Iprice, crude, export, import, CPI, price, building	31544.26	213.42
Steel	16036.35	141.87
Export, import	17422.04	158.48
Buildings	10851.03	85.97
Iprice, crude, export, import, CPI, steel, price	40858.37	296.98
Price	14759.69	126.17
CPI	12731.19	91.44
Iprice, crude, export, import, steel, price	10798.51	72.50
Crude	**8522.46**	**56.51**
Iprice, export, import, steel, price	16526.88	92.44
Iprice, export, import, steel, price, CPI	40282.57	250.37
Iprice, export, import, steel, price, buildings	12203.12	82.21
Iprice, import, steel, price	32539.02	249.19
Iprice, crude, export, import, CPI, steel, price, building, cement	27708.92	224.94
Iprice, crude, export, import, CPI, steel, price, cement	17001.96	83.69
Iprice, crude, export, import, steel, price, cement	16027.89	102.76
Iprice, export, import, steel, cement	17749.30	132.31
Iprice, import, steel, cement	18929.36	152.35
Export, CPI, steel, price	72310.48	500.75
Crude, price, building, cement	18558.69	147.54
Price, building, cement	30421.07	174.29
Steel, price, building, cement	16873.38	87.42
Iprice, steel, price, building, cement	20114.30	137.42
Iprice	9972.89	72.79
Export	13781.15	106.03
Import	11820.87	106.14
Export, steel	22579.83	192.76
Cement	14775.37	105.85
Export, import, price	23810.84	150.24
Export, import, price, cement	27715.87	203.14
Iprice, export, import, price, cement	25445.78	202.34
Iprice, crude	9292.66	63.56
crude, export	10488.96	67.22
crude, steel, building	16772.50	121.36
Iprice, crude, export, steel, building, cement	19683.20	130.49
Crude, sales, export	8789.90	62.62
Crude, sales, export, steel, building	28507.59	134.91

Source: Created by Author based on MATLAB neural network toolbox output

Figure 100 illustrates the results of the NARX out of forecasts for domestic iron shipping loaded at Ports of the Black Sea. Generally, models forecasted high values than actual observations. Developed out of sample forecasts is capable of produce effective forecasts.

Figure 100. Results of NARX Forecasting for Domestic Iron Shipping



Source: Created by Author based on MATLAB neural network toolbox output

4.3.3.13.4. Results of the Hybrid model

Firstly, the ARMAX model with export, imports, price and cement variables were estimated. The model generated from the dataset is ARMAX (1, 0, 1). Then, the MLP model constructed with the below-mentioned lags and best model composed of three input variables, three hidden layers with five, five and three neurons, one output layer. The activation function was tanh. Epoch was tried as 120 for all lags, and the best model was also generated with different epoch and specified with 120 epochs as well.

Table 61 shows the used variable lag combinations while developing the hybrid model. The results are not good enough in terms of accuracy performances. ARIMAX-ANN-11 is found as the best-performed models.

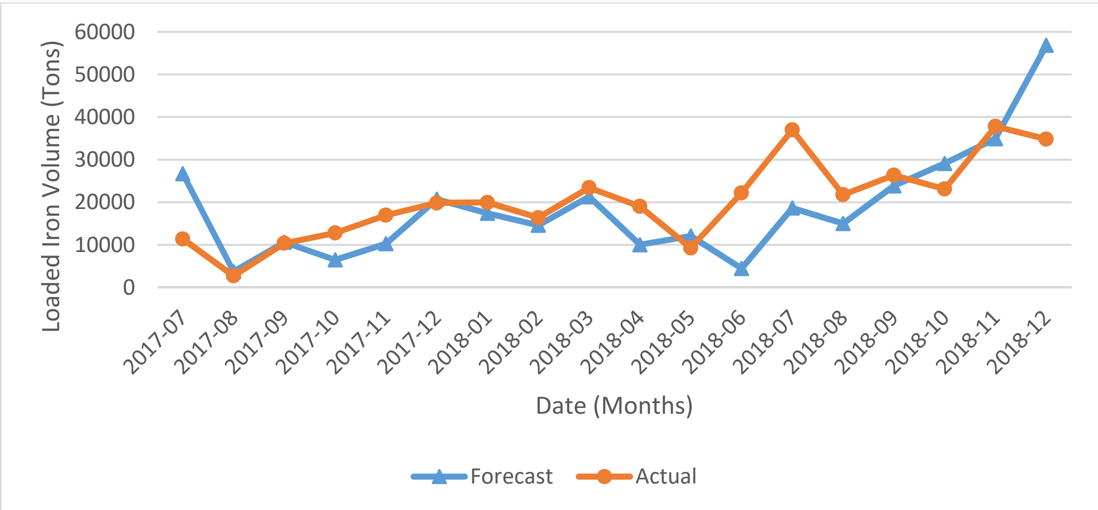
Table 61. Comparison of the Hybrid Forecasts for Domestic Iron Shipping

	Hybrid Model	
Variables	**RMSE**	**MAPE**
ARIMAX-ANN-1: Qt-1, Qt-4	11139.14	45.59
ARIMAX-ANN-2: Qt-1, Qt-2	12547.84	78.28
ARIMAX-ANN-3: Qt-1, Qt-3	11251.39	85.07
ARIMAX-ANN-4: Qt-1, Qt-2, Qt-3	14120.69	78.23
ARIMAX-ANN-5: Qt-1, Qt-2, Qt-3, Qt-4	14365.93	95.25
ARIMAX-ANN-6: Qt-3, Qt-4	11882.8	48.06
ARIMAX-ANN-7: Qt-2, Qt-4	14080.54	94.08
ARIMAX-ANN-8: Qt-2, Qt-3, Qt-4	14206.14	93.08
ARIMAX-ANN-9: Qt-2, Qt-3	12762.7	91.40
ARIMAX-ANN-10: Qt-1, Qt-2, Qt-4	14066.8	90.41
ARIMAX-ANN-11: Qt-1, Qt-3, Qt-4	**9593.418**	**35.67**

Source: Created by Author based on "auto_arima" from Pyramid outputs and Keras Deep Learning Package outputs

Figure 101 illustrates the results of the hybrid model out of forecasts for domestic iron shipping loaded at Ports of the Black Sea. It is inferred that hybrid model forecasts are not good enough. The estimated model is relatively good at forecasting 2017-09, 2017-12, 2018-09, 2018-11.

Figure 101. Results of Hybrid Forecasting or Domestic Iron Shipping



Source: Created by Author based on "auto_arima" from Pyramid outputs and Keras Deep Learning Package outputs

4.3.3.13.5. Comparison of the Results

Table 62 shows that the ARMAX model outperformed than the other methods. According to the results, the NARX model has the worst performances. Although the ARMAX-ANN model can capture both the linear and nonlinear nature of the data and uses the advantages of both models, it did not present better performance.

Table 62. Accuracy Comparisons of Domestic Iron Shipping Forecast Models

Forecast Model	MLP Model		ARMAX (1,0,1)		LSTM		NARX		ARMAX-ANN-11	
Forecast Error	MAPE	RMSE	MAPE	RMSE	MAPE	RMSE	MAPE	RMSE	MAPE	RMSE
	52.48	8807	**28.91**	**7710**	49.59	9966	56.51	8522	9593.41	35.67

Source: Author

Similar variable combinations are used in forecasting domestic iron shipping. Export, import, price, sales were the resulted as most accurate combination for ARMAX, while Iprice, crude combination resulted in the best accuracy rate for MLP. The best model for the LSTM is export and crude variables' combination, while the NARX model developed with the only crude variable.

4.3.3.13.6. Significances of the Model Performances

To discuss the developed models in detail, t-tests are conducted to examine the significances of the model performances. T-test results are based on the comparison of MAPE of the residuals. The p-value for each t-test presented in Table 63. The tests have resulted at a significance level of 95%, therefore p-values <0.05 indicate models that vary significantly.

Furthermore, Diebold–Mariano test (1995) is adopted to evaluate the statistical significance of performances of developed models in depth. DM test aims to test the null hypothesis of equal accuracy of the two competing models. In this paper, the null hypothesis of the DM test cannot be rejected for the compared models. All p-values are presented with high values than 0.05. Therefore, it is obtained that developed models' have equal forecasting accuracy.

Table 63. T-Test and DM Test Results of Domestic Iron Shipping Forecast Models

	MLP	ARMAX	LSTM	NARX	Hybrid
MLP		0.49967 (0.6237)	1.0793 (0.2955)	0.14248 (0.8884)	-0.3868 (0.7037)
ARMAX	**1.2412 (0.2314)**		1.201 (0.2955)	-0.57269 (0.5744)	-1.5001 (0.1519)
LSTM	**-0.40104 (0.6934)**	**1.4019 (0.179)**		0.75488 (0.4606)	0.19807 (0.8453)
NARX	**0.39471 (0.698)**	**1.4019 (0.179)**	**-0.76115 (0.457)**		-0.61181 (0.5488)
Hybrid	**-0.68435 (0.503)**	**0.70471 (0.4905)**	**-0.66017 (0.518)**	**-0.95283 (0.354)**	

* Bold fonts are the results of the t-test

4.3.3.14. Quantitative Study: Findings and Discussion

This part presents forecasting models for domestic dry cargo shipping demand. First, pre-interviews are conducted to select the application area. Then, environmental analysis of application area: Black Sea ports of Turkey are assessed and current demand on domestic dry cargo shipping is reviewed. After collecting this information, forecasting models for the region are developed. ARIMA, MLP, NARX, LSTM, and hybrid models are benchmarked for the most loaded dry cargoes in the region.

For the domestic cement shipping demand, ARMAX (1,0,1) model presented accurate forecasts. The hybrid forecasting model is presented good forecasting performance as well. Variables of sales (domestic cement sales at the Black Sea) and IPI (Calendar adjusted industrial production index, Nace rev 2.23) are used while developing this model. Export and import variables are tried in combinations as well. However, these models show less forecasting accuracy. Similarly, Seabrooke et al. (2003) developed the OLS regression model of inward and outward ocean traffic forecast for Hong Kong. They used variables of "expenditures on building and construction" for inward traffic forecasting model of cement and clinkers, while "domestic exports" and "re-export prices" variables for outward traffic forecasting model of cement and clinkers.

For the domestic slag shipping demand, LSTM models presented accurate forecasts. In terms of the MAPE accuracy metric, the forecast model developed with only import variable. However, import, cement, sales, iron, and steel variables are used while developing the best performing model in terms of RMSE accuracy metric.

For the domestic copper shipping demand, both ARX (2,0) and LSTM models presented accurate forecasts. The ARX (2,0) model consists of the exchange rate, IPI and export variables, while the LSTM model consists of price, exchange rate, export, and IPI variables. When Seabrooke et al.' s (2003) study considered, it includes an inward and outward ocean traffic forecast model for basic metal. They used the variable of "Trade value of imports" for inward traffic forecasting model of basic metals, while "re-export prices" variables for outward traffic forecasting model of basic metals.

For the domestic steel shipping demand, MLP and NARX models presented close forecasts. In terms of MAPE accuracy metric, the MLP model is the best performing model and it is composed of export, import, iron, and Iprice. However, import and export variables are used while developing the NARX best performing model in terms of RMSE accuracy metric.

For the domestic iron shipping demand, ARMAX (1,0,1) model presented accurate forecasts. Export, import, price, and sales are used while developing this model. Seabrooke et al. (2003) developed forecasting models for iron and steel as well. They used variable of "trade value of total exports" for outward traffic forecasting model of iron and steel, while variable of "expenditure on building and construction" for inward traffic forecasting model of iron and steel.

Seabrooke et al. (2003) used "expenditures on building and construction" "domestic exports", "re-export prices" "trade value of imports" and "trade value of total exports". They proposed that these independent variables improve the models. Similarly, in our study, it has appeared that variables of "sales volume of the commodity and related commodities", "IPI", "import", "exchange rate", "export", "prices of the commodities and related commodities" might use while developing domestic dry cargo shipping models.

In terms of accuracy rates, the domestic cement shipping forecast model presents a good forecast. However, domestic slag, copper, steel, and iron shipping presents reasonable forecasts. It has appeared that this finding is related to the volatility of the domestic shipping volume.

4.3.4. Qualitative Study: Identifying Dry Cargo Shipping Demand Variables

This part constitutes the qualitative study that is realized through the semi-structured interviews and presents the aim and scope of the qualitative study, the importance of the study, sampling procedure, development of the data collection tool. Codes, themes, and findings with interpretations, restrictions of the study are also stated.

4.3.4.1. Aim and the Scope

Domestic dry cargo demand depends on various dynamics. Through the qualitative study, it is aimed to identify the variables influencing domestic dry cargo shipping. Another aim of the study is to reveal current issues and specify the environment of domestic dry cargo shipping.

The literature on the shipping demand forecast focuses on basic macroeconomic variables. It is observed that the variables other than the macroeconomic ones are not significantly considered in the models. This study tries to point out this issue by analysing which additional variables are affecting and what their importance are. Variables effective for the shipowners, shippers, and ports regarding domestic dry cargo shipping are investigated. These actors' views on the demand variables of domestic dry cargo shipping are taken into consideration. Therefore, perspectives of the demand-side and supply-side actors are collected.

Demand-side and supply-side perspectives are collected on the domestic dry cargo shipping environment, current issues, future projections, weaknesses, and competitive power. Therefore, it is aimed to support the literature review, current demand and environment analysis parts of this dissertation.

The literature on shipping market forecasts generally focused on quantitative data. To explore additional variables and get a deeper understanding of the demand at the market, this qualitative study is planned following the aim of this dissertation. The interview is the data collection method which involves presenting ideas with the person to person interaction on a specific purpose. Interviews provide deeper information from deep strategic analysis (Kenny, 2019) on the issue with the flexibility (Gupta and Gupta, 2011:62). Semi-structured interviews are the most widely used interviewing format and generally formed of predetermined open-ended questions with other questions that emerged during the interviewing. Semi-structured interviews take between 30 minutes to several hours (DiCicco-Bloom, 2006: 315). Interviews have strengths in terms of revealing the thoughts, ideas, data, experiments, and feelings of the respondents while using the benefits of verbal communication. In this aspect, the interview surpasses the artifact of tests and surveys. The main issues while conducting interviews are the development of interview form, organization of interviews, preparations, and conducting interviews (Yıldırım and Şimşek, 2018: 130, 136).

Content analysis is used for the analysis of the data collected through the interviews. The purpose of the content analysis is to define the data and revealing the implications. The basic process is connecting, relating and organizing similar concepts and themes, and interpreting them in a reader-friendly way. While conducting a content analysis, the following steps are considered; Coding data, finding themes, defining and organizing data regarding codes and themes, and interpreting findings (Yıldırım and Şimşek, 2018: 242).

Time, economic and geographic related constraints have been the main constraints encountered during the study. Respondents' difficulties in allocating time to participate in the study during their intensive practical programs have been one of the time constraints of the study. The residence of the researcher was one of the geographic related constraints of the study. Additionally, travel expenses to reach respondents in different locations can be considered as economic constraints of the study. Despite these limitations, the time interval of the research process has been long and a significant number of respondents were reached.

4.3.4.2. Data Collection Tool

Interview form is composed of two parts; the first part includes general questions on demand and aims to clarify the current demand for domestic dry cargo shipping. The second part aims to explore the demand variables in detail. A sample of the semi-structured interview form is presented in Appendix 9.

In this dissertation, while developing the interview form peer review is applied. Three experts are asked to comment on the interview form. Experts have the expertise on dry cargo, chartering, ports and qualitative studies in general.

After the peer review, the questionnaire form is shortened and some corrections on wording are applied. The principles which are mentioned by Yıldırım and Şimşek (2018: 136) are considered while developing the questionnaire form such as; easily understandable and open-ended questions are presented, alternative questions are prepared and follow up questions are asked, encouragement of the respondents is avoided, questions are organized as deductively.

4.3.4.3. Population and Sampling

The population of the study is composed of contracting parties of domestic dry cargo shipping. However, it is not possible to reach the exact numbers and lists of the parties, and the population as a whole cannot be specified accurately.

It is aimed to reach the optimum sample size that has the ability to represent the population of the study. The generalizability principle is considered during the determination of the sampling size. Saturation is another essential element considered in this step. The sample size is increased until reaching the saturation point (Creswell and Poth, 2018).

Respondents have been selected with a purposeful sampling method representing participants of the shipping business negotiations. Purposeful sampling provides the researcher with a sample of a group that has the best information about the research problem (Creswell and Poth, 2018: 118). A combined criterion-i and snowball purposeful sampling are used. Criterion-i sampling allows to identify and select all cases that meet the predetermined criterion of importance while snowball sampling allows sampling that has similar characteristics (Palinkas, 2015: 536). In this regard, experienced people who act as shipowners, shippers, brokers and agencies and ports at dry bulk shipping were reached. Table 64 presents the profile of the respondents. These actors act especially at the domestic dry cargo shipping market and they mainly involved in carrying steel, iron, cement, fertilizer, and coal. During the interviews with the experts, it is asked to offer other contracting parties who can give information on the specified market.

4.3.4.4. Data Collection

Following the development of data collection tool and sampling, data collection process started with conducted interviews. First, phone calls are made with the people in the sample and appointments are made. Then, face to face interviews are realized during July-October 2019 with the respondents at their offices. Interviews lasted in min 30 - max 60 minutes. During these interviews, respondents are asked on voice recordings and assenting respondents' responses are recorded and the others are taken as written notes. Any personal information is not requested and the purpose of the research is clearly stated to the respondents. Moreover, it is stated that obtained data will be used only for scientific purposes and the company and participant names would not be mentioned in the study. In this way, it is tried to establish an environment of mutual trust.

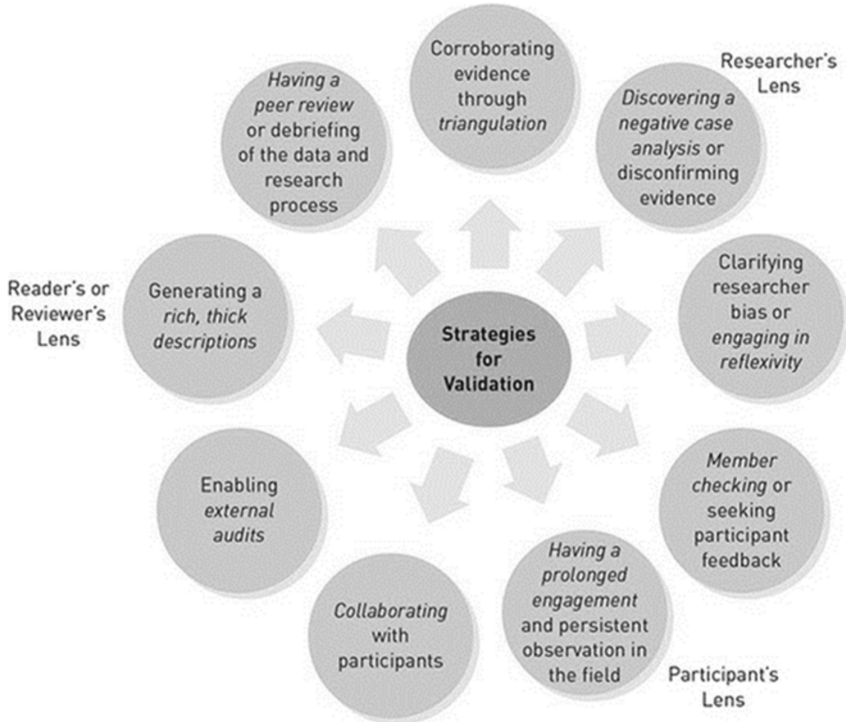
4.3.4.5. Validity and Reliability

Validity means the representing ideas during the research that fits with actual reality (Neuman, 2014: 2012). There are many perspectives and types of validation in qualitative research which is presented in Table 65. Creswell and Poth (2018: 338) defined validation as an attempt to assess the "accuracy" of the findings. Creswell and Poth (2018) also suggests several validation strategies as described in Figure 102 and proposed at least two of the validation strategies to use in a qualitative study.

Table 64. Profile of the Respondents of Qualitative Study

	Position	Working Period at Institution	Education	Company Establishment Year	Residence of the Company	Services	Date
1.	Broker	5	Master	1998	Singapore	Ship chartering and operation	02.08.2019
2.	Director and chartering manager	15	Bachelor	1998	Singapore	Ship chartering and operation	02.08.2019
3.	Shipping agency and maritime services executive	7	Bachelor	1975	İstanbul	Fertilizer supplier, Port and Ship agency services	01.08.2018
4.	Director	19	Bachelor	2000	İzmir	Ship brokering and agency	31.07.2019
5.	Director	15	Bachelor	2004	İzmir	Ship brokering and agency	31.07.2019
6.	Port manager	25	Bachelor	2006	İzmir	Port services	29.07.2019
7.	Broker	22	Bachelor	1989	İzmir	Ship chartering, ship agency, shipowner	26.07.2019
8.	Broker	12	Bachelor	1975	İzmir	Steel producer, shipowner, port services	26.07.2018
9.	Logistics manager	9	Bachelor	1953	İzmir	Cement	21.08.2019
10.	Director	4	Bachelor	2015	Muğla	Marble	25.08.2019
11.	Port manager	13	Bachelor	1956	İzmir	Port services, iron and steel	27.08.2019
12.	Ship agency executive	8	Bachelor	1997	İzmir	Ship agency	27.08.2019
13.	Director	16	Master	2003	İzmir	Ship brokering and agency	28.08.2019
14.	Director	24	Master	1995	İzmir	Ship brokering and agency	28.08.2019
15.	Port officer	12	Bachelor	1973	İzmir	Port	29.08.2019
16.	Port officer	2	Bachelor	1977	Antalya	Port services	09.08.2019
17.	Director	10	Bachelor	1988	İzmir	Shipowner agency	02.09.2019

Figure 102: Strategies for Validation in Qualitative Research



Source: Creswell and Poth, 2018: 341

In this study, the triangulation strategy is used in terms of collecting data from the various data sources (collecting information from the supply and demand side). As was given in Figure 102, following a prolonged engagement and persistent observation strategy in the field, a sense of saturation, that means getting the same ideas from the interviews is reached, and accordingly considerable time is spent in the field. Discovering a negative case analysis or disconfirming evidence is used by scanning the conflicting ideas of the interviews. Clarifying researcher bias is also applied as being objective throughout the interpretations and avoid to be influenced by past experiences and prejudices. During the interviews, respondents are asked whether the perception of the researcher reflected the data precisely. In this way, this study tries to ensure collaborating with the participants.

Considering these attempts to validate the study, it can be concluded that evidence on the internal validity or credibility which are listed in Table 65 is obtained.

Table 65. Establishing Trustworthiness: A Comparison of Conventional and Naturalistic Inquiry

Quantitative Measure	**Qualitative Measure**	**Used Strategies**
Internal Validity	Credibility	Triangulation Having a prolonged engagement and persistent observation Discovering a negative case analysis or disconfirming evidence Clarifying researcher bias Collaborating with participants
External Validity	Transferability	Generating a rich, thick descriptions Purposeful sampling
Internal Reliability	Dependability	External audits
External Reliability	Confirmability	Data Achieving

Source: Erlandson et al., 1993: 133

In terms of external validity proving rich description and purposeful sampling strategies are applied. Data are tried to describe and report in detail and without commenting on them. The purposeful sampling strategy is also used to get relevant data on the issue. With these strategies, transferability or external validity is ensured.

Reliability explained as dependability or consistency. It suggests that the research findings are repeated or recurs under identical or very similar conditions (Neuman, 2014: 2012). To support the dependability of this exploratory study, raw data are tried to transmit with exact citations from the respondents', the research process is explained as detailed as possible and coded data are grounded on during the interpretation of the findings. The dependability of the study is also tried to be ensured with the auditing of the research process. For the confirmability of the study, semi-structured interview forms, voice recordings, transcriptions, external notes, themes, codes and the used content at the MAXQDA are saved by the researcher as open for any inspection.

4.3.4.6. Data Analysis: Results of the Content Analysis

The qualitative study consists of content analysis as analysis method and MAXQDA software programme is utilized for data analysis. Moreover, Edraw Mindmaster is used to create a list of the main theme, themes and codes.

4.3.4.6.1. Determination of the Themes and Codes

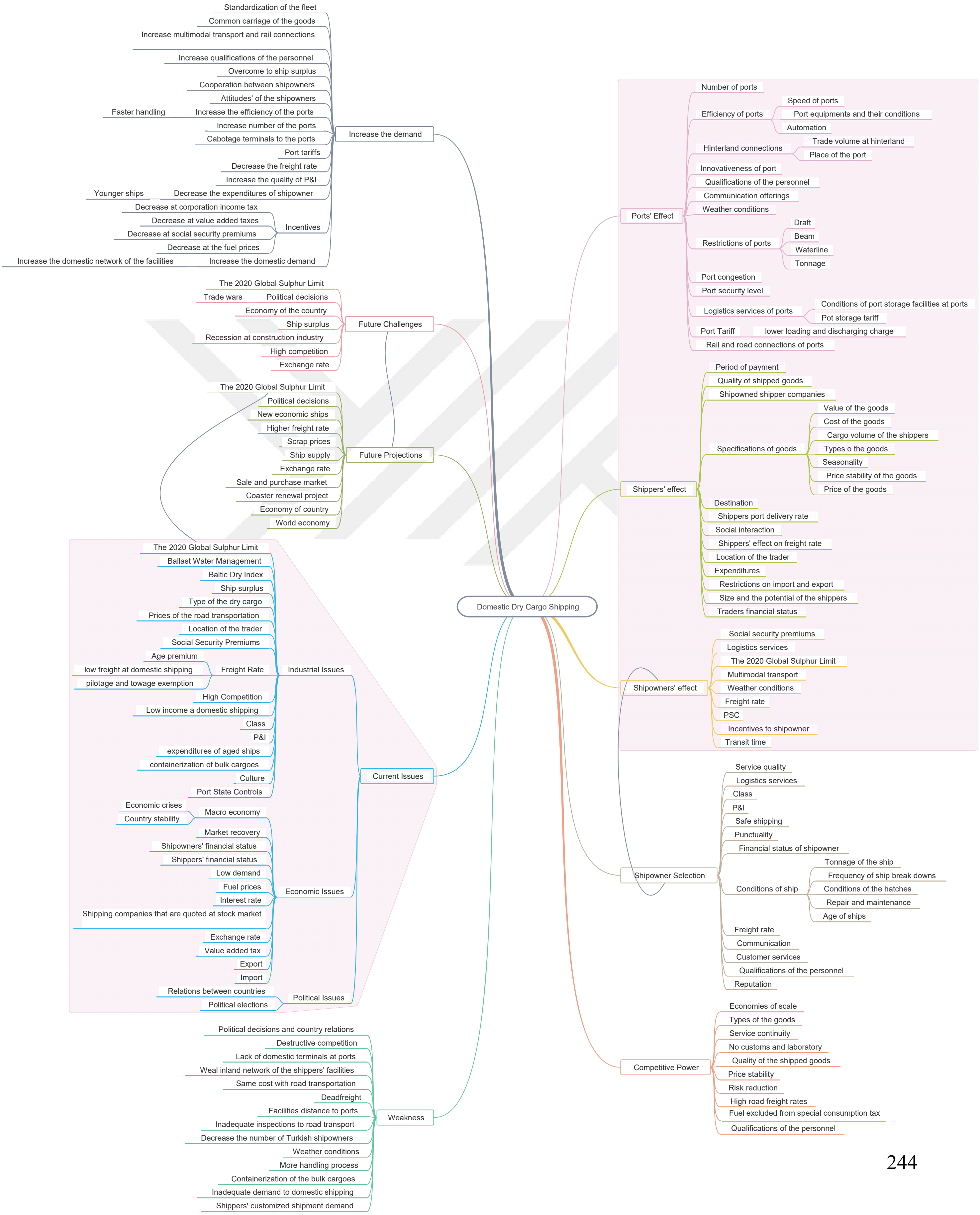
Concepts used during the data coding process can be retrieved from the literature, researchers or collected data. The researcher tries to find out a suitable code that reflects the meaning of the issue accurately. That code can be changed afterward. The important point in that process is finding the most accurate code that reflects the meaning (Yıldırım and Şimşek, 2018: 244).

In the light of this information, codes are deducted from the collected data in this study. First, the documents have been read repeatedly and important points are identified. Preliminary codes and categories were formed based on various concepts and definitions based on the interview form. Code list created with assigned important points by the researcher. Then, obtained data has been read repeatedly and new categories and codes are formed. Finally, the structure of codes is created. The code list is formed a few times during the analysis process. A list of the main theme, themes and codes are illustrated as a map through "Edraw Mindmaster 7.2." software.

Figure 103 shows the main theme, themes and codes that are obtained from the interview data. In this regard, the main theme is domestic dry cargo shipping. Themes and the codes are identified as follows: "current issues", "future projections", "future challenges", "competitive power", "weakness", "port's effects", "shipowners' effects", "shippers' effects", "shipowners' choice" are the determining themes that are deduced from interview form.

Revealing current issues encountered at the domestic dry cargo shipping market is aimed at the "current issue" theme. "Future projections" and "future challenges" themes are tried to reveal future issues at the domestic dry cargo shipping market.

Figure 103. Map of Domestic Dry Cargo Shipping of Codes, Themes, and Main Theme



Competitiveness, behaviors of market actors and market environment issues are tried to point out with “Competitive power” and “weakness” themes. Variables and their effects on domestic dry cargo shipping demand are aimed to reveal with the “shipowners’ effects”, “shippers’ effects” and “ports’ effects” themes. “Shipowners’ effects” and “shipowners’ selection” themes point out the industrial and company level demand variables.

This stage of the analysis part of the study is continued using “MAXQDA Analytics Pro v.18.1.1.”. The interviews were transcribed and coded with the software. Therefore, qualitative content analysis has done with revealing statistics of the codes, relation maps, and code sub-category maps. At last, interpretations of the researcher also presented in the study.

Figure 104 illustrates the code clouds composed of the most assigned codes. Cloud scaled with the most frequent code as larger. The font size represents the proportions of the code frequencies.

Figure 104: Code Cloud of The Overall Coding System of The Study

Source: MAXQDA output

4.3.4.6.2. Current Issues

Current issues are those that drive the domestic dry cargo shipping market is addressed under this theme. Current issues are classified and divided into three sub-themes as industrial issues, political issues, and economic issues. The co-occurrence model of the themes is created to indicate the relations and connections across codes and illustrated in Figure 105. Straight lines represent the subcategories of the themes and hyphenated lines represent the co-occurred codes. Purple circles represent the political and legal issues and green circles represent the economic issues and the pink circle represents the industrial issues.

Political and legal issues theme is composed of following codes, “relations between countries”, “political elections”. “Relations between countries” and “trade wars” are co-occurred codes. It is inferred that there is a relationship between country relations and trade wars. Trade wars are the result of the country relations that have an impact on domestic dry cargo shipping.

Economic issues theme is composed of following codes, “macroeconomy”, “shipowners financial status”, “shippers’ financial status”, “market recovery at last months”, “fuel prices”, “exchange rate”, “low demand to market”, “shipping companies that are quoted at the stock market”, “value-added tax”, “export”, “import”. Most frequent codes are “macroeconomy”, “fuel prices”, “exchange rate”, “export” respectively.

The macro-economic performance of the countries has been found closely related to the domestic dry cargo shipping market. The recent increase in exchange rates, its impact, and its significance on exports and fuel prices have been revealed. The connections of these economic indicators and importance on the domestic dry cargo shipping have been pointed out. Some of the responses related to the issue are:

R4 “*There is an economic difficulty happening and have negative effects on the markets. Therefore, the domestic market has narrowed*.”

R12 “*First of all, the economic situation of the countries is the current issue*.”

R16 “*Within the framework of the measures taken regarding the increase of the exchange rate, contracts are quoted in TL. Therefore, freight rates fell due to round downs.”*

R15 “*Since the raw materials have been imported, the effect of the exchange rate is felt*.”

R7 “*Goods that have more volume are clinker, cement, iron ore ect., and these goods are processed at export-oriented companies. The export capability of a country influences the market.”*

Economic issues have also co-occurred codes which are majorly concentrated on value-added taxes and fuel prices. It is inferred that there is a strong relationship between value-added taxes and fuel prices. Shipowner that acts domestic shipping market has exemption on special consumption tax of fuel. However, there is no exemption on value-added taxes of fuel on the contrary to transit fuel. Fuel prices and value-added taxes also have co-occurred codes within the industrial variables as prices of the road transport, location of the trader, social security premiums, and freight rate. The connections and relations can be associated with these codes.

Industrial issues theme is composed of following codes, “The Global 2020 Sulphur Limit”, “Ballast Water Management”, “Baltic Dry Index”, “Ship surplus”, “Type of dry cargo”, “Prices of the road transportation”, “Location of the trader”, “Social security premiums”, “Freight”, “Competition on market”, “Class”, “Low income at market”, “P&I”, “Containerization of the dry cargo”, “Culture”, “Port State Control”.

“Location of the trader”, “type of dry cargo”, “The Global Sulphur Limit” “Freight” are the most frequent codes respectively. Domestic dry cargo shipping in Turkey generally preferred by the companies that have their own terminal and have facilities near the terminal. In this case, it is emphasized that there is no need for inland transportation.

R10 *“The place of the factory and its proximity is very important”*

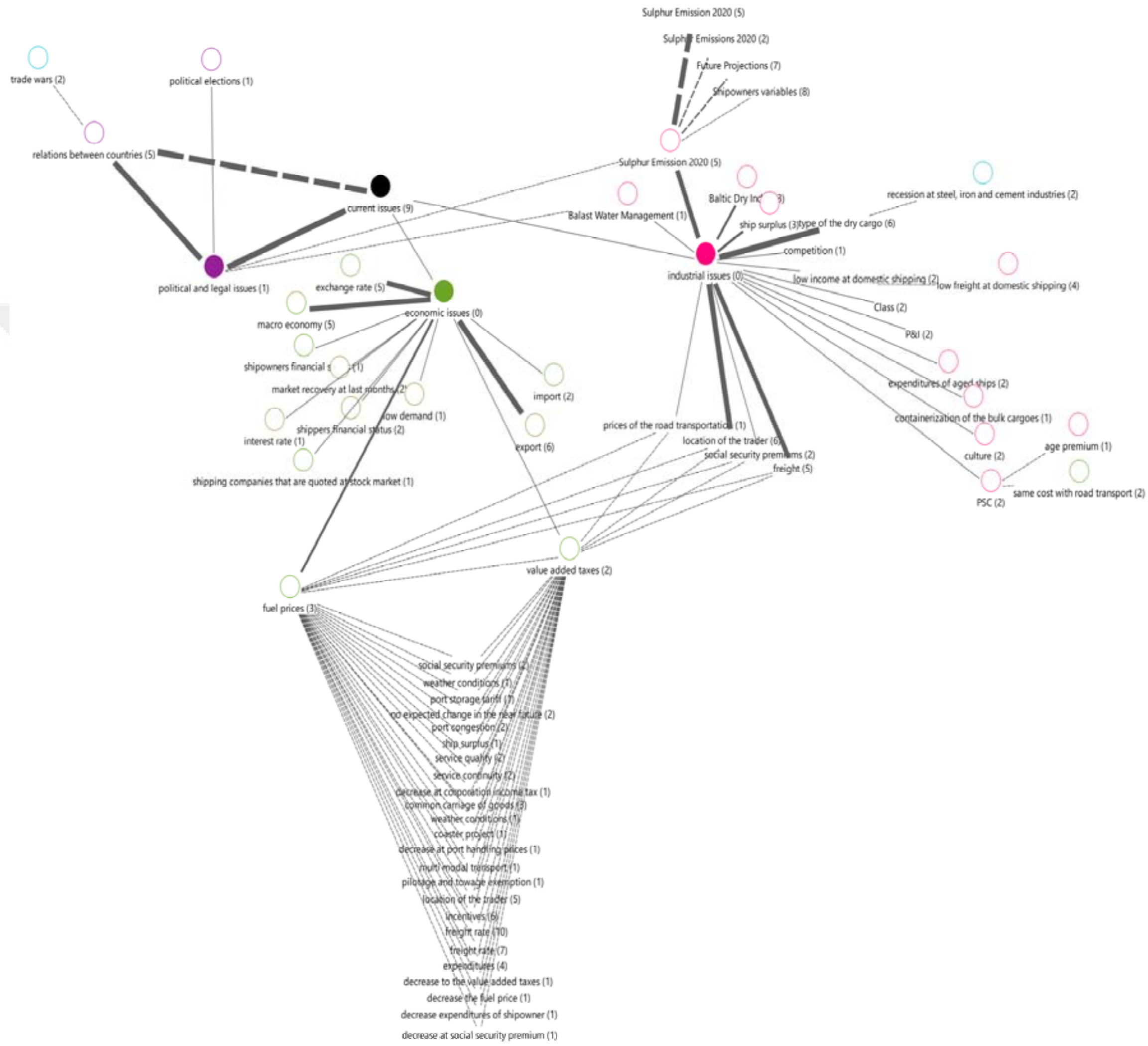
R2 “*It is very important that the factory is in the port town.”*

The type of cargo is also an important factor in choosing dry cargo transportation.

R8 “*In Turkey, mostly cement derivatives, iron, steel, and fertilizer are the goods that shipped at dry cargo domestic shipping market.”*

R12 “*There are certain loads in Turkey, such as fertilizer. Cement, iron and steel are transported a lot, such raw materials and semi-finished products are usually shipped*.”

Figure 105: Co-Occurrence Map of The Current Issues Theme



Source: MAXQDA output

R16 “*When I talk about iron and steel industry, it is not going through a very good period for Turkey. Construction industry has stopped in Turkey especially in the last year. With the slowdown of construction industry, distribution and sales of the iron and steel at domestic market also slowing down. And iron and steel is an industry that have important place at domestic shipping. So, of course, this could affect domestic shipping transport. The slowdown of the construction industry will be a* *weakening in cement need and cement shipments will also be affected by this slowdown*."

Moreover, the 2020 Global Sulphur Limit is mentioned as an important issue for shipping companies and that will affect the whole industry. The effect of this regulation on freight rates also pointed out.

R8 "*Suphur Regulation will affect that way. Good ships will remain in the market and good ships will have high running costs. Good ships will have qualified personnel again freight rates will tend to rise.*"

R13 "*When you look at dry cargo, a lot of things change. The new IMO rules are coming, and it increased the costs and creates scrubber costs. There is a change at the dry cargo in the World. We will try to change it even though our ships will affect it even if it is the Turkish flag*."

4.3.4.6.3. Competitive Power

The co-occurrence model of the competitive power theme is created to indicate the relations and connections across codes and illustrated in Figure 106. Straight lines represent the subcategories of the themes and hyphenated lines represent the co-occurred codes. Grey circles represent the competitive power sub-categories and other circles represent the co-occurred codes. Competitive power theme is composed of following codes, "economies of scale", "risk reduction", "types of goods", "fuel prices excluded from special consumption tax", "high road freight rates".

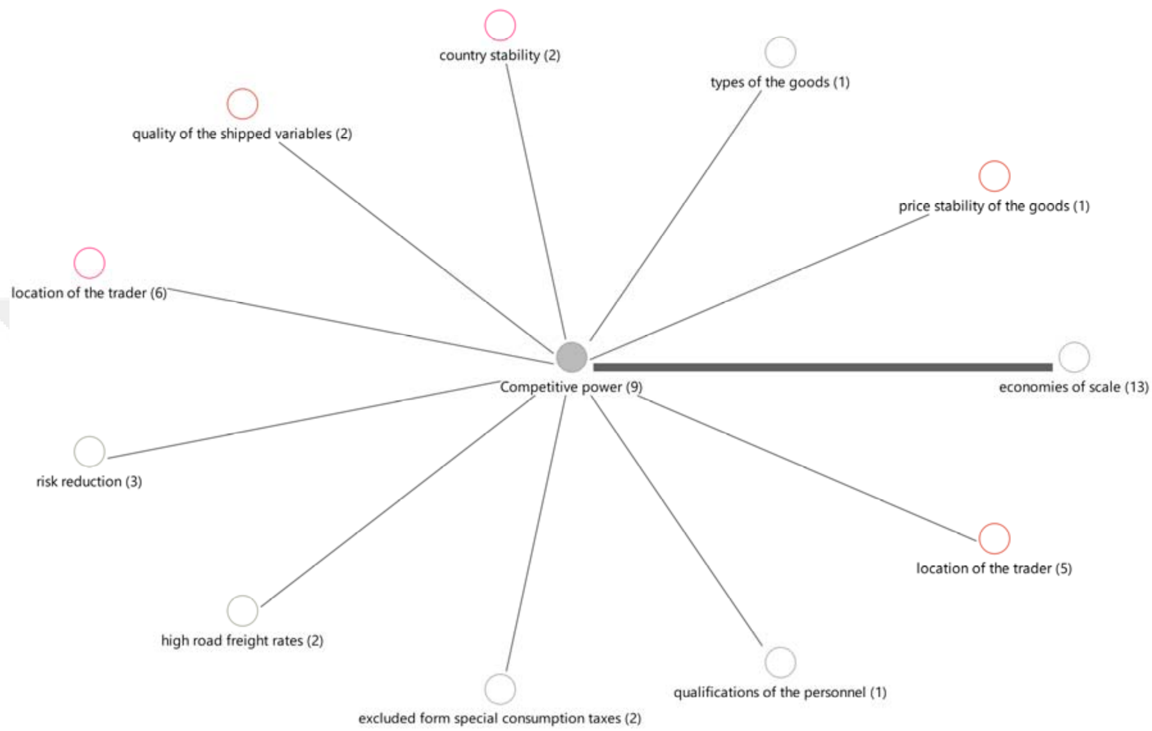
The competitive power of domestic dry cargo shipping is economies of scale as consistent with the shipping literature. Most of the respondents mentioned economies of scale and it is one of the most frequent codes. Risk reduction is another competitive power issue of domestic dry cargo shipping.

The location of the trader is found another important point that has connections with the competitive power theme. When the trader closes the port, domestic dry cargo shipping is a more economical way of transport goods.

R1 "*Normally this is also done by truck in the domestic market, but when the amount of cargo is high, maritime trade seems to be a cheaper alternative to reduce costs.*"

R5 "*Besides, the ability to transport in high tonnages proves its competitive power in terms of time and cost.*"

Figure 106. Co-occurrence Map of The Competitive Power of Domestic Dry Cargo Shipping



Source: MAXQDA output

4.3.4.6.4. Weaknesses

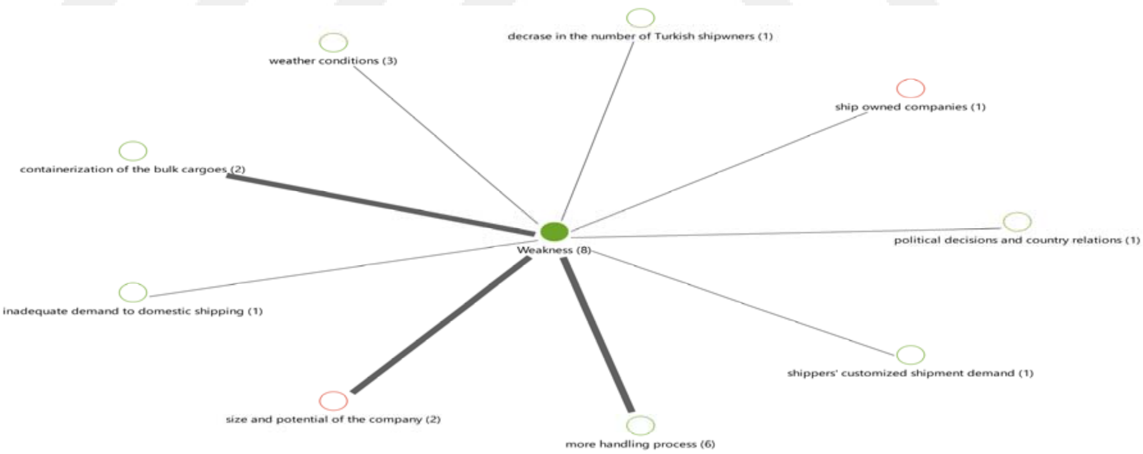
The co-occurrence model of the weakness theme is created to indicate the relations and connections across codes and illustrated in Figure 107. Straight lines represent the subcategories of the themes and hyphenated lines represent the co-occurred codes. Green circles represent the competitive power sub-categories and other circles represent the co-occurred codes. Weakness theme is composed of following codes, "more handling process" "containerization of bulk cargo", "weather conditions", political relations and country decisions", "shippers' customized shipment demand", "inadequate demand to domestic shipping".

The weakness of the domestic dry cargo shipping is the need for handling.

R4 *“You have to choose the highway at a short distance due to the loading and discharging prices of the ships. “When the shipping is preferred, at first cargo transported to the port, then loaded to ship and unloaded from the ship, at last transported to the last destination with road transportation again. How man transactions are going on? But when road transportation is preferred, the truck takes the cargo from the origin and delivers to the destination. Road transportation has that advantage. Especially when the exchange rates rise, road transportation becomes at competitive levels over the domestic dry cargo shipping. Even if road transport costs the same or little more expensive, shippers can prefer road transport.”*

There are also some other important weaknesses mentioned during the interviews. When the loads are small volumes, container shipping also becomes competitive in terms of freight. Dry cargo shipping also affected by weather conditions at ports and leads to an increase in loading and unloading time. Shippers have the ability to influence freight rates consistent with their financial status and cargo volumes.

Figure 107. Co-occurrence Map of The Weakness of Domestic Dry Cargo Shipping



Source: MAXQDA output

4.3.4.6.5. Future Projections and Challenges

This theme evaluates the future projections and challenges for domestic dry cargo shipping. The co-occurrence model of the themes is created to indicate the relations and connections across codes and illustrated in Figure 108. Red lines represent the subcategories of the themes and grey lines represent the co-occurred codes. Brown circles represent the future projections and blue circles represent the future challenges.

Future projections theme is composed of following codes, “The Global 2020 Sulphur Limit Regulation”, “no expected change in the near future”, “political decisions”, “expected negative change in the near future”, “new economic ships”, “higher freights”, “scrap prices”, “ship supply”, “exchange rate”, “sale and purchase”, “coaster renewal project”, “economy of Turkey”, “world economy”. These codes point out the issues that will be encountered in the near future.

It is found that there is no consensus on the positive or negative change in the market. Both negative and positive change expectations have been mentioned by the respondents. However, it is mostly reported that there is no change in the near future. Some of the responses are related to the following issues:

R 12 “*I don’t think that anyone can expect too much for 2 years or generate a projection about what the market.*”

R13 “*I do not think there will be much improvement, especially in the domestic market there is a longstanding system. There is no objection to this system and there is no effort to change it. So I don't think anything will change.”*

Respondents also connect the future of the market with the macroeconomic variables. The world economy, economy of Turkey, exchange rate and political decisions are specified as important determinants for future projections. The Global Sulphur Limit is also expected to have an effect on the market. This regulation expected to direct ships to the demolition.

Future challenges composed of “exchange rate”, “high competition”, “The Global 2020 Sulphur Limit Regulation”, “ship surplus”, “economy of Turkey”, “trade wars”, “political decisions”, “recession at construction industry”. These codes point out the challenges that will be encountered in the near future.

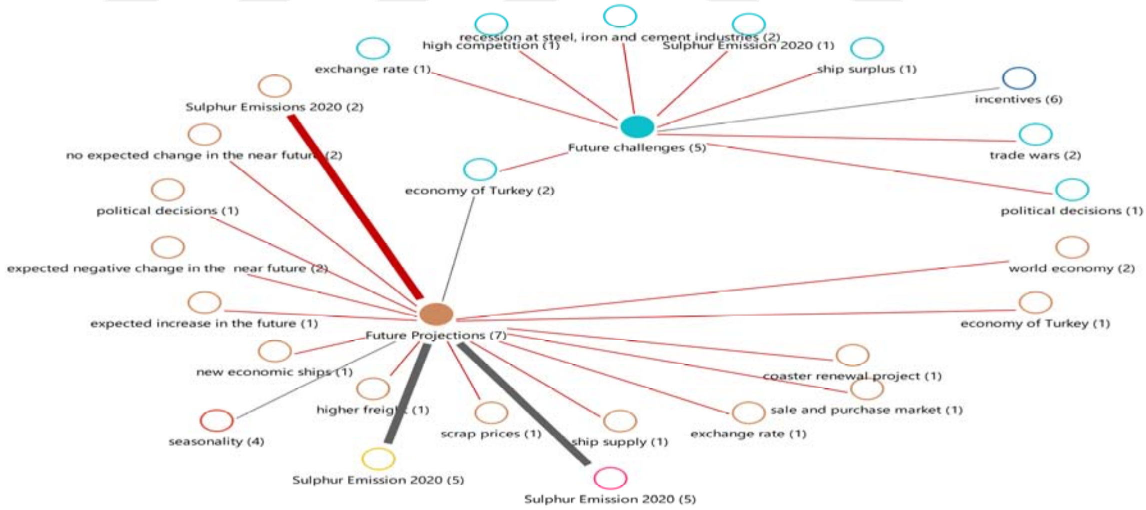
Recession at the construction and building industry is mentioned as a strong challenge for domestic dry cargo shipping. Some of the responses related to the issue are:

R15 “*Together with the recession at the construction industry, the marble industry that is closely connected to the construction industry and thus its transportation has been affected by this recession.*”

R16 “*From the point of view of iron and steel industry, iron and steel are not going through a very good period in Turkey. The construction and building industry have stopped in Turkey especially in the last year. With slowing down of the construction and building sales and the distribution of the steel and iron has been also slowing down. And iron and steel is an industry that places a lot on domestic dry cargo transport. So this, of course, could affect domestic shipping. Cement is also another industry that supplies raw materials to the construction and building, which means that the weakening of the construction will result in a weakening of the cement demand and distribution.*”

Global trade wars and the economy of Turkey is also mentioned as a critical challenge for the dry cargo domestic shipping market. In addition to these, The Global 2020 Sulphur Limit will pressurize the domestic shipping as well.

Figure 108. Co-occurrence Map of The Future Projections and Challenges Themes



Source: MAXQDA output

4.3.4.6.6. Policies and Strategies

This theme presents the offered policies and strategies to deal with the above-mentioned challenges. The co-occurrence model of the themes is created to indicate the relations and connections across codes and illustrated in Figure 109. Brown circles represent the codes of increased demand theme. “Fuel price”, “Attitudes of the shipowners”, “Cooperation between shipowners”, “overcome to ship surplus”, “increase rail connections and multimodal transportation”, “faster handling”, “increase the domestic demand”, “incentives”, “increase the quality of P&I of the ships”, “younger ships”, “decrease the freight rates”, “port tariffs”, “increase the efficiency of the ports”, “fuel prices” are the determined codes.

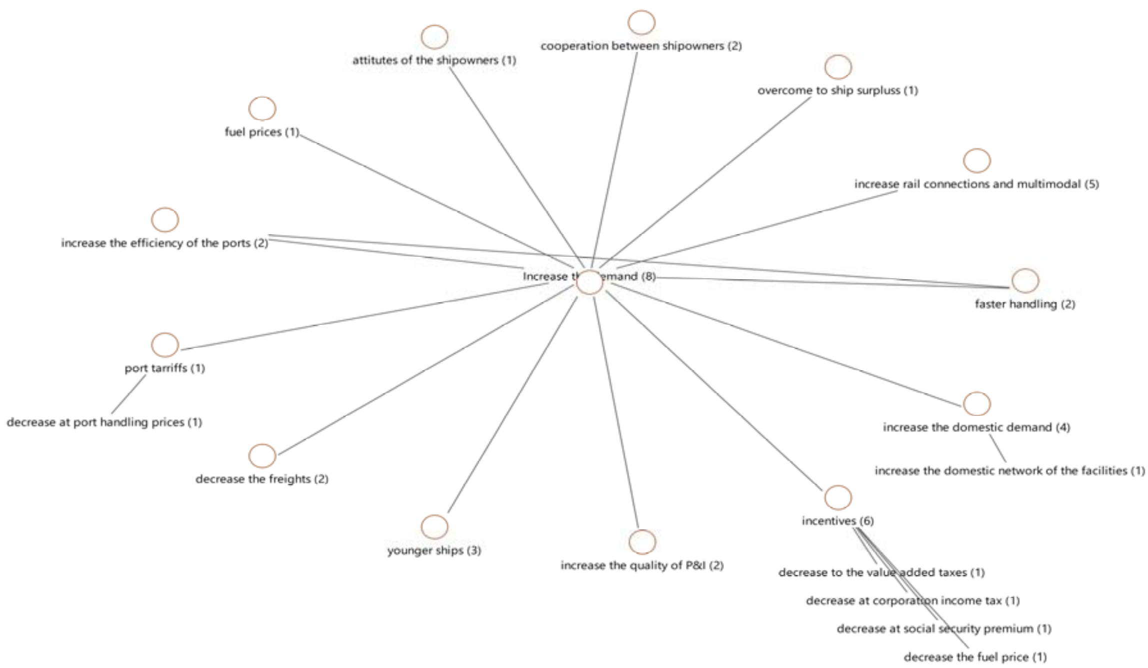
Incentives are important supports for the industries and have a critical role in the domestic shipping market as well. Increasing domestic demand for goods and the network of the facilities is another factor that could affect an increase in domestic dry cargo shipping.

Increasing rail connections from the ports and giving attention to multimodal transportation could increase the domestic dry cargo shipping.

R14 “*To increase demand, a railway connection between ports and industrial areas is required.”*

R16 *“Railway and multimodal intermodal transport should be developed. Railway and maritime integrated systems need to be improved.*”

Figure 109. Co-Occurrence Map of The Policies and Strategies to Increase Domestic Dry Cargo Shipping Demand



Source: MAXQDA output

4.3.4.6.7. Shipowner Effects on Domestic Dry Cargo Shipping Demand

Shipowners' factors that could influence domestic dry cargo shipping demand are considered to reveal within this theme. The co-occurrence model of the themes is created to indicate the relations and connections across codes and illustrated in Figure 110. The co-occurrence model is generated from the themes of shippers' effects, shipowners' effects, and selection of shipowners' effects. Red lines represent the subcategories of the themes and grey lines represent the co-occurred codes. Red circles represent the shippers' effects and yellow circles represent the shipowners' effects and dark brown circles represent the selection of shipowners' variables.

"Selection of shipowners" and "shipowners effects on demand" have indicated close connections and relations as expected. Shipowners' effects point out dry cargo domestic demand at the industrial level, while the selection of shipowners' theme indicates company level effects'.

Shipowners' effects on dry cargo domestic shipping demand have coded as "transit time", "incentives to shipowner", "Port State Control", "freight rate", "weather conditions", "multimodal transport", "P&I", "The 2020 Global Sulphur Limit", "common carriage of goods", "logistics services", "social security premiums". "Selection of shipowners" theme presented following codes: "service quality", "logistic services", "class of the ship", "safe shipping capability", "punctuality", "financial status of the shipowner", "conditions of the ship", "freight rate", "P&I", "communication capability", "customer services", "qualifications of the personnel", "shipowners' reputation".

The 2020 Global Sulphur Emission Regulation affects the industry worldwide. The regulation will impact on shipping costs. Older ships will be phased out due to scrubber installation costs.

R8 "*Sulfur Emission Regulation will have effects as good ships will remain in the market and good ships will have high running costs. So it will raise the freight.*"

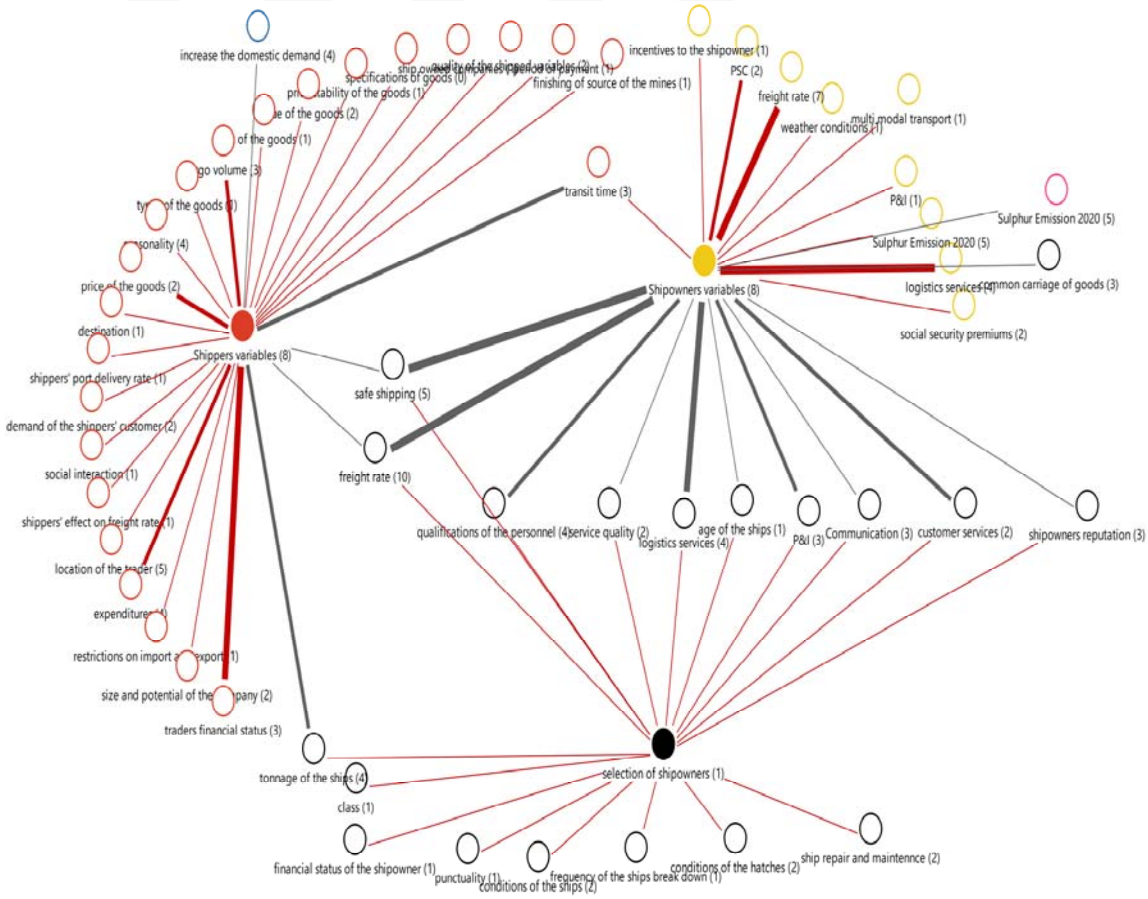
The freight rate is the most mentioned code under this theme. Therefore, freight rate is one of the most important expenditures of shippers', it is also the most important purpose of the commercial transactions as income and the source of the income of the shipowner.

R14 *“The cheaper the freight is the more impact it will have on-demand and the more freight domestic shipping can take the freight from the road.”*

R2 “*Shipowners may influence demand if they reduce freight.”*

Conditions’ of the ships as tonnage of the ships, frequency of the ships’ breakdown, conditions of the hatches, ship repair and maintenance, and age of the ships, freight rate, safe shipping capabilities of the shipowner, providing logistics services and qualifications’ of the personnel are the most preferred choice criteria’s for shipowners respectively. Service quality and freight rate, class of the ships and frequency of the ships’ break down, communication capabilities and provided customer services found closely related.

Figure 110: Co-Occurrence Map of The Shipowner Effect on Domestic Dry Cargo Shipping Demand



Source: MAXQDA output

R3 *"Before chartering the ship, we have got the photos and specifications of it and hatches. When the ships used as containership before and transformed to dry cargo ships, these ships require physical force. You need to get someone out and clean the ship up. We try not to prefer ships like that. Because both are slow to load and too risky by employing more workers in the dangerous area."*

R10 *"The condition of the ship and the condition of the holds should be well maintained."*

R11 *"Ships need to be properly maintained and its hatches should be clean and its machine needs to maintained properly as well."*

R3 *"Freight rate and the conditions of the ships' hatches are important."*

R15 "Freight rate is important in selecting shipowners."

R5 "Operational difficulties that prevent the safe shipping lead shippers to the other transport modes."

R2 "The qualification of the personnel is also very important so everything else can be very difficult with a tough captain. The agent is the object of shipper there but sometimes the subject can recourse to the shipper and they do not prefer that shipowner for the next time."

4.3.4.6.8. Shipper Effects on Domestic Dry Cargo Shipping Demand

This theme reveals the shippers' factors that could influence domestic dry cargo shipping demand. The co-occurrence model of the themes is created to indicate the relations and connections across codes and illustrated in Figure 111. The co-occurrence model is generated from the themes of shippers' effects. Red lines represent the subcategories of the themes and grey lines represent the co-occurred codes. Red circles represent the shippers' effects.

Shippers' effects on dry cargo domestic shipping demand have coded as "finishing source of the mines", "period of payment", "quality of the shipped goods", "shipping companies", "specification of the goods", "destination of the goods", "shippers' port delivery rate", "demand of the shippers' customer", "social interaction", "shippers' effect on fright rate", "location of the trader", "expenditures", “restriction on foreign trade”, “size and the potential of the shipper”, “traders financial status”.

Specification of the goods is the most influencing factor and cost and value of the goods, price of the goods, seasonality and the types of goods are also within the scope of this code.

R2 *“The type of cargo offered by the shippers’, the amount of cargo and destination is important.”*

R8 *“So, the amount produced by the shipper is important.”*

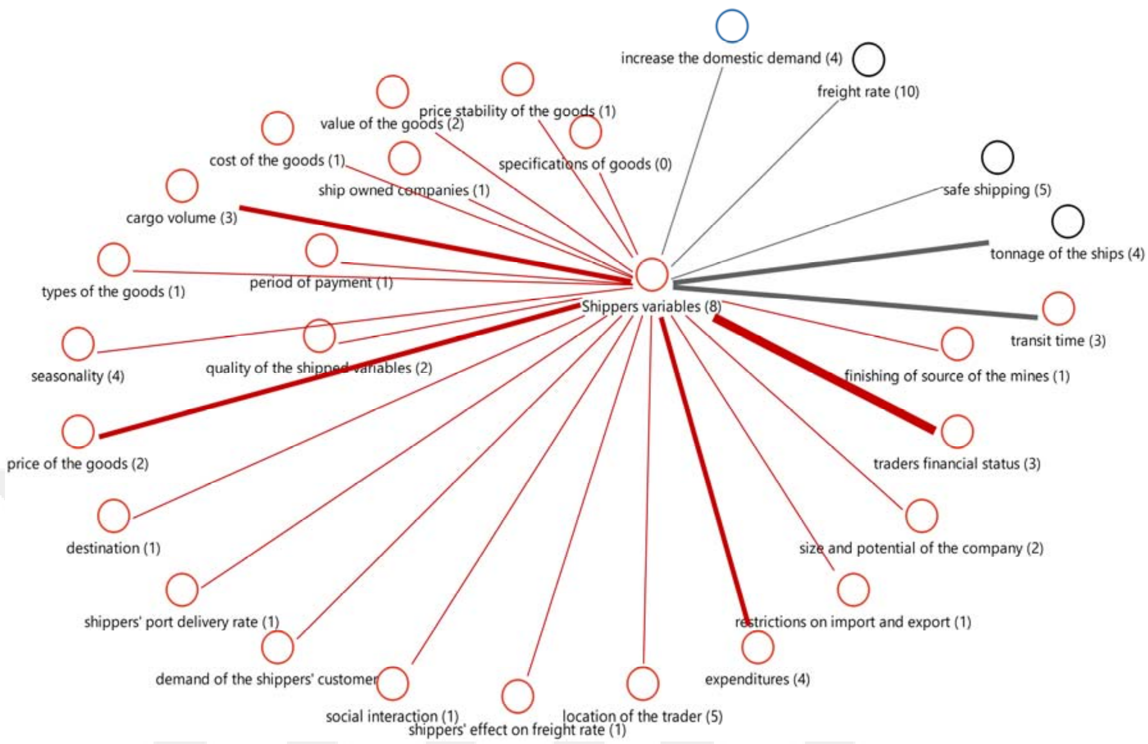
The location of the trader has also significant importance due to the proximity to the sea, proximity leads shippers to yield on preferring domestic shipping.

R2 *“At that point location of the trader is very important. The cargo originated from the Samsun do not moved to the Diyarbakır via domestic shipping. As a result, cargo generally transported to a port town. So of course, in this case, domestic shipping becomes more effective.”*

R4 *“Domestic shipping is cheap in terms of expenditures at large volumes. Besides, it pulls the trucks from the highway. But, not everyone is that lucky. Domestic shipping can be made if the facilities are close to the ports.”*

Expenditures of the shipper also have considerable influence on domestic dry cargo shipping demand. Expenditures’ of the shipper and location of the trader and traders’ financial status is also found closely related.

Figure 111. Co-Occurrence Map of The Shippers' Effect on Domestic Dry Cargo Shipping Demand



Source: MAXQDA output

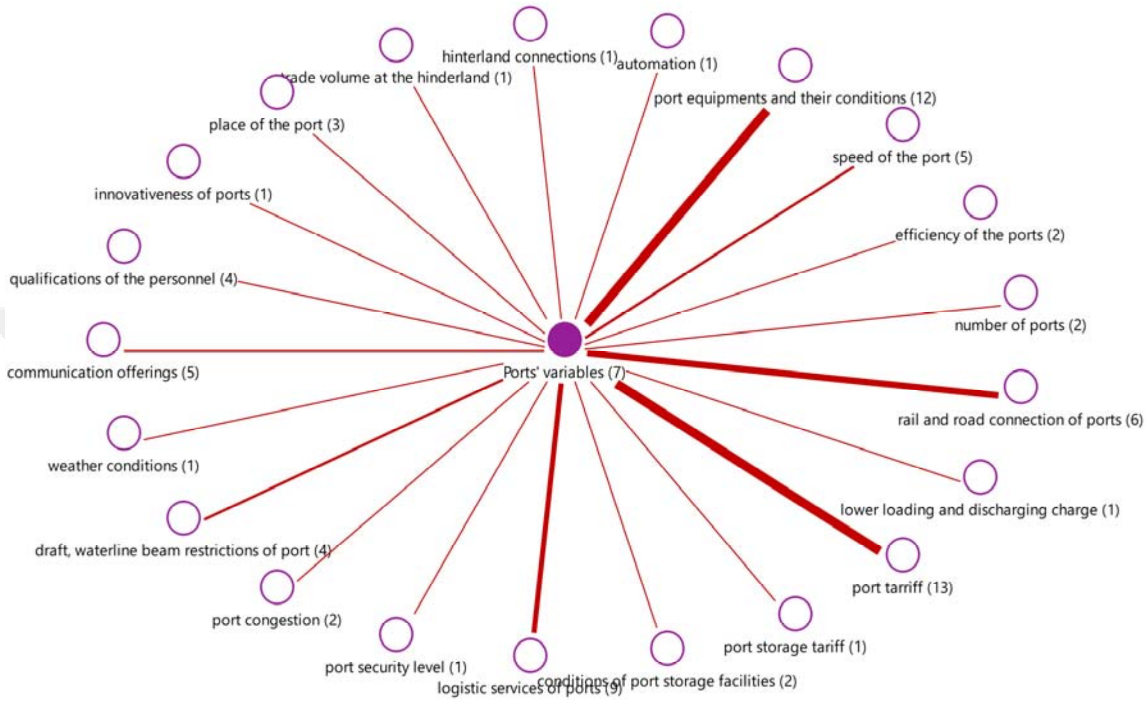
4.3.4.6.9. Port Effects on Domestic Dry Cargo Shipping Demand

This theme reveals the ports' factors that could influence domestic dry cargo shipping demand. The co-occurrence model of the themes is created to indicate the relations and connections across codes and illustrated in Figure 112. The co-occurrence model is generated from the themes of ports' effects. Red lines represent the subcategories of the theme.

Ports' effects on dry cargo domestic shipping demand have coded as "number of ports", "efficiency of ports", "hinterland connections", "innovativeness of ports", "qualifications of the port personnel", "communication offerings", "weather conditions", "restrictions of ports (draft, beam, etc.)", "port congestion", "port security level", "logistics services of ports", "port tariff", "rail and road connections of ports".

The efficiency of the ports is found as the most influencing factor and speed of the port, port equipment's and their conditions, automation is also within the scope of this code. Port tariff, logistics services of ports and hinterland connections are the other mostly mentioned effects of ports.

Figure 112. Co-Occurrence Map of The Ports' Effect on Domestic Dry Cargo Shipping Demand



Source: MAXQDA output

4.3.4.7. Qualitative Study: Findings and Discussion

Domestic dry cargo shipping is a dynamic market influenced by many variables. The literature review at 1.3. Forecasting in Shipping Markets: Literature Review and 2.3.3. Literature Review on Demand Forecast Variables in Industrial Marketing highlights the macroeconomic variables in demand forecast models. This part aimed to understand the determinants of demand for domestic dry cargo shipping and additional variables that are not revealed with the literature review. To determine these variables, face-to-face semi-structured interviews have conducted with a total of 17 domestic maritime dry cargo shipping experts. The factors have been examined under the following themes: “current issues”, “future projections”, “future challenges”, “competitive power”, “weakness”, “port's effects”, “shipowners' effects”, “shippers' effects”, “shipowners' choice”.

These findings have highlighted some key issues influencing domestic dry cargo shipping in Turkey. The current issues are fuel prices, freight rates, aged ships, high competition, concerns on the environment (The 2020 Global Sulphur Limit, Ballast water management), exchange rate, trade wars, location of the trader, type of dry cargo and ship surplus.

To increase domestic dry cargo shipping, the following key policy options are offered: increase in usage of multimodal transportation, an increase of inspections of road transportation, faster handling, cooperation between shipowners, serving with younger ships and overcoming ship surplus. Some scholars pointed out this issue in different country cases as well. Brooks and Frost (2004) offered the use of multimodal solutions to increase cooperation with other transport modes in the Canadian Case. Recently, Brooks and Wilmsmeier (2017: 39) offered full access to cabotage markets for promoting domestic shipping at Chilean ports, subsidy to establish a coastal feeder and access by international container shipping lines to carry their empty equipment for repositioning. These perspectives can also be considered for further growth of domestic shipping services

Domestic dry cargo shipping of Turkey is a challenging market that has geographical characteristics both domestic and global terms and industrial characteristics. Due to this complex nature and environment, many influencers of demand are identified. These findings of this qualitative study are used to design the survey questionnaire on the investigation of domestic dry cargo shipping demand that will be used in the field study part of this dissertation.

4.3.5. Field Study: Domestic Dry Cargo Shipping Demand

Upon the exploration of demand variables of domestic dry cargo shipping, this part of the dissertation consists of revealing the relationships of these variables. A field study among shipping industry actors is conducted and quantitative results are achieved.

4.3.5.1. Aim and Scope

The purpose of this part is to reveal the impacts of the variables on domestic dry cargo shipping and to develop a model for domestic dry cargo shipping demand. With this aim the perceptions of the shipping industry actors are measured with the help of a questionnaire which is developed through background research and the qualitative study.

4.3.5.2. Development of Data Collection Tool

The data collection measurement is constructed according to the demand forecast requirements of the research. Previous information on demand prediction and area of the field study was effective in construction of the data collection measurement. Previous information on demand predictions was gathered from Turkey and the area of field study was also chosen as Turkey so these facts are reflected in the data collection tool. A questionnaire is developed as a data collection tool. The questionnaire consists of five main sections. The first section attempts to identify respondents of the questionnaire that includes ship-owners, shippers, agencies and shipbrokers and decision-makers of dry cargo domestic shipping. This section named profile information. The next section of the questionnaire aims to determine the agreement level of the demand forecast that is presented at Turkey's 11th Development Plan that constitutes the period between 2019-2023. The third section aims to identify the effects of country variables on dry cargo domestic shipping. The next section also focuses on the effects of industry variables on dry cargo domestic shipping. The final section aims to identify the effects of company variables on shipping companies that are acting at domestic dry cargo shipping industry. The data collection tool is named as “Questionnaire on Investigation of Domestic Dry Cargo Shipping Demand” and it is presented in Appendix 11.

Section A. “Profile Information” aimed to identify respondents of the questionnaire that includes shipowners, shippers, agencies and shipbrokers and decision-makers of dry cargo domestic shipping. All actors have been asked different profile information. While developing profile information of the ports, Karataş Çetin (2012: 599) was referred. Moreover, while developing profile information of the shipowners, Ozer and Çetin (2012: 226) were referred. Shipbroking, agencies, and decision-makers were not directed any specific company profile questions. Respondents’ profile questions involve age, education level, experience, and position.

Section B. “Scenario Information and Questions” aimed to determine the agreement level of the respondents to the demand forecast of domestic dry cargo shipping that is compiled from Turkey’s 11th Development Plan that aims the period between 2019-2023. 11th Development Plan presented a forecast on cabotage shipping. This forecast specified the share of cabotage shipping to total handlings. The cabotage shipping share to total handlings was 12.8% in 2018 (SBB, 2019). 11th Development Plan predicts this share as 18% for 2023 as one of the logistics and transportation industries’ main objective. As stated in Apppendix 11, Section B. is prepared based on this information. The share of domestic (cabotage) dry cargo transportation is calculated as 6% in 2018, and according to the 18% share forecast for 2023 this is calculated as 8%. Respondents are asked to state their agreement level to this forecast and to the increase rate. Moreover, respondents are asked to state their own expectations on the share of the domestic (cabotage) dry cargo handlings in 2023. For further investigation on the related forecasts, previous development plans were also considered. The previous 10th Development Plan for the years 2013-20118 had presented forecast for total domestic and international shipping volumes of container shipping (million TEU), loaded and unloaded (million tons), Turkish Flagged Merchant Fleet (million DWT). It was forecasted as 8,1 million TEU for container shipping in 2013, while 7,9 million TEU is realized. It was also forecasted as 13,8 million TEU for 2018, while 10.8 million TEU is realized (TR Ministry of Development, 2013: 109, SBB, 2019: 76, Can, 2018: 65). Turkish Flagged Merchant

Fleet was forecasted as 11,0 million DWT for 2013, while it is realized as 9,2 million DWT. It was also forecasted as 14,0 million DWT for 2018, while 7,5 million DWT is realized (MTI, 2019c; TR Ministry of Development, 2013: 109). Loaded and unloaded total volume was forecasted as 418 million tons for 2013, and 615 million tons for 2018. However, it is realized as 385 million tons in 2013, and 460 million tons in 2018 (MTI, 2019d; TR Ministry of Development, 2013: 109). It has appeared that the specified forecasts have not been reached.

For the following sections of the questionnaire within the scope of the field research, firstly scientific studies and used variables in these studies were considered. To include the related demand variables in the industrial marketing literature "demand" and forecast" and "demand forecast" keywords have been searched and content analysis has been carried out. European Journal of Marketing, Marketing Intelligence & Planning, Journal of Marketing Research, Journal of Business & Industrial Marketing, Journal of Services Marketing, and Industrial Marketing Management journals are considered in this research. To find out shipping demand variables "shipping forecast", "shipping + forecast", "freight rate forecast", "merchant fleet forecast", "average haul forecast", "ship productivity forecast", "ship demand forecast", "seaport forecast" keywords have been searched from the Web of Science databases. After reading the related and selected articles of the fields, the variables have been selected for both disciplines. To compile the demand variables from the industrial marketing demand variables, shipping demand variables and all the related variables are collected and cross-tabulated as presented in Table 66.

Table 66. Cross Tabulation of Industrial Marketing Demand Variables and Shipping Demand Variables

Industrial Marketing Demand Variables / Shipping Demand Variables	1.Exchange rate	2.Export	3.Import	4.Population	5.Industrial production index	6. GDP/GNP	7. Wholesale price	8.Distance/average haul	9.Oil dependency	10. Oil consumption	11.Oil price	12.Oil production	13. New building prices	14.Second-hand prices	15.Demolition price	16.Trade volume/seaborne	17. Trade value	18. Freight index/rate	19.Cargo throughput	20.Fleet size/capacity	21. Demolition volume	22.Operational costs	23. Interest rates	24. Inflation rates	25.Seasonality	26.War and crises	27. Regulation	28. Charter rates	29. Ship size	30. Electricity consumption	31. Profits	32. Terminal tariff	33. Commodity	34.Investment	35. Consumer price index	36. Expenditure of building and
1.Collaboration-competition																																				
2. Concord-conflict																																				
3.Integration-differentiation																																				
4. Price											x		x	x	x			x																		
5.Coordination																																				
6.Communication																																				
7.Orders																																				
8.Investments																																		x		
9.Cost																						x														
10. Speed and punctuality/time																																				
11.Innovation																																				
12.Ssales																																				
13.Substitutes																																				
14.Promotion																																				
15.Brand																																				
16.Market Share																																				
17.GDP/GNP						x																														
18.Population				x																																
19.Service Channels and Distribution																																				
20. Market information																																				
21.Expertise/Past experiences																																				

Table 66. Cross Tabulation of Industrial Marketing Demand Variables and Shipping Demand Variables (Cont.)

Industrial Marketing Demand Variables / Shipping Demand Variables	1.Exchange rate	2.Export	3.Import	4.Population	5.Industrial production index	6. GDP/GNP	7. Wholesale price	8.Distance/ average haul	9.Oil dependency	10. Oil consumption	11.Oil price	12.Oil production	13. New building prices	14.Second-hand prices	15.Demolition price	16.Trade volume/seaborne	17. Trade value	18. Freight index/rate	19.Cargo throughput	20.Fleet size/capacity	21. Demolition volume	22.Operational costs	23. Interest rates	24. Inflation rates	25.Seasonality	26.War and crises	27. Regulation	28. Charter rates	29. Ship size	30. Electricity consumption	31. Profits	32. Terminal tariff	33. Commodity	34.Investment	35. Consumer price index	36. Expenditure
22.Customer involvement																																				
23. Culture																																				
24. Finance status																																				
25. Customer expectations																																				
26.Available response alternatives																																				
27.Customer value/																																				
28. Customer or market interface																																				
29.Social interactions																																				
30.Import			x																																	
31.Export		x																																		
32. Market size																																				
33.Market growth																																				
34.Competitors																																				
35.Risk Management																																				
36.R&D																																				
37.Responsiveness																																				
38.Interest Rate																							x													
39.Value Creation																																				
40.Security Capability																																				
41.Exceptional Management																																				
42.Service Rate																																				

A total of 53 and 36 variables have been identified and 14 corresponding variables have been found among a total of 91 total variables. However, some of the other variables were also utilized.

Section C. "Effects of Country Variables on Domestic Dry Macro Shipping Demand" aimed to identify the relative effects of country variables on domestic dry cargo shipping. This section composed of 22 variables. Eight of these variables were deduced from the same variables of industrial marketing demand literature and shipping demand literature. International trade agreements and customs tariffs were deduced from the macro external environment analysis of domestic dry cargo shipping that is explained in Section 4.3.3.4.1. Macro External Environment Influencers. "Restrictions on foreign trade" variable was collected from the 4.3.4. Qualitative Study: Identifying Dry Cargo Shipping Demand Variables of this dissertation. "Unemployment" variable was deduced from industrial marketing literature. Rest of the variables "oil prices", "commodity prices", "electricity consumption", "Expenditure of building and construction", "trade value", "cargo throughput", "wars and political crises", "legal regulations", "Marine environmental rules (The Global 2020 Sulphur Limit, Ballast Water Management, etc.)" were collected from the shipping demand literature. "Oil prices", "oil dependency", "oil consumption" and "oil production" variables were utilized under the "oil price" variable. Most of these variables are also collected from the qualitative study.

Section D "Effects of Industry Variables on Domestic Dry Cargo Shipping Demand" aimed to focus on the relative effects of industry variables on dry cargo domestic shipping. This section composed of 44 variables. Eleven variables such as "demand for the shipping goods", "number and size distributions of shippers and shipowners", "market size of domestic dry cargo shipping market", "growth rate of domestic dry cargo shipping market", "innovations at domestic dry cargo shipping market", "added value of domestic dry cargo shipping market", "number of the competitors", "freight competition", "non-freight competition", "number of the distribution channels", "substitutes" were deduced from the industrial marketing literature. Ten variables "seasonality of the shipping goods", "average haul", "fleet size", "loading and discharging volumes", "port tariffs", "new building orders", "new building prices", "second-hand ship prices", "ship demolition volume" and "ship demolition prices" were collected from shipping literature. Shipping and Industrial marketing literature indicated several same variables as "price of the shipping goods", "value of the shipping goods", "investments to the domestic dry cargo shipping market", "freight rates", "chartering rates", "costs of the shipping companies", "profitability of the shipping companies", "costs of the shippers", "profitability of the shippers". The rest of the variables were deduced from the qualitative study.

Section E "Effects of Company Variables on Shipping Company Demand" aimed to find out the relative effects of company variables on shipping companies' demand operating at the domestic dry cargo shipping market of Turkey. This section is composed of 41 variables. Four variables "freight rate", "investments", "profitability", "operational costs" were deduced from both shipping and industrial marketing literature, while "innovativeness" and "giving logistics services support to the shippers" were collected from both marketing literature and qualitative study. Ten variables such as "class of the ships", "P&I insurance of the ships", "tonnage of the ships", "frequency of the ship breaks", "regular ship repair and maintenance", "condition of the hatches", "qualification of the personnel" "dry cargo type of the shipper", "period of payment of the shipper", "place of the shipper" were deduced from the qualitative study. The rest of the variables were collected from the industrial marketing literature.

4.3.5.3. Validity of the Data Collection Tool

Generally, three main themes are focused on relating the validity concept. First is the suitability of the data collection tool with the desired issue to be measured. The second theme considers the question of whether the measurement is carried out in accordance with the rules. The third theme considers the question of whether the measurement data reflect the desired issue (Şencan, 2005: 724). Validity means; the data collection items measure what the researcher desire to measure (Newman, 1998: 39). Validity is related to how accurately the data collection tool items measure the desired issue without confusing with other features. There are several classifications of validity types and as seen in Crocker and Algina (1986: 217). The most preferable grouping is composed of "content validity", "criterion-related validity" and "construct validity (Büyüköztürk, 2016: 117).

Content validity examines the data collection tool items that cover the dimension to be measured. The issue to be measured have to both represent and be relevant to that domain. Content validity is performed by either subjective and empirical methods. Subjective methods are regarded by asking experts to evaluate the relevance and representativeness of the data collection tool (Domino and Domino, 2006: 53). In this dissertation, content validity is confirmed by the subjective method and interviews were carried out with industry experts and academicians. The profile of these experts is presented in Table 67. Therefore, to support content validity, all variables that are found as a result of detailed literature review and cross-tabulation were included and these variables were supported with the qualitative study, during the development of the questionnaire form.

Table 67. Profile of the Experts Confirming Content Validity

Institution / Position	**Explanation**	**Application Format**	**Date**	**Place**
Port / Port Director	Assessing the relevance and representativeness of the questionnaire items	Face to Face interview	12.09.2019	Samsun
Agency	Assessing the relevance and representativeness of the questionnaire items	Face to face interview	12.09.2019	Samsun
Dokuz Eylul University Maritime Faculty / Prof. Dr.	Assessing the relevance and representativeness of the questionnaire items	Face to face interview	08.10.2019	İzmir
Dokuz Eylul University Faculty of Economics and Administrative Sciences /Assoc.Prof. Dr	Assessing the relevance and representativeness of the questionnaire items	Face to face interview	22.10.2019	İzmir

Source: Author

While content validity is a subjective assessment, criterion validity produces more empirical evaluation of the measure. Criterion validity is the "*ability of the measure to correlate with other standard measures of the same construct or established criterion*" (Zikmund et al. 2017: 277). However, it is not possible to determine the criterion validity of the developed questionnaire due to a measure regarding the investigation of domestic dry cargo shipping demand that has not been encountered during the literature review.

Construct validity is found during the statistical analysis of the data. It is the ability of a measure to support empirical findings with the theory-based concepts (Zikmund et al. 2017: 277). Construct validity convergent and discriminant validity should be focused. Convergent validity deals with the similarity as correlations or convergences of new measures with similar measures. Discriminant validity deals with the dissimilarity as correlations or convergences of new measure with dissimilar measures (Bajpai, 2011: 64). There are many methods, techniques, and calculations offered for establishing construct validity in the literature. (Sencan, 2005: 744). In this context, Crombach Alpha, total item correlation and factor loads collected from factor analysis are used to test construct validity. In this study, all variables' corrected item-total correlation is found above 0.3 and none of the variables decreases the internal consistency (Cronbach Alpha) coefficient. Therefore, factor loads of all variables are found above 0.40. However, only the culture variable has been excluded from the analysis due to being multi-factor loadings from EFA and being in one factor in factor group. Briefly, content, construct and criterion validity of the developed questionnaire regarding effects of macro, micro and company variables on the domestic dry cargo shipping demand was ensured. In this manner, the questionnaire on the investigation of domestic dry cargo shipping demand with 107 variables was obtained.

4.3.5.4. Sampling and Data Collection

Probability sampling techniques are generally more useful for qualitative oriented studies due to the nature of these studies (Gürbüz and Şahin, 2017: 131). Judgmental sampling provides researcher to select information-rich cases and obtain deeper insights. It is preferred when one or more specific cases are desired to be studied to meet certain criteria or have certain characteristics (Büyüköztürk et al., 2016: 90). Judgmental sampling and convenience sampling methods are used together in this part of the study. The area of field study is chosen as Turkey and it is tried to reach many actors as possible. However, it is not possible to reach a definite number and define a population of domestic dry cargo shipping stakeholders and in Turkey. The population of the study is composed of actors acting at domestic dry cargo shipping in Turkey. Experts, top-level managers of related institutions and other actors who are directly and indirectly related to the forecasting of demand for dry cargo shipping are selected as sampling.

Firstly, respondents are selected from the members of the 9th, 10th and 11th Development Plan Transport Specialized Commission. Development plans are legal and technical macro plans that consider the overall economy, covers the relations between social and economic factors with a long term integrated perspective and guides industries for the medium and long terms (Takım, 2011: 155). From these aspects, it is necessary to obtain information from the members of related commission members who are experts in the field. These members also have representative power of shipping transport in Turkey. A total of 18 respondents were reached for sampling.

Ports are determined using Turkish Chamber of Shipping (TCS) Professional Committee members. All members of Group 33 which have institutions under the NACE Code 52.22.06, Management of Ports and Waterways as supportive waterway transportation, are taken into consideration. A total of 162 institutions were found and these include branches, ship agency companies, port supply companies, liquid bulk cargo handling ports and container handling ports. These institutions were excluded from the sample. Therefore, only general cargo and dry bulk cargo handling ports are considered. A total of 42 ports are found from Group 33 of the TSC Professions Committee. Port Operators Association of Turkey members are also reviewed for the sampling. A total of 11 ports are included from the members that are not found from the members of Group 33. Finally, a total of 59 ports are compiled. However, only domestic dry cargo shipping loading and unloading ports are considered and questionnaires were collected from 15 ports.

Shipowners are determined using TCS Professional Committee members. All members of Group 15, 16 and 17 which has institutions under the NACE Code 50.40.05. freight transport in inland waters, 50.20.26. Transport of Bulk Dry Cargo on the Line of Cabotage and 50.20.91 Other Freight Transport made in the line of cabotage are taken into consideration. A Total of 213 institutions were found and these also include branches, ship agency companies, port supply companies, liquid bulk cargo companies, and container shipping companies, ship supply companies. These institutions and foreign-flagged ship owned companies were excluded from the sample. Therefore, only general cargo and dry bulk cargo carrier owned companies are considered. A total of 18 institutions that have dry cargo and general cargo Turkish flagged ships are found from Group 15,16 and 17 of the TSC Professions Committee. Turkish Shipowners' Association members are also reviewed for the sampling. A total of 25 shipowning companies are included from the members that are not found from the members of Group 15, 16 and 17. A total of 43 institutions are found. However, most of these companies stated that they do not give service to the domestic shipping market. Finally, 18 shipowners that give service at the domestic dry cargo shipping market were reached.

Shippers are determined using personal contacts and snowball sampling to reach the respondents. Three key informants have been reached during the empirical research process and asked for the domestic dry cargo shippers. Eventually, a total of 9 institutions are considered for sampling.

Finally, the questionnaire collection process that started on the 14th of December ended on 20 March 2020 and a total 60 surveys were obtained.

4.3.5.5. Data Analysis Methods

This field study consists of analysis with independent sample t-tests, factor analysis and binary logit regression as analysis methods.

- **Comparative Analysis**

Independent sample t-test is used to conduct comparative analysis. T-test is a type of parametric test that used to compare the means of two groups. T-test assumes that the sample data of the population are independent and normally distributed (Gerald, 2018: 50). Independent sample t-test is a type of t-test along with a dependent sample t-test and a one-sample t-test. Within these methods, independent sample t-test is one of the most frequently used t-test methods (Urdan, 2015: 89). Independent sample t-test is used to compare two groups whose means are independent within each other (Ravid, 2015: 136). Categorical or nominal independent variable and continuous or intervally scaled dependent variable is needed to apply an independent samples t-test. The independent variable used in the t-test is a variable with two values (e.g. men and women, young and elder, etc.) (Urdan, 2015: 89).

- **Factor analysis**

In marketing research, there can be a considerable number of the variables that are most correlated and they are needed to be reduced to a manageable level. Factor analysis is used for the reduction of factors and summarization. It examines the interdependence of variables and provides identifying underlying structures, identifying smaller data set and determining uncorrelated variables. (Malhotra and Birks et al. 2006: 493, 646, 647)

Mathematically in factor analysis, each variable is represented as a linear combination of underlying factors. For the meaningful factor analysis, variables should be correlated. Bartlett's test of sphericity and KMO measure of sampling adequacy are the statistical tests for measuring the appropriateness of the factor model. For the appropriate factor analysis high values (between 0.5 and 1.0) KMO values should be reached (Malhotra and Birks, 2006: 651). For the conformation of the significant relationship between variables, the null hypothesis should be rejected and p-value <0.05 should be provided (Rajaretnam, 2015, 251).

Principal component analysis total variance in the data is considered (Malhotra and Birks. 2006: 652). If the factors and errors in the factor model are not accepted to follow a normal distribution and causal model, PCA is preferred. Principal axis factoring is preferred when the factor analysis aims to reduce data. The maximum likelihood method is preferred when the factors and errors in the factor model are accepted to follow a normal distribution (Rajaretnam, 2015, 255).

- **Binary Logit Regression**

Logistic regression is a method used to estimate the probability of a case or event and is the most important model for categorical consequent data (Onder, 2013: 87). Binary logistic regression, a kind of logistic regression method, is a variation of ordinary linear regression. It is used when the consequent variable is a binary and the antecedent variables are categorical or continuous. As in linear regression, logistic regression does not assume that the relationship between the variables is linear. Binary logistic regression is a favorable method to analyze the data holds categorical consequent variables (Midi et al., 2010: 254). Logistic regression implements maximum probability prediction after modifying the consequent variable into a logic variable (Pourghasemi et al., 2013). The logistic regression model can be represented by the following equation (Lee and Pradhan, 2007);

$$P = \left(\frac{1}{1 + e^{-Z}}\right) \tag{22}$$

where, P is the estimated probability of landslide occurrence and varies from 0 to 1 on and S-shaped curve, and Z is the linear combination while defined as the following equation;

$$Z = intercept + b_1x_1 + b_2x_2 + b_3x_3 + \cdots b_nx_n \tag{23}$$

where b_1, b_2, b_3, and b_n, are the slope coefficient of the logistic regression model and x_1, x_2, x_3, and x_n are the independent variables.

4.3.5.6. Findings

To model the domestic dry cargo shipping demand, perceptions of industry stakeholders on domestic dry cargo shipping variables have been collected. Two dependent variables are generated from Turkey's 11th Development Plan predictions and they were presented as a basis for the evaluations.

As explained in the section 4.3.5.2. Development of Data Collection Tool, the share of domestic (cabotage) dry cargo transportation is calculated as 6% in 2018, and it is forecasted as 8% for 2023. Respondents are asked to state their agreement level to this forecast and to the increase rate. Respondents of the field study stated their agreement level to this statement as 3.11 out of a scale of 1 to 5. This can be considered as slightly above "neutral".

Moreover, respondents are asked to state their own expectations on the share of the domestic (cabotage) dry cargo handlings for 2023. The average expectation rate of share stated by the respondents came out to be 6.65% for 2023 in comparison to the forecasted 8% in the 11th Development Plan. While developing the domestic dry cargo shipping demand model, respondents' expectations on this share is considered as the dependent variable. The dependent variable is included in the model as (0) below 6% and (1) 6% and above.

Analyzed data gives insight into the effects of domestic dry cargo shipping variables and models are developed for the domestic dry cargo shipping demand by taking into account of the results of this analysis.

4.3.5.6.1. Profile of the Respondents

As stated earlier, the sample of the study has been selected by judgemental sampling. Collection of a total of 60 questionnaire forms took approximately four months between 14 December 2019 and 20 March 2020. 60 forms were valid and have no missing values. The questionnaire forms have been collected by the researcher. Table 68 summarizes the positions of the respondents at their institutions and by this way the expertise of the respondents has been revealed.

4.3.5.6.2. Comparative Analysis

A comparative analysis is realized to test the findings on the perceptions of the respondents. In this section, t-test is applied to test the perceptions of two groups performing in the domestic dry cargo shipping. With reference to Table 67, these two groups are considered as “shippers and shipowners” as one group and the “other industry actors (ports and other stakeholders)” as the second group. The perceptions of the respondents on country, industry and company base variables that were present as Likert type scale statements in the questionnaire are tested comparatively. Table 69 sums up the findings of the significantly differing variables.

Country based variables:

- Responses to the statement of “exports have effect on domestic dry cargo shipping” is significantly different according to the respondent groups.
- Responses to the statement of “inflation rates have effect on domestic dry cargo shipping” is significantly different according to the respondent groups.
- Responses to the statement of “interest rates have effect on domestic dry cargo shipping” is significantly different according to the respondent groups.

Table 68. Profile of The Respondents of Field Study

Respondents Positions	Frequency
Deputy Port General Manager	2
Manager	1
Commercial Manager	1
Port General Manager	4
Purchasing Manager	1
Port Operation Manager	2
Customer Relations Manager	2
Coordination and Security Manager	1
Port Operation Shift Supervisor	1
Total Numbers of Ports	**15**
Logistics Manager	3
Port And Procurement Manager	1
Operation Manager	2
General Manager	1
Commercial Manager	1
Agency Manager	1
Total Numbers of Shippers	**9**
Chairman of the Board	2
Researcher	1
Operation Manager	1
Shipbroker	5
General Manager	5
Executive of the Company	1
Fleet director	1
DPA	1
Human Resources Manager	1
Total Numbers of Shipowners	**18**
Academic personnel	5
Researcher	1
Independent Auditor	1
General Secretary	2
Regional Logistics Manager	2
Harbour Pilot	2
General Manager	1
International Relations Coordinator	1
Specialist	1
Port Service Manager	1
Port General Manager	1
Total Numbers of Other Stakeholders	**18**
Total Respondents	**60**

Source: Author

- Responses to the statement of “unemployment have effect on domestic dry cargo shipping” is significantly different according to the respondent groups.

Industry based variable:

- Responses to the statement of “ship demolition volumes have effect on domestic dry cargo shipping” is significantly different according to the respondent groups.

Company based variable:

- Responses to the statement of “P&I of the ships have effect on domestic dry cargo shipping” is significantly different according to the respondent groups.

Table 69. Results of the Comparative Analysis

Variable	Respondent Groups	N=60	Mean	Std. Dev.	t-Test Findings		
					Levene Test Sig. Value	t	Sig. (p)
Export	Shippers and shipowners	27	4.03	1.05	0.480	2.007	0.049
	Ports and other stakeholders	33	3.48	1.06			
Inflation rate	Shippers and shipowners	27	4.07	0.78	0.015	2.906	0.005
	Ports and other stakeholders	33	3.36	1.05			
Interest rate	Shippers and shipowners	27	3.96	1.09	0.515	2.024	0.048
	Ports and other stakeholders	33	3.42	0.96			
Unemployment	Shippers and shipowners	27	3.44	1.17	0.149	2.863	0.006
	Ports and other stakeholders	33	3.45	0.97			
Ship demolition volume	Shippers and shipowners	27	3.55	1.21	0.155	2.633	0.011
	Ports and other stakeholders	33	2.81	0.95			
P&I of the ships	Shippers and shipowners	27	3.59	0.97	0.273	2.039	0.046
	Ports and other stakeholders	33	3.03	1.13			

Source: Created by the author based on SPSS 23 outputs

As a result, it appears that responses to the statement on export, interest rates, unemployment, and ship demolition volume and P&I of the ships have effect on domestic dry cargo shipping is significantly different according to the respondent groups.

4.3.5.6.3. Factor Analysis

Nonresponse bias consists of the failure of responding to a survey completely or partially. Lack of knowledge, the unwillingness of respondents to answer can be the reasons for this bias (Sreejesh, et al. 2014: 119). In this part, at first synthetic data generated from the obtained questionnaire data and it is inferred that the sections in the dataset tend to be grouped in the same factors. Therefore, factor analysis has been carried out to each section with obtained questionnaire data. The synthetic data, factor analysis process and the findings have been explained here.

Data collection and availability for the small area have serious problems as data disclosure (Hermes and Poulsen, 2012: 281), high cost, low response rate, time-consuming data processing (Mohammadian et al. 2010: 869), complex sample designs (Hundepool, 2012). For complex designs, synthetic data sets can provide valid interferences (Reiter, 2002: 542). Synthetic data or referred to as simulated data has been used in microsimulation modelling or providing detailed data. Simulated data used various disciplines such as social policy, population changes, transportation, marketing, health (Hermes and Poulsen, 2012: 281).

Synthetic data compromise imputed values generated from a predictive model using observed data (Sakshaug and Raghunathan, 2014: 2013). Rubin (1993: 461) proposed using simulated data with multiple imputations instead of actual data due to confidentiality issues. Peterson (2000) found that factor analysis of synthetic data has a similar general structure as the observed data (Peterson, 2000: 261). Raghunathan (2003:1) compared actual and simulated datasets and concluded the similarity between them.

Greaves and Stopher (2000) generate synthetic data and estimated similar models with local travel survey data. Mohammadian et al. (2010) generated synthetic household travel survey data and made comparisons with the actual data. They concluded a very good fit between simulated and actual data. Stakhovych (2010) offered Bayesian Spatial Factor Analysis which is an extension of the heterogeneous confirmatory factor model. This research is based on Monte Carlo simulations with synthetic data and resulted estimation of the BSFA model performs very well on synthetic data.

Based on this information and restrictions as a small population, time and cost, this dissertation considers synthetic data based on simulating the actual data. After the collection of sampled survey data, Monte Carlo Simulation in IBM SPSS Statistics. Monte Cargo simulation samples values at random from the input probability distributions. After thousands of iteration, a probability distribution of possible outcomes is estimated with this method (McCormick and Salcedo, 2017: 54). In this dissertation, the Monte Carlo Simulation is used to create synthetic data. Simulated data is created without a model. The closest fitting distribution is fitted based on the actual data. B, C, D and E fields in the questionnaire are included in the simulation model. C14, C16, D24, D26, D36, D44, E6, E18, E24 were chosen uniform distribution, respondent's variable was chosen categorical distribution and other variables were chosen triangular distribution. This fitting is automatic distribution fitting based on actual data.

After this simulation process, the explanatory factor analysis has been conducted. KMO was found as 0.773. Barletss' 0.000. A total of 23 sets of factor groups were obtained through the factor analysis of simulated data and the factors extracted explain 78.209 % of the variation in the data. It is inferred that the sections in the dataset tend to be grouped in the same factors. Therefore, factor analysis was applied with real data to each group separately.

One of the aims of this part is to investigate the relationships and structure between demand variables of domestic dry cargo shipping demand of Turkey. Explanatory factor analysis was used to reach this aim. Steps and explanations regarding the factor analysis are shown in Table 70.

Table 70. Steps and Explanations of the Factor Analysis

Steps of the Factor Analysis	Explanation of the Factor Analysis
Research Design	Sample size: 60 Number of the variables Section C: 22 variables Section D: 44 variables Section E: 41 variables Scale type: 5 Point Likert Scale
Factor Extraction Method	Principal Component Analysis
Rotation Method	Orthogonal rotation: Varimax
Bartlett's test of sphericity	Section C: .000 Section D: .000 Section E: .000
KMO	Section C: .760 Section D: .734 Section E: .741
Anti-Image Correlation Matrix	Section C: All anti-image correlations are above 0.5 for all variables (Except from C17 that is 0.47 which is close to 0.5) Section D: All anti-image correlations are above 0.5 for all variables Section E: All anti-image correlations are above 0.5 for all variables
Determination of Factor Numbers	Eigenvalues (> 1) are selected. There is no limit on the number of factors.
Total Variance (> %0.60)	Section C: %72.65 Section D: %81.24 Section E: %78.54
Rotated Factor Matrix	Section C: 6 factor groups are obtained Section D: 9 factor groups are obtained Section E: 6 factor groups are obtained
Factor Loads (> 0.4)	Factor loads are above 0.4
Communalities (> 0.5)	Section C: Communalities are above 0.5 Section D: Communalities are above 0.5 Section E: Communalities are above 0.5

Source: Author

Table 71 presents the factor loadings of twenty-two country variables, alpha values that state reliability degrees for each factor groups and as a whole, means and standard deviations of each variable. In this factor analysis, twenty-two variables have been turned into six factor groups. The six factor groupings are stated as follows in order of their reliability;

- Political and legal environment
- Foreign trade
- Trade and investments
- Commodity expenditures
- Energy consumption

- International seaborne trade

These six factor groupings explain %72.65 of the variance of the dataset. The highest factor scores have been found in the variables of import (0.8059), expenditures of building and construction (0.7944) and customer income level (0.7932), wars and political crises (0.7858), and fuel prices (0.7680).

From the perspectives of mean deduced from the responses given to the questionnaire; electricity consumption (4.31), international trade agreements (4.15), commodity prices (4.15), restrictions on foreign trade (4.05) and fuel prices (4.05) have the highest mean values.

In the foreign trade factor group, the highest factor score has been found in the variable of import, while the highest mean has been found in the variable of restrictions of foreign trade. In the political and legal environment factor group, the highest factor score has been found in the variable of wars and political crises, while the highest mean has been found in the variable of the exchange rate. In the trade and investments factor group, the highest factor score and mean has been found in the variable of customer income level. In the energy consumption factor group, the highest factor score has been found in the variable of fuel prices, while the highest mean has been found in the variable of electricity consumption. In the international seaborne trade factor group, the highest factor score and mean has been found in the variable of customs tariffs. In the commodity expenditures factor group, the highest factor score has been found in the variable of expenditures of building and construction, while the highest mean has been found in the variable of commodity prices.

Table 71. Factor Groupings and Factor Scores of Country Variables

Factor Groupings	Alpha	Mean*	Std.	Factor Loadings					
General Reliability	**.922**			**1**	**2**	**3**	**4**	**5**	**6**
Section C									
Foreign Trade	**.836**								
Import		3.8333	1.0278	0.8059					
Export		3.7333	1.0871	0.7675					
Population		3.9333	0.9719	0.7002					
Inflation Rate		3.8333	1.1522	0.6412					
Restrictions on Foreign Trade		4.0500	0.9464	0.6369					
Interest Rate		3.5000	1.2143	0.5572					
Political and Legal Environment	**0.882**								
Wars and Political Crises		3.5000	1.2002		0.7858				
Legal Regulations		3.6500	1.1472		0.7116				
Exchange Rate		3.6667	1.0523		0.6837				
Marine environmental rules		3.6833	0.9998		0.655				
Seaborne trade volume		3.2667	1.1329		0.5633				
Trade and Investments	**0.774**								
Customer income level		3.9500	0.9099			0.7932			
Investments		3.6667	1.1741			0.7567			
Trade value		3.8500	0.0860			0.6275			
Energy Consumption	**0. 743**								
Fuel prices		4.0500	1.0484				0.768		
Electricity consumption		4.3167	0.9295				0.604		
Gross Domestic Product		4.1500	0.8601				0.4769		
International Seaborne Trade	**0.712**								
Customs Tariffs		3.5000	1.0496					0.7396	
Seaborne trade volume		3.4000	0.9242					0.7151	
International trade agreements		4.1500	0.8601					0.5038	
Commodity Expenditures	**0.756**								
Expenditures of building and construction		3.6167	1.2363						0.7944
Commodity prices		4.1500	0.9173						0.5912

Source: Created by the Author based n SPSS 23 outputs

Table 72 shows the factor loadings of forty-four industry variables, alpha values that state reliability degrees for each factor groups and as a whole, means and standard deviations of each variable. In this factor analysis, forty-four variables have been turned into nine factor groups. The nine factor groupings are stated as follows in order of their reliability;

- Transport costs, and ports
- Profits
- Freight market
- Ship recycle market
- New building and second hand market
- Cargo effects
- Shipowner supports
- Regulations
- Distribution channels

These nine factor groupings explain %81.24 of the variance of the dataset. The highest factor scores have been found in the variables of new building prices (0.8524), price of the shipping goods (0.8395) and order book (0.8459), expenditures of shippers (0.8268), and social security premiums of shipping crew that operates under Turkish flag (0.8265) which refers the expenditures of shipowners.

From the perspectives of mean deduced from the responses given to the questionnaire; demand to shipping goods (4.41), freight rates (4.30), substitutes of the domestic dry cargo shipping (road transport, rail transport, etc) and profitability of shippers (4.28), chartering rates and prices at road transport (4.23) and rail and road connections of ports, multimodal transport, and place of the ports (4.21) have the highest mean values. It should be stated that these variables are from the transport costs and ports, profits, and cargo effects factor groups.

In transport costs and ports factor group, the highest factor score has been found in the variable of port tariffs, while the highest mean has been found in the variable of freight rates. In the profits factor group, the highest factor score has been found in the variable of expenditures of shippers, while the highest mean has been found in the variable of profitability of shippers. In cargo effects factor group, the highest factor score has been found in the variable of price of the shipping goods, while the highest mean has been found in the variable of demand to the shipping goods. In the regulations factor group, the highest factor score and mean has been found in the variable of social security premiums of shipping crew that operates under the Turkish flag. In the freight market factor group, the highest factor score has been found in the variable of innovations at the market, while the highest mean has been found in the variable of added value. In the newbuilding and second hand factor group, the highest factor score has been found in the variable of new building prices, while the highest mean has been found in the second hand prices. In the ship recycle market factor group, the highest factor score and mean has been found in the variable of ship demolition volume. In the distribution channels factor group, the highest factor score has been found in the variable of the number of the distribution channels (freight forwarders, brokers), while the highest mean has been found in the restrictions of ports (draft, tonnage ect.). In the shipowner supports factor group, the highest factor score has been found in the variable of SCT incentives in fuel prices, while the highest mean has been found in the VAT at shipping companies that have a Turkish flag.

Table 72. Factor Groupings and Factor Scores of Industry Variables

Factor Groupings	Alpha	Mean*	Std.	Factor Loadings								
General Reliability	**0.967**			1	2	3	4	5	6	7	8	9
Section D												
Transport Costs, and Ports	**0.952**											
Port tariffs		3.9167	1.1831	0.7835								
Efficiency of ports		3.9500	1.1992	0.7706								
Port storage facilities		3.6333	1.0730	0.7099								
Congestion of ports		3.7833	1.2634	0.7064								
Freight rates		4.3000	0.9966	0.6746								
Freight competition		4.0333	1.0245	0.6722								
Prices at road transport		4.2333	1.0793	0.6654								
Number of ports		3.8000	1.1903	0.6375								
Rail and road connections of ports, multimodal transportation		4.2167	1.1061	0.5935								
Non freight competition		3.7667	1.1254	0.5752								
Cargo volume		3.8833	1.0099	0.5224								
Number of the competitors		3.4500	1.1992	0.4537								
Profits	**0.916**											
Expenditures of shippers		4.1000	1.1304		0.8268							
Substitutes of the domestic dry cargo shipping (road transport, rail transport ect.)		4.2833	0.8847		0.7559							
Profitability of shippers		4.2833	1.0099		0.7424							
Expenditures of shipping companies		3.7167	1.1213		0.7377							
Place of the ports (proximity to the industrial facilities)		4.2167	0.9930		0.6249							
Market growth		3.6833	1.0655		0.5881							
Profitability of shipping companies		3.8500	0.9173		0.5759							
Cargo Effects	**0.888**											
Price of the shipping goods		4.1167	1.0906			0.8395						
Value of the shipping goods		3.9833	0.9998			0.7225						
Chartering rates		4.2333	1.0311			0.6984						
Demand to the shipping goods		4.4167	0.9618			0.6251						
Seasonality of the shipping goods		3.8833	1.0430			0.5483						
Transit time		3.9500	1.2132			0.5174						
Regulations	**0.839**											
Social security premiums of shipping crew that operates under the Turkish flag		3.4667	1.2550				0.8265					
Port State Controls		3.3000	1.2662				0.6688					
Security levels of ports		2.8167	1.3715				0.6556					
Number and size distributions of shippers and shipowners		3.4000	1.1527				0.6554					
Qualifications of port personnel		3.3500	1.2598				0.4841					
Freight Market	**0.894**											
Innovations at the market		3.9167	0.0133					0.6357				
Market size		4.0500	0.9816					0.6018				
Added value		4.0833	0.8495					0.5547				
Fleet size		3.8833	0.9222					0.5429				
Investments to the market		3.5333	0.0162					0.5002				
Newbuilding and Second Hand Market	**0.890**											
New building prices		3.3167	1.1422						0.8524			
Order book		3.2667	1.1179						0.8459			
Second-hand prices		3.5333	1.0162						0.7319			
Ship Recycle Market	**0.893**											
Ship demolition volume		3.1500	1.1323							0.8255		
Demolition prices		3.0833	1.1540							0.8201		
Distributions Channels	**0.608**											
Number of the distribution channels (freight forwarders, brokers)		3.5500	1.0484								0.7392	
Restrictions of ports (draft, tonnage, etc.)		3.7833	1.2768								0.5402	
Shipowner Supports	**0.883**											
SCT incentives in fuel prices		4.1167	1.0430									0.6856
VAT at shipping companies that have Turkish flag		4.1333	1.0490									0.5800

Source: Created by the Author based on SPSS23 outputs

Table 73 shows the factor loadings of forty-one company variables, alpha values that state reliability degrees for each factor groups and as a whole, means and standard deviations of each variable. In this factor analysis, forty-one variables have been turned into six factor groups. The six factor groupings are stated as follows in order of their reliability;

- Transport service costs, and quality
- Market share
- Operational safety
- Ship variables
- Competitive management
- Company profits and investment

These six factor grouping explain %78.54 of the variance of the dataset. The highest factor scores have been found in the variables of the class of the ships (0.8687), P&I of the ships (0.8633) and profitability of the shipping companies (0.8410), market share (0.8021), and produce available response alternatives (0.7884) which refers the expenditures of shipowners.

From the perspectives of mean deduced from the responses given to the questionnaire; freight rate (4.36), pricing practices (4.16), service continuity (4.15) and produce available response alternatives (4.11), service rate/ punctuality (4,08) have the highest mean values. It should be stated that these variables are from the transport service costs and quality factor group.

In transport service costs and quality factor group, the highest factor score has been found in the variable of produce available response alternatives, while the highest mean has been found in the variable of freight rates. In the market share factor group, the highest factor score has been found in the variable of market share, while the highest mean has been found in the variable of expertise. In the ship variables factor group, the highest factor score has been found in the variable of the class of the ships, while the highest mean has been found in the variable of market information. In the operational safety factor group, the highest factor score has been found in the variable of safe shipping capabilities, while the highest mean has been found in the variable of supporting damage claim. In the competitive management factor group, the highest factor score has been found in the variable of collaborations and mean has been found in the variable of ability to differentiate and breakdown rate of the ships. In company profits and investment factor group, the highest factor score has been found in the variable of profitability, while the highest mean has been found in the variable of operation costs. It is noteworthy that statements relating to the transport costs and quality, profitability and customer relations management transport have received the highest attributes.

Table 73. Factor Groupings and Factor Scores of Company Variables

Factor Groupings	Alpha	Mean*	Std.	Factor Loadings					
General Reliability	**0.975**			1	2	3	4	5	6
Section E									
Transport Service Costs, and Quality	**0.952**								
Produce available response alternatives		4.1167	1.0266	0.7884					
Ability to respond shippers' expectations		4.0333	0.9736	0.7700					
Giving importance to the shippers' involvement to the dry cargo shipping service		3.7833	0.9930	0.7557					
Creating customer value (offering additional benefits beyond the expectations of shipper)		3.9000	1.1000	0.7009					
Dry cargo type of shipper		3.9500	1.1263	0.6950					
Service continuity		4.1500	0.9884	0.6874					
Pricing policies (cost-oriented, profit-oriented, competitive-oriented ect.)		4.1667	0.9943	0.6526					
Supporting shipper on logistics activities (storage, packaging, ect.)		3.8667	1.1269	0.6316					
Freight rate		4.3667	1.0409	0.6302					
Service rate/ punctuality		4.0833	1.0781	0.6213					
Communication skills		3.7000	1.0939	0.5731					
Place of the shipper		3.5333	1.1566	0.5604					
Shipper or market interface and social interactions		3.7167	1.1213	0.5481					
Efforts to increase demand (promotions /advertising)		3.6333	1.0245	0.5267					
The income of the shipper		3.6667	1.1299	0.4820					
Service quality		4.0000	1.1046	0.4619					
Market Share	**0.936**								
Market share		3.5500	1.1263		0.8021				
Reputation		3.5167	1.1570		0.7115				
Financial status of the shipper		3.6667	1.1299		0.6793				
Sales quantity		3.6500	1.1323		0.6616				
Period of payment of shipper		3.8167	1.1273		0.6301				
Expertise		4.0500	1.1263		0.6029				
Tonnage of the ships		3.7167	1.0906		0.5533				
Ship Variables	**0.887**								
Class of the ships…		3.3000	1.1394			0.8687			
P&I of the ships…		3.2833	1.0906			0.8633			
Qualification of the personnel		3.5000	1.0969			0.6852			
Regular ship repair and maintenance		3.4667	0.9649			0.6327			
Market information		3.7500	1.1878			0.6091			
Financial status		3.2333	1.1103			0.5588			
Operational Safety	**0.920**								
Safe shipping capabilities		3.4333	1.0635				0.7255		
Risk management capabilities		3.7000	1.1244				0.7187		
Condition of the hatches		3.7333	1.0393				0.6541		
Supporting on damage claim		3.9167	1.1243				0.5576		
Competitive Management	**0.873**								
Collaborations		3.7000	0.8694					0.7338	
Ability to differentiate		3.7167	0.9930					0.7226	
Break down rate of ships		3.7167	1.0266					0.5915	
Innovativeness		3.6167	1.1061					0.5774	
Company Profits and Investment	**0.824**								
Profitability		3.4167	1.1243						0.8410
Investment		3.3833	1.0266						0.6748
Operation Costs		3.7833	1.0750						0.6464

Source: Created by the Author based on SPSS23 outputs

4.3.5.6.4. Reliability

The reliability of the Likert type scale questions of the research is processed by calculating Crombach Alpha value. Table 74 shows the Crombach Alpha value of the five Likert scale questions regarding the domestic dry cargo shipping demand from the perspectives of macro external, micro external and company environments.

Table 74. Reliability Analysis of the Questionnaire

Part of the Questionnaire	Number of the Variables	Crombach Alpha Value
Section C	22	0.922
Section D	44	0.967
Section E	41	0.975

Source: Created by the author based on SPSS 23 outputs

As seen in Table 72, Crombach alpha values are regarded as satisfactory (Loewenthal and Lewis, 2001: 12). These high-reliability values of the study indicate high internal reliability.

4.3.5.6.5. Binary Logistics Regression Model for Domestic Dry Cargo Shipping Demand

To investigate the relative contributions of the factors to domestic dry cargo shipping demand, the binary logistics regression model is developed. “Increase in domestic dry cargo shipping” is used as a dependent variable, while “factor scores” obtained through the factor analysis are used as independent variables. The results of the field study provided these data.

The average expectation rate of share of domestic (cabotage) dry bulk cargo handlings for 2023 stated by the respondents, which appeared to be 6.65%, is used as a basis for the dependent variable. The groupings are considered as “expectations below 6” and “expectations as 6 and above”.

Backward LR tests have been applied to the variables and thirteenth best-fitted one has been chosen. To measure the usefulness of the model R^2 table is used. The closer the values of R2 to 1, the better the fit of the model (Sreejesh, 2014: 225). Table 75 presents the results and the values of the Nagelkerke R^2 are considered. The value of 0.542 indicates that the model explained 54.2 percent of the variation and useful for predicting observations.

Table 75. Model Summary

Step	-2 Log likelihood	Cox & Snell R^2	Nagelkerke R^2
13	49.343[b]	.399	.542

Source: Created by the Author based on SPSS23 outputs

The Hosmer–Lemeshow test is a goodness of fit test and p-value computed from the chi-square distribution (Hosmer and Lemeshow, 2013: 160). This test recommended for the sample size greater than 400 and it is unlikely to detect deviations from the logistic model (Bewick, 2005: 117). Large Chi-square values (and correspondingly small p-values) indicate a lack of fit for the model (Sreejesh, 2014: 225). Although, relatively large chi-square value and small p-value found in 13[th] model than the other models, the results of the Hosmer–Lemeshow test results ($\chi 2 = 11.306$, 8 degrees of freedom, $p = 0.185$) which is a $P > 0.05$ indicate that the goodness of fit is satisfactory and suggests that the accepted model has satisfactory predictive value.

The omnibus test of model coefficients is another validity method of the model. In this case, the Chi-square value reached statistical significance and it is deduced that the model with independent variables is significantly better than the constant only model.

Table 76. Domestic Dry Cargo Shipping Market Forecast Model

Variables	B	S.E.	Wald	Sig.	Exp(B)
Foreign trade	-1.417	0.581	5.951	0.015*	0.242
Energy consumption	-1.537	0.697	4.862	0.027*	0.215
International Seaborne Trade	-1.094	0.496	4.865	0.027*	0.335
Profits	1.446	0.610	5.621	0.018*	4.247
Cargo Effects	2.978	0.954	9.746	0.002*	19.647
Ship Recycle Market	-.945	0.492	3.696	0.055**	0.389
Distribution Channels	1.361	0.601	5.122	0.024*	3.898
Transport Service Costs and Quality	-1.036	0.573	3.270	0.071**	0.355
Operational Safety	-1.260	0.613	4.229	0.040*	0.284
Constant	0.924	0.400	5.336	0.021*	2.519

*Significant values in confidence interval of 95%
**Significant values in confidence interval of 90%

Source: Created by the Author based on SPSS23 outputs

From the above obtained model, following domestic dry cargo shipping demand equation is proposed:

$$y = 0.924 - 1.417*F - 1.537*E - 1.094*I + 1.446*P + 2.978*C - 0.945*S + 1361*D - 1.036*T - 1.260*O \quad (24)$$

y	Domestic dry cargo shipping demand increase
F	Foreign Trade
E	Energy consumption
I	International seaborne trade
P	Profits
C	Cargo effects
S	Ship recycle market
D	Distribution channels
T	Transport service costs and quality
O	Operational safety

According to Table 76, the participants who think that foreign trade has an important role in domestic dry cargo shipping demand are 0.24 times less likely to agree that domestic dry cargo shipping demand will increase 8% than those who do not agree. The participants who think that energy consumption has an important role in domestic dry cargo shipping demand are 0.21 times less likely to agree that domestic dry cargo shipping demand will increase 8% than those who do not agree. The participants who think that international seaborne trade has an important role in domestic dry cargo shipping demand are 0.33 times less likely to agree that domestic dry cargo shipping demand will increase 8% than those who do not agree. The participants who think that ship recycle market has an important role in domestic dry cargo shipping demand are 0.38 times less likely to agree that domestic dry cargo shipping demand will increase 8% than those who do not agree. The participants who think that operational safety has an important role in domestic dry cargo shipping demand are 0.28 times less likely to agree that domestic dry cargo shipping demand will increase 8% than those who do not agree.

In contradiction to the above-mentioned variables, the participants who think that profits have an important role in domestic dry cargo shipping demand are 4.24 times more likely to agree that domestic dry cargo shipping demand will increase 8% than those who do not agree. The participants who think that cargo effects have an important role in domestic dry cargo shipping demand are 19.64 times more likely to agree that domestic dry cargo shipping demand will increase 8% than those who do not agree. The participants who think that distribution channels have an important role in domestic dry cargo shipping demand are 3.89 times more likely to agree that domestic dry cargo shipping demand will increase 8% than those who do not agree.

4.3.5.7. Field Study: Findings and Discussion

This part of the dissertation presents the determinants of domestic dry cargo shipping and proposes a model for domestic dry cargo shipping demand. The determinants obtained from the literature review and qualitative study have been used to develop the domestic dry cargo shipping demand questionnaire. After developing the questionnaire form, this instrument is used in the field study to model the relationships. Following the data collection process, statistical analysis, factor analysis, and the binary logistics regression model are presented.

In the 11th Strategic Development Plan of Turkey, Logistics and Transportation part indicated the share of cabotage shipping to total loaded and unloaded cargo as 12.8% in 2018. The plan constitutes a forecast for this share as 18% for 2023. The share of domestic (cabotage) dry cargo transportation is calculated as 6%, and it is 8% for 2023. In the research it is deduced that respondents are neutral to this forecast rate presented by 11th Development Plan. It is appeared that respondents are not expecting considerable increase in the share of domestic dry cargo shipping. The results of the field study are more conservative that produced by 11th Development Plan.

In search for the importance of variables effective in the domestic dry cargo shipping demand in Turkey the variable of “demand for shipping goods” is found as having the highest mean among all asked determinants. “Electricity consumption”, “freight rates”, “substitutes of the domestic dry cargo shipping”, “profitability of the shippers” are the other following variables. It has appeared that the variables that are especially related to the cargo are perceived as effective determinants for domestic dry cargo shipping.

When comparative analysis is considered, it is concluded that the industry groups have different perspectives on the effects of “export”, “inflation rate”, “interest rate”, “unemployment” and “ship demolition volume”, “P&I of the ships” on domestic dry cargo shipping demand.

It is observed that transport costs, cargo effects, and profits factor groups are the prominent factors groups in terms of having the highest means and factor scores. These groups are referred to as cost, sales and profit as well and these are the main future demand prediction terms (Wright, 2004: 94) and reflecting market conditions (Moutinho and Chien, 2008: 108). The importance of the micro external environment on domestic dry cargo shipping and Porter’s Five Force Approach also appeared in this field study. Prominent variables as “rail and road connections of ports, multimodal transport”, “prices at road transport”, “substitutes of the domestic dry cargo shipping” from the prominent factor groups as “transport costs and ports”, “profit” points out especially threat of substitutes. Similarly, another prominent variable “freight rates” points out rivalry among existing competitors, “order book” points out threats of new entrant, and “demand for shipping goods” and “expenditures of shippers” points out the bargaining power of buyers and “new building prices” and “port tariffs” point out the bargaining power of suppliers.

It is observed that transport service costs and quality, profitability and customer relationship management are effecting issues of domestic dry cargo shipping. The importance of the cost, quality, and profitability is obviously for industries. Along with these issues, CRM is a competitive advantage tool for the shipping industry as well (Yang and Nguyen, 2011: 6525). As suggested by Fotiadis and Vassiliadis (2017: 347), shipping companies are needed to focus on customer relationship management (CRM) procedures. It has appeared that CRM has effects on domestic dry cargo shipping. Customer relationship management provides developing higher relationships, understanding customers and creating more value to customers (Kotler and Armstrong, 2018: 141).

According to the findings of the domestic dry cargo shipping model, the demand increase heavily depends on cargo effects, profits and distribution channels. These model variables point out the marketing mix. Product is regarded as cargo effects, price is regarded as profits, and the place is regarded as distribution channels. It is deduced that the increase in these variables increases domestic dry cargo shipping demand. Moreover, the negligence of the promotion oriented culture of the domestic dry cargo shipping industry has revealed.

It has appeared that any decrease in foreign trade especially import, export, and restrictions on foreign trade result in increases in domestic dry cargo shipping. It is perceived that decrease of energy consumption such as fuel prices and electricity consumption results with an increase in domestic dry cargo shipping. Decrease of operational safety as supporting damage claim, conditions of the hatches, risk management capabilities result with an increase in domestic dry cargo shipping.

When the two of the analysis results of (1) factor analysis and (2) binary logit regression are considered, there are only two different issues (1) CRM and (2) operational safety that attracts attention. The findings of the factor analysis associated with prominent issues such as; foreign trade, international seaborne trade, commodity prices, energy consumption, transport costs, profitability, cargo effects, quality, ports, and CRM. However, along with these issues, only the direct effect of CRM has not been observed in developed domestic dry cargo shipping demand models. Moreover, the operational safety factor has not been regarded as one of the prominent issues in terms of the means and factor scores. This deduction indicates that the assigned importance to the operational safety underestimated by the industry stakeholders.

4.3.6. RESEARCH FINDINGS AND DISCUSSION

The quantitative part of this dissertation has focused on developing and benchmarking ex-post forecast models for domestic dry cargo shipping demand. These models have been based on macro-economic variables as proposed by the literature. Export, import, commodity prices, commodity sales volumes, IPI, exchange rate are the variables that are used while developing models. Developed models were benchmarked and it was demonstrated that ARIMA models and LSTM models provided promising forecasts. Forecasting literature in shipping markets constitutes different findings on the best performing models. For instance, Xiao (2016) and Xie et al. (2013) found that SARIMA outperformed than benchmarked single models. Mostafa (2004) concluded that ANN forecast more accurately than ARIMA. As consistent with our findings, Chan et al (2018) proposed that machine learning approaches may not present a better performance than traditional forecasting methods.

After this quantitative research, there is a need to find out more specific market information and variables. Domestic dry cargo shipping of Turkey is a challenging market that has geographical characteristics both domestic and global terms and industrial characteristics. Due to this complex nature and environment, through the qualitative study many influencers of demand are identified. Alongside the variables, some problems were also pointed out. The higher age and the technical deficiency of the coaster fleet, the need for acquiring a younger fleet and for increasing the tonnage and lack of demand to the domestic transport of Turkey, that were mentioned by Dalkanat (2001) are still valid. These problems are reached in this study as well. Policies regarding these problems are required.

Some scholars pointed development of domestic shipping in different country cases. Brooks and Frost (2004) presented problems against the development of short sea shipping as port interfaces, transit time, demand, seasonality, the extra cargo handling costs, and institutional rules. These challenges are reached in this dissertation as well along with the regional problems. Competitive road transportation, ship surplus, higher freight rates, exchange rates, the aged fleet are found challenges to the development of domestic dry cargo shipping in Turkey. Brooks and Frost (2004) offered coordination and cooperation between road transport and shipping instead of competing. This strategy implies that the multimodal transportation can be implemented and should be further investigated for the possible areas in Turkey. Recently, Brooks and Wilmsmeier (2017: 39) offered full access to cabotage markets for promoting domestic shipping at Chilean ports, subsidy applications to establish a coastal feeder and access by international container shipping lines to carry their empty equipment for repositioning. These perspectives can also be considered as further growth of domestic shipping services. To increase domestic dry cargo shipping, following key policy options are offered by this study: increase in usage of multimodal transportation, increase of inspections of road transportation, faster handling, cooperation between shipowners, serving with younger ships and overcoming ship surplus. Special attention should be given to the inland waterways and feasibility studies and promoting activities to increase inland waterway shipping in Turkey should be regarded. This result was also consistent with the suggestions from Servantie (2016) that integrates TINA and VIKING projects with the Sakarya River Transport Project.

Field study presented the effecting variables of domestic dry cargo shipping demand and models this relationship between variables. While developing the domestic dry cargo shipping demand model, foreign trade, energy consumption, international seaborne trade, profits, cargo effects, ship recycle market, distribution channels, transport service cost and quality, and operational safety variables were used. These variables were deduced from the factor analysis results.

As a result of these three researches, models were complemented which aims to present much more details of the nature of the domestic dry cargo shipping demand. The generated models from the qualitative study and field study are complemented and the results supported with the qualitative study. By the way, the models validate each other. Following findings are the results of the complementing the models.

Cargo effects appear as the most influencing variable of domestic dry cargo shipping demand. Similarly, Tambakis (1984) had found the demand for shipping goods as the main determining factor for world seaborne trade. The importance attributed to the cargo effects variable has been validated by every one of the conducted three studies. Demand to the shipping goods has the highest mean under this factor group and it is also mentioned by the experts at the qualitative study. Qualitative study and field study have indicated that demand for these commodities affects the demand for the domestic shipping services that are specified as the derived demand. The value of shipping goods affects the determination of the mode choice indicated by two studies. Price of these commodities, which has the highest factor load under the cargo effects factor group, found in the quantitative study as well. Prices of the shipping commodities and related commodities were used while developing forecasting models. The seasonality of the shipping goods is another key factor classified under the cargo effect factor group. Seasonality is an important pattern that should be considered while developing domestic shipping demand models.

“Profits” were encountered as another key variable for domestic dry cargo shipping demand. This variable supported the cargo effects variable. “Profits” variable includes profitability and expenditures of shippers, substitutes, market growth. All these variables indicated high competition at the market which is one of the highly referred topics of the qualitative study as well. Place of the ports was another key determinant of domestic dry cargo demand. This determinant was mentioned in the qualitative study as well. The proximity of the industrial facilities increases the demand for domestic shipping while decreasing expenditures of shippers.

Distribution channels were the direct influencers of domestic dry cargo shipping demand. As obtained from the qualitative study, generally specific ports were loading and unloading domestic cargoes. The ship recycle market was found as affecting variables at the domestic dry cargo shipping demand model. The qualitative study has indicated that the ships serving at the domestic shipping are generally aged ships and ship demolition volume and demolition prices directly influence the decision of shipowner on recycling ship. Ship demolition volume and prices are one of the used variables at shipping forecast models. Above mentioned highly influencing variables were all micro external environmental variables.

Transport service cost and quality determinant include freight rates which is one of the most mentioned variables in qualitative study. Freight rates are one of the most important expenditures of shippers and this variable is also associated with profits. Therefore, it is the income of the shipowner. The freight rate is affecting domestic shipping demand as cheaper freight increases the demand. At this point, competition with the substitutes in terms of freight becomes prominent.

Operational safety is found as an effective variable at domestic shipping demand. This variable was not referred to by qualitative and quantitative studies. Here, the negative effect of operational safety is associated with the aged ships. Transport service cost and quality and operational safety variables are company variables and indicate the selection factors of shipowners.

International seaborne trade, foreign trade, and energy consumption are macro variables. Moreover, foreign trade and energy consumption variables are mostly used variables while modelling shipping demand. Custom tariffs and domestic dry cargo shipping have a positive relationship. If custom tariffs are increasing, as well as domestic shipping is expected to increase.

Before developing the domestic dry cargo demand model, the foreign trade variable was expected to have more effect on it. The reason is that demand models are generally based on foreign trade figures due to the ease to collect them. In this study, foreign trade mainly includes export, import, and restrictions on foreign trade. Export and import variables are used in the quantitative study as well. These variables were one of the most mentioned issues in the qualitative study. Moreover, the importance of this variable is associated with current issues. The effect of trade wars between the US-China is observed from the respondent's perceptions at both qualitative study and field study. Trade wars as mentioned in the qualitative study have significant impacts on the shipping industry. Restrictions that are exposed by trade wars such as increased custom tariffs at some specific commodities increases domestic shipping.

Energy consumption is another variable that is mostly encountered at the demand forecasting models. The reason for this popularity is the undeniable effect of fuel prices on the shipping industry. The utmost importance of fuel prices is revealed by the qualitative study as well.

From the findings conducted through the studies, it is deduced that cargo effects have the highest effect on domestic dry cargo shipping and it is used in the shipping demand forecast models as well. Foreign trade, energy consumption, and ship recycle market numbers are mostly encountered variables at shipping demand forecast models. However, other most influencing variables as profits, distribution channels, transport service costs and quality, international seaborne trade and operational safety have been neglected by the shipping demand models.

CONCLUSIONS

Increasing road congestion, environmental concerns, multimodal transportation intensifies the domestic shipping need. There is a global increasing trend of shifting transport modes from road to sea. Countries are promoting this movement by developing short sea projects. Several scholars pointed out barriers, challenges, opportunities, and strategies to increase short sea shipping. Therefore, recently, cabotage policies are under investigation and attempts to reveal strategies to increase domestic shipping have increased. In parallel with this movement, there is a need for investigation of the current demand for domestic shipping and future projections.

In order to develop strategies and projects on increase in the domestic shipping, initially market environment and conditions should be well understood. Therefore, this dissertation aims to reveal the current demand of domestic dry cargo shipping, find out the demand variables and relationships of these variables, and to develop forecast models for future projections.

First, demand variables are deduced from the literature review. Then ex-post forecasting models for cement, slag, copper, steel and iron-loaded at Black Sea Ports of Turkey are developed using ARIMA models, LSTM, NARX, MLP and hybrid ARIMA-MLP models. Exports, imports, prices of the commodities and related commodities, sales of the commodities and related commodities, IPI, exchange rate are used as variables while developing the models. Developed models are benchmarked and ARIMA models and LSTM models are provided promising forecasts. However, the significances of the model performances do not present differences. Thus, it is proposed to develop these forecasting models case by case and one should not be considered as an outperforming model.

The qualitative study part aimed to provide insights on the market and reveal additional and specific industrial variables that are not issued before in the forecasting demand models. Fuel prices, freight rates, age of the ships, high competition in the market, exchange rates, trade wars, location of the trader are found as the highlighted issues.

After identifying the industry specific variables, another contribution of this study is investigated. By conducting a field study, it is aimed to reveal relationships between variables and develop a model for domestic dry cargo shipping demand. Variables are grouped by factor analysis. 6 factor groups from macro variables, 8 factor groups from micro variables and 6 factor groups from company variables are deduced. Macro variables are grouped in political and legal environment, foreign trade, trade and investments, commodity expenditures, energy consumption, international seaborne trade variables. Micro variables are grouped in transport costs, and ports, profits, freight market, ship recycle market, new building and second hand market, cargo effects, shipowner supports, regulations and distribution channels. Company variables are classified into transport service costs and quality, market share, operational safety, ship variables, competitive management, and company profits and investment.

According to the perceptions of respondents micro variables such as demand for shipping goods, freight rates, substitutes of the domestic dry cargo shipping (road transport, rail transport ect.) and profitability of shippers are perceived as the most effeective variables. Variables of export and import, which are mostly used variables in shipping demand models, are not regarded as one of the most effective variables. GDP, which is another frequently encountered variable in literature, has been emphasized more by the respondents.

Based on the results of the factor analysis, binary logistics regression model has been developed to model the domestic dry cargo shipping demand. It is indicated that foreign trade, energy consumption, international seaborne trade, profits, cargo effects, ship recycle market, distribution channels, transport service costs and quality, operational safety are the determinants of domestic dry cargo shipping demand. According to this model; *an increase or a decrease in domestic dry cargo shipping demand depends on the cargo, profitability and expenditures of shipper, number and efficiency of the distribution channels, foreign trade, profitability, expenditures and service quality of the shipowners, ship recycle numbers, fuel prices, substitutes, and operational safety and it is the sum of macro, micro and company determinants.*

Eventually, developed models from the quantitative study and field study are complemented and the results supported with the qualitative study. By the way, models developed by the second hand and first hand data complemented and significant contributions obtained from this complementing.

ACADEMIC IMPLICATIONS

This dissertation has several contributions and implications to the literature in both industrial marketing literature and shipping demand forecast literature. As far as the comprehensive literature that includes Ph.D. dissertations and international academic journals has been reviewed, this is the first study that used NARX and LSTM at the shipping industry demand forecast. Performances of these models and benchmarks are contributed to the literature. Shipping forecast literature generally issues the freight rate forecasts and specific port traffic forecasts. There are limited studies focusing on broader geographic areas and this dissertation developed models for shipping demand forecast of broader geographic areas.

In terms of forecasting model development, a clear cut process is presented. It is recommended to the researchers that bootstrap tests should be applied in order to reveal the significances of the accuracies of the developed models. It is concluded that finding out best performed forecasting model changes according to the dynamics and environment of the industries. Therefore, more than one forecasting model should be developed to get accurate forecasts and provide a crosscheck.

Through this study additional variables that are not encountered at the shipping demand and forecast literature and industrial marketing demand and forecast literature are explored in terms of domestic dry cargo shipping. Along with these variables, current issues, encountered problems and key policy options are presented. These findings have enabled a unique contribution toward finding out industry specific variables and dynamics.

The main contribution of this dissertation is to offer a model and provide empirical evidence to the determinant variables which explain the relations of domestic dry cargo shipping demand. Moreover, the international shipping demand forecast literature has, from a theoretical point of view, formulated and estimated demand functions in general without considering the micro and company variables. The determinants as profits, distribution channels, transport service costs and quality, international seaborne trade and operational safety should be used by other shipping demand forecast models. It is proposed that the figures related to these determinants should be considered collected and stored for future research purposes. Therefore, new models can be developed using these variables.

Another contribution of this dissertation is to the industrial marketing literature. The importance of the derived demand concept for the survival of the industries has been emphasized by providing an empirical evidence, from the domestic dry cargo shipping market to explain the derived demand concept in industrial markets.

PRACTICAL IMPLICATIONS

Shippers, shipowners, policy makers, ports, brokers, agencies, suppliers and external stakeholders can be regarded as parties to be evaluated as practitioners. Policy makers can benefit from this dissertation, particularly in the comparison of the expected domestic dry cargo shipping volumes, uses of choosing accurate forecasting models, choosing related variables and collecting related data for forecasting the demand. Shipowners, brokers, agencies, ports and suppliers may benefit from the presented current environment and issues at the domestic dry cargo shipping and use the presented process of shipping demand forecast.

Carrying out a pre-interview and a detailed analysis of macro and micro external environment of domestic dry cargo shipping may provide a picture of domestic dry cargo shipping to the shipowners, brokers, agencies, ports and suppliers. Moreover, current loading and unloading volumes were presented to get detailed information about the current demand. These insights may be useful for shipowners, brokers, agencies, ports and suppliers to observe the current demand. A clear cut way of formulating shipping demand was presented and the process may be useful for accurately formulating shipping demand for the shipowners. Development and benchmarking models enable shipowners to choose which models to use.

The field study emphasized the increase in domestic dry cargo shipping demand by considering Turkey's 11th Development Plan for the period 2019-2023. In 11th Strategic Development Plan of Turkey, Logistics and Transportation part indicated the share of cabotage shipping to total loaded and unloaded cargo as 12.8% at 2018. The plan constitutes a forecast for this share as 18% for the 2023. In the light of this information, the share of domestic (cabotage) dry cargo transportation is calculated as 6%, and it is 8% for 2023. This dissertation's answer to the "how much the share of the dry cargo handled in domestic (cabotage) shipping will be for 2023 in total handling?" question is a result that can be useful for policy makers and investors and industry stakeholders. Moreover, this study presents a more conservative forecast when compared with the prediction in the 11th Development Plan of Turkey. This difference in forecasts indicates another important implication for the industry. While preparing development plans, in addition to trend analysis on ex-post data, decision makers may perform corresponding field studies among industry actors to collect their predictions. In this manner, more accurate forecasts can be obtained by combining first hand and second hand data. Besides, industry actors can follow a similar way while developing their plans.

As stated earlier, there is a high and complex competition environment at the industry. Therefore, this dissertation presented highly emphasized variables from the points of view of the contracting parties of domestic dry cargo shipping. Shipowners may consider these variables such as freight rate, pricing practices, service continuity and producing available response alternatives and service rate/ punctuality as a source of competitive advantage.

LIMITATIONS AND FURTHER STUDIES

This research has several limitations, and some of them can be considered for future research. First of all, the quantitative research, ports of the Black Sea, Turkey's data with only 167 observations as a monthly basis is used while developing demand forecast models. Data form wider and varied data, yearly or quarterly time horizons can be used in the future research. While developing models, combinations of variables were manually chosen, for further researches selection of used variables can be utilized by variable selection methods. Furthermore, hyperparameters are manually tuned as well, developing soft computing methods with an optimization grid and different learning algorithms can contribute to the forecasting ability of shipping markets. There is no right way to find out input combinations for the developed hybrid model. Evolutionary algorithms or other classification algorithms can be used to select these combinations. For the future researches hybridized models by soft computing methods and also hybridized models by both the time series and soft computing methods should be investigated. The accuracy metric that is suitable for shipping demand should also be investigated.

Second, for qualitative research geographic constraints related to the applications area can be specified. The results and findings can be regarded as valid for these areas. Therefore, further studies may include a wider geographic area. Another limitation of this study was related to the data used for the analysis. The data is collected only from 17 semi-structured interviews. The theoretical saturation was considered being reached and field study data would be useful in terms of data triangulation and the findings of this study mostly validated by the results of the field study.

As for the field study, geographic constraints and a limited population should be noted since the existing limited number of domestic dry cargo shipping actors of Turkey have been targeted. These constraints can be expanded for further researches. Future studies may involve different stakeholders from a different profile and discover the differences in terms of variables' influences on domestic dry cargo shipping.

The field study showed "ship demolition" as an effective variable for domestic dry cargo shipping. Moreover, shipping demand forecast literature uses figures of four shipping markets in a variety of studies. Further studies are required to include the effects of these markets in developing the demand models.

This study as a whole focused on specific routes and types of cargo. Further studies are required to investigate new routes and cargo types. This may provide comparison of the variables used. Accordingly, comparative studies can be realized for other dry bulk cargoes and geographic scopes.

The special focus of this study lies in the industrial marketing aspects and other functions of businesses are not considered. For the further researches the effects of other business functions such as finance, operational aspects or functions related with the organizational and managerial functions should be regarded.

Although many methods can be used for forecasting demand in industrial marketing literature, little attention has focused on usage of different methods. For further studies, combination of qualitative and quantitative studies would contribute to the industrial marketing literature.

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APPENDIX 1. Forecast results of the domestic cement loaded at Black Sea Ports

Date	Cement	Forecast_ARMAX	Forecast_MLP	Forecast_LSTM	Forecast_NARX	Forecast_Hybrid
2017-07	50607	46218.6	53510.01	30114.13	50502.69	42520.72
2017-08	46927	50738.9	57427.52	33320.6	42631.96	39691.9
2017-09	35090	49710.2	52600.6	31335.35	52761.46	41976.44
2017-10	51936	53874.1	60953.14	35434.73	47860.55	47703.82
2017-11	55358	53996.9	58702.93	35320.9	44374.57	42157.8
2017-12	59857	54265.5	59095.18	33385.21	53115.78	45046.47
2018-01	29612	44976.2	45804.38	33375.11	58920.83	39656.62
2018-02	41046	46160.6	48422.75	32375.04	43901.32	45097.55
2018-03	57057	52937.1	58648.55	35322.01	42436.46	43937.12
2018-04	62348	56025.1	64961.78	38498.32	52599.88	47645.55
2018-05	84764	56649.5	59802.87	41578.45	63061.28	54219.87
2018-06	51780	53812.9	50844.86	41806.61	78961.54	55557.3
2018-07	69248	58218.9	59268.98	42293.31	67769.01	68084.2
2018-08	56475	54890.7	52083.52	40216.77	58722.59	58333.29
2018-09	50058	52718.1	46895.54	42131.07	64356.33	55767.08
2018-10	53240	53424.3	47698.88	44354.07	56224.1	55052.07
2018-11	44374	49031.4	37824.76	43330.54	53460.2	46351.36
2018-12	44115	46520.4	32666.53	42640.84	52692.65	44442.45

APPENDIX 2: Forecasts results of the domestic slag loaded at Black Sea Ports

Date	Slag	Forecast_ARIMAX	Forecast_MLP	Forecast_LSTM	Forecast_NARX	Forecast_Hybrid
2017-07	28250	31916	28167.2	23063.2	37690.58	30719.61
2017-08	29150	26189.1	34283.2	23153.3	35899.27	44467.8
2017-09	13100	18746.7	29755.1	23236.8	19101.79	13390.32
2017-10	19602	19780	28653.5	22601	23110.19	18179.08
2017-11	24050	20201.7	27359.2	22367.8	29139.2	13375.97
2017-12	10500	19636.3	18358.5	22550.6	21396.34	16676.3
2018-01	24650	17258	29665.4	24933.6	17633.26	15686.28
2018-02	38300	18540.8	31553.7	27105.8	35845.87	11546.75
2018-03	49846	19907.6	36042.9	21877.2	41025.27	22681.17
2018-04	57600	20201.2	31701.9	27583	35247.28	31026.5
2018-05	40830	21804.6	52890	24321.5	42020.51	38676.4
2018-06	37415	21919.4	36812	27444.6	27921.63	41542.2
2018-07	23000	21725.1	42709	21891.6	45435.65	20335.22
2018-08	28830	20525	38488.2	29119.4	25038.52	21195.91
2018-09	38310	20379.5	33987.7	28559.3	36016.86	14407.08
2018-10	18025	20052.6	37547.1	22235.5	32944.78	20048.53
2018-11	41870	19570.7	34690.9	27570.9	23410.89	28456.95
2018-12	30350	17736.2	21625.1	22169.7	40799.94	10552.64

APPENDIX 3: Forecasts results of the domestic copper loaded at Black Sea Ports

Date	Copper	Forecast_ARX	Forecast_MLP	Forecast_LSTM	Forecast_NARX	Forecast_Hybrid
2017-07	27150	27861.1	21923.5	26377.7	23751.16	40987.8
2017-08	48900	29196.6	24587.2	22984.6	23196.66	39740.3
2017-09	29600	24105.8	22325.9	19249.4	23943.79	36093.3
2017-10	20550	23938.9	23465.1	20429.6	25249.24	29651.5
2017-11	33669	22199.5	25882.7	19867.8	25207.74	35251.1
2017-12	31250	28251.7	25819.1	22501.4	27142.56	35125.23
2018-01	14850	26954.2	24318.2	21211.7	28247.04	28745.08
2018-02	18450	25750.6	22606.6	15875.6	26744.95	30082.41
2018-03	21900	25529	23929.1	19646.6	24007.37	27865.91
2018-04	40125	20699	23917.4	20028.9	26328.85	19039.83
2018-05	25275	24732.3	27367.4	29431.7	27719.51	38552.1
2018-06	20550	24707.4	22594.1	20667.9	27907.49	27376.81
2018-07	28100	24945.9	29594.4	29204.5	30342.55	40093
2018-08	30900	23836.4	13005.1	24428.8	30952.01	29178.28
2018-09	30825	28555.4	23081	33479.9	32539.59	38040.34
2018-10	30625	29079.3	37143.8	33400.5	35423.07	45002.7
2018-11	30800	30439.9	39897.2	28188.8	35097.8	47869
2018-12	30800	29185.9	36361.2	20594.4	33837.26	41567.4

APPENDIX 4: Forecasts results of the domestic steel loaded at Black Sea Ports

Date	Steel	Forecast_ARMAX	Forecast_MLP	Forecast_LSTM	Forecast_NARX	Forecast_Hybrid
2017-07	41254	39542.6	34267.1	37356.3	36472.95336	61293.7
2017-08	19590	39130.4	29997.7	31855.2	34717.51463	60496.1
2017-09	25410	34140.7	32575.4	35248.6	24645.29812	32034.79
2017-10	33708	30631.3	37262.4	32590.3	23747.423	33011.68
2017-11	33616	31263.8	31780.3	28817	32307.54128	41126.54
2017-12	46333	31866.4	30017.5	26847.5	34601.66384	38566.1
2018-01	35805	30868.8	27229.9	22393.6	40686.78372	52117.2
2018-02	39448	30964.9	28701.2	25632.9	37468.0143	38870.85
2018-03	33700	28814.3	35139.8	22329.2	38273.06088	41968.1
2018-04	34720	25340.6	29924.3	21326.7	35726.39988	31869.81
2018-05	26948	23783.1	26331.9	20942.4	32283.94228	29600.72
2018-06	10260	25611.9	23790.4	20238.6	28249.98817	24433.03
2018-07	22170	25852.8	16405.8	19575.4	17422.88715	13886.2
2018-08	19008	26608.2	25415	20586.6	24909.99918	19854.19
2018-09	20186	26625.8	18478.4	19606.4	25319.65548	20449.87
2018-10	19739	27827.4	17899.2	19646.9	27262.44615	19867.98
2018-11	26159	33317.1	21255.4	19542.3	29415.64332	25251.37
2018-12	49007	35309.5	30231.5	19780.5	34511.14623	34104.29

APPENDIX 5: Forecasts results of the domestic iron loaded at Black Sea Ports

Date	Iron	Forecast_ARMAX	Forecast_MLP	Forecast_LSTM	Forecast_NARX	Forecast_Hybrid
2017-07	11400	11745.6	14782.1	12617.4	26583.9	26705.7
2017-08	2750	5955.86	14162.3	12839.7	14064.82	3739.2
2017-09	10415	6089.44	15415.7	13104.1	5135.346	10629.71
2017-10	12809	10142.8	17474.4	13516.6	10229.52	6502.73
2017-11	16990	16354.2	18690.5	14391.8	10432.32	10289.16
2017-12	19858	18737	17740.9	14567.7	11167.54	20743.77
2018-01	19975	15975.5	19070	15489.5	15207.27	17442.55
2018-02	16410	15079.8	17706.9	14966	13473.07	14623.51
2018-03	23450	20444.6	19260.3	15259.9	18844.57	21317.05
2018-04	19055	11436.9	22494.6	16003.9	18140.04	10056.36
2018-05	9300	12093	25423.8	17240.8	14633.75	12102.61
2018-06	22225	7292.49	24645.6	16829.7	9190.652	4482.13
2018-07	37008	16061.4	25232.8	17055.1	19724.23	18673.59
2018-08	21797	14020	23579.9	16579.4	30246.08	15027.92
2018-09	26381	21798.8	26351.4	17830.5	29761.15	23877.82
2018-10	23140	23139.5	26313.2	18255.9	21918.21	29130.62
2018-11	37830	38205.3	17986.6	15460.1	25142.71	34954.51
2018-12	34841	48847.8	16015.4	14135.3	34814.55	56879.04

APPENDIX 6: Shapiro-Will and Jarque-Bera Normality Test Results

Variable	Jarque Bera test for normality	Shapiro-Wilk test for normality
Cement	p value: 0.0023	p value: 0.0002
Cement (log)	p value: 0.3238	p value: 0.3994
Sales	p value: 0.0470	p value: 0.0022
IPI (Cement)	p value: 0.0717	p value: 0.006
Export (Cement)	p value: 0.005	p value: 0.000
Import (Cement)	p value: 0.1482	p value: 0.1185
Slag	p value: 0.0204	p value: 0.0040
Slag (square root)	P value: 0.6541	P value: 0.8023
IPI (Slag, Copper, Steel)	p value: 0.0097	p value: 7.8769
Export (Slag, Copper)	p value: 0.4292	p value: 0.0375
Import (Slag, Copper)	p value: 0.0702	p value: 0.0363
Iron	p value: 3.0844	p value: 2.0359
Steel	p value: 0.3153	p value: 0.3575
Steel (log)	p value: 0.1229	p value: 0.2472
Copper	p value: 0.0010	p value: 0.0001
Copper (square root)	p value: 1.311	p value: 2.8600
Price (Copper)	p value: 0.1074	p value: 0.0040
Exchange Rate	p value: 0.0000	p value: 5.7957
Export (Steel)	p value: 0.0000	p value: 0.0000
Import (Steel)	p value: 0.0205	p value: 0.0860
Price (Steel)	p value: 0.0864	p value: 0.0046
CPI	p value: 0.0019	p value: 0.0000
Iprice	p value: 0.0001	p value: 5.3502
Crude	p value: 0.0054	p value: 4.0640

APPENDIX 7: Descriptive statistics of the variables used for the forecasting of domestic shipping

Variable	Count	Mean	Std	Min	Max	Skew	Kurtosis
Cement	168	48404	17178	16760	107110	0.659673	0.162991
Sales	168	626203	211823	4650	973878	-0.45545	-0.21237
IPI (Cement)	168	88.5	19.4	45	127	0.143847	-0.80786
Export (Cement)	168	181806	51808	65567	286271	-0.49583	-0.72446
Import (Cement)	168	32600	8101	14061	59648	0.267645	0.565953
Slag	168	5200	12995.52	30979.77	70760	0.525	-0.1381
IPI (Slag, Copper, Steel)	168	59.16	14.4	88.65	114.72	-0.2542	-1.0287
Export (Slag, Copper)	168	14158.41	39445.15	90370.45	205157.5	-0.041	-0.4629
Import (Slag, Copper)	168	5855.32	39563.81	80553.11	228303.1	0.408	0.3698
Iron	168	1	22957.82	25161.79	106350	1.1083	0.9425
Steel	168	1750	11727.6	30592.42	65281	0.2748	-0.1505
Copper	168	18831.97	11474.74	1	58040	0.597843	0.812392
Price (Slag)	168	6515.983	1543.3	3071.98	9867.6	-0.344074	-0.391042
Exchange Rate	168	2.155357	1.044517	1.17	6.37	1.684668	2.774495
Export (Steel)	168	745128.79	275019.24	277192.82	1993513.92	1.702119	5.109908
Import (Steel)	168	1287909.71	450537.28	207401.65	2860550.85	0.240262	0.746045
Price (Steel)	168	86.18	19.24	50.63	126.26	0.108818	-0.796102
CPI	168	211.53	70.98	114.49	401.27	0.648981	-0.338591
Iprice	168	101.67	43.23394	40.5	197.12	0.684522	-0.82957
Crude	168	75.04	24.05816	29.78	132.83	0.29158	-1.070379
Buildings	168	105.80	10.43	78.5	130.1	-0.208997	-0.403841

APPENDIX 8: Unit root test results of the variables

Variable	Level (ADF)	Level (P-P)	First Difference (ADF)	First Difference (P-P)
Cement	-2.159 (4)	-7.121 (14)***	-10.546 (3)***	-
Sales	-1.604 (11)	-7.653 (14)***	-11.789 (10)***	-
IPI (Cement)	-1.564 (13)	-2.889 (14)**	-2.887 (11)**	-
Export (Cement)	-2.347 (14)	-3.195 (14)**	-3.053 (13)**	-
Import (Cement)	-4.736 (1)***	-7.682 (14)***	-	-
Slag	-1.643 (12)	-6.829 (14)***	-6.343 (11)***	-
IPI (Slag, Copper, Steel)	-2.209 (12)	-2.169 (14)	-2.260 (11)	-13.379 (14)***
Export (Slag, Copper)	0.068 (2)*	-5.351 (14)***	-	-
Import (Slag, Copper)	-2.609 (7)*	-13.379 (14)***	-	-
Iron	-1.918 (13)	-10.711 (14)***	-5.750 (9)***	-
Steel	-4.523 (3)***	-9.421 (14)***	-	-
Copper	-4.959 (0) ***	-7.868 (14) ***	-	-
Price	-3.179 (0)***	-2.740 (14)**	-	-
Exchange Rate	4.551 (14)	3.289 (14)	-3.388(11)*	-7.899(14)***
Export (Steel)	-3.660 (2)***	-3.679 (14)***	-	-
Import (Steel)	-3.925 (3)***	-3.432 (14)*	-	-
Price (Steel)	-2.677 (1)*	-2.522 (14)*	-	-
CPI	3.310 (5)	5.145 (14)	-2.936 (4)**	-8.596 (14)***
Iprice	-2.360 (1)	-2.184(14)	-7.931 (1)***	-8.355 (14)***
Crude	-2.712 (1)*	-2.164 (14)	-	-2.212 (14)
Buildings	-2.363 (14)	-8.306 (14)***	-1.903 (13)	-

Note:*, ** and *** represent statistical significance at the 10%, 5%; and 1% level, respectively. Trend and intercept are added according to statistical significance in the model.

- First differencing has not been applied due to data is stationary at level.

APPENDIX 9. Data Collection Tool of Qualitative Study in English

Factors Affecting Domestic Dry Cargo Shipping Demand: Semi-Structured Interview Questions

This form is presented to your valuable interest to reveal the status of domestic dry cargo shipping at Turkey and investigate the role of the contracting parties at this market. The collected information will help us to organize an extensive field research. Thank you for your support.

Demand for Domestic Dry Cargo Shipping

1. What are the current issues in domestic dry cargo shipping market?
2. How do you expect these effects to change over the next period (within 2 years) and how will this change affect dry cargo shipping?
3. What are the reasons for preferring domestic dry cargo shipping? What are the competitive power of domestic dry cargo shipping?
4. Could you please evaluate the overall condition (size, type, number, age, technological status) of the ships providing service in domestic dry cargo shipping and explain the effects of these on the demand?
5. What are the weakest aspects of domestic dry cargo shipping compared to other types of transportation? Why?
6. What might be the challenges for domestic dry cargo shipping in the next period (within 2 years)? By which policies and strategies should be followed to overcome these challenge?
7. What should be done to increase the demand for domestic dry cargo shipping?

Shipping Companies' Effects On Domestic Dry Cargo Shipping

8. Which factors of shipping companies have effect on domestic dry cargo shipping?
9. How these factors affect domestic dry cargo shipping, please evaluate (Location of establishment, ships, services process, transit time, safety of shipping, ship personnel, land personnel, financial structure, costs, freights, communication facilities, customer service, logistics services storage, environmental awareness, social responsibility, innovation etc.)?

Shippers' Effects On Domestic Dry Cargo Shipping

10. Which factors of shippers' have effect on domestic dry cargo shipping?
11. How these factors affect domestic dry cargo shipping, please evaluate (Type of cargo, cargo volume, origin and destinations, delivery time, technical specifications, financial structure, costs, demands / requests of customers, etc.)

Ports' Effects On Domestic Dry Cargo Shipping

12. Which factors of ports' have effect on domestic dry cargo shipping?
13. How these factors affect domestic dry cargo shipping, please evaluate (Place of establishment, port capacity, handling equipment, loading and unloading operations, logistics services storage activities, automation, road and rail connections, port tariffs, communication facilities, etc.)

Respondent Information Form:

Gender: □Male □Female
Education: □PhD □Master □ Bachelor □High School
Position in this company: …………………………..
Period of employment in this company: …………………………..

Company Information Form:

Company Name: ……………………
Year of Company Establishment: ……………………
Place of Company Establishment: ……………………
Basic Services Provided by Company: ……………………
Number of the ships/ Cargo Type: ……………………

APPENDIX 10. Data Collection Tool of Qualitative Study in Turkish

Yurt İçi Denizyolu Kuru Yük Taşımacılığı Talebini Etkileyen Faktörler: Yarı Yapılandırılmış Mülakat Soruları

Türkiye'de kabotaj limanları arasında gerçekleştirilen denizyolu kuru yük taşımacılığının durumunu ve bu taşımacılıkta taşıyanların, taşıtanların ve yükleme-boşaltma limanlarının rolünü araştırmak amacıyla hazırlanan soru formunu değerli ilginize sunmaktayız. Bu soru formuna yanıtlarınız ile elde edilecek olan bilgiler geniş bir saha araştırması düzenleyebilmemiz için bize yardımcı olacaktır. Destekleriniz için teşekkür ederiz.

Yurt İçi Denizyolu Kuru Yük Taşımacılığına olan Talep

1. Yurt içi denizyolu kuru yük taşımacılığının karşı karşıya olduğu güncel konular nelerdir?
2. Bu etkilerin gelecek dönemde (2 yıl içerisinde) ne şekilde değişmesini bekliyorsunuz ve bu değişim kuru yük denizyolu taşımacılığına ne şekilde yansıyacaktır?
3. Yurt içi kuru yük taşımacılığının tercih edilme nedenleri nelerdir? Yurt içi kuru yük taşımacılığının rekabetçi gücü sizce hangi konuda ortaya çıkmaktadır?
4. Yurt içi denizyolu kuru yük taşımacılığında hizmet sunan gemilerin genel olarak durumunu değerlendirip (büyüklüğü, cinsi, sayısı, yaşı, teknolojik durumu) talebe etkisini açıklayınız.
5. Diğer taşıma türleri ile kıyasladığınızda yurt içi kuru yük taşımacılığının en güçsüz yönleri sizce nelerdir? Neden?
6. Gelecek dönemde (2 yıl içerisinde) yurt içi denizyolu kuru yük taşımacılığını nasıl zorluklar beklemektedir? Hangi politika ve stratejiler ile bu zorlukların üstesinden gelinebilir?
7. Yurtiçi denizyolu taşımacılığına olan talebin arttırılması için neler yapılması gerekir?

Yurt İçi Denizyolu Kuru Yük Taşımacılığı Hizmetini Sunan İşletmelerin Talebe Etkisi

8. Hizmet sunan işletmelerin yurt içi denizyolu kuru yük taşımacılığı talebi üzerinde etkisi olduğunu düşündüğünüz faktörleri nelerdir?
9. Bu faktörler talebi ne şekilde etkilemektedir, değerlendiriniz. (Kuruluş yeri, gemiler, taşıma hizmetleri süreci, taşıma süresi, emniyetli taşıma, gemi personeli, kara personeli, finansal yapı, maliyetler, navlunlar, iletişim olanakları, müşteri hizmetleri, lojistik hizmetler depolama, çevre duyarlılığı, sosyal sorumluluk, yenilikçilik vb.)

Taşıtanların Yurt İçi Denizyolu Kuru Yük Taşımacılığı Talebine Etkileri

10. Taşıtanların yurt içi denizyolu kuru yük taşımacılığı talebi üzerinde etkisi olduğunu düşündüğünüz faktörleri nelerdir?
11. Bu faktörler talebi ne şekilde etkilemektedir, değerlendiriniz. (yük cinsi, yük hacmi, sefer başlangıç varış noktaları, teslimat süresi, teknik spesifikasyonlar, finansal yapı, maliyetler, müşterilerinin talepleri/istekleri vb.)

Limanların Yurt İçi Denizyolu Kuru Yük Taşımacılığı Talebine Etkileri

12. Hizmet sunan limanların yurt içi denizyolu kuru yük taşımacılığı talebi üzerinde etkisi olduğunu düşündüğünüz faktörler nelerdir?

13. Bu faktörler talebi ne şekilde etkilemektedir, değerlendiriniz. (kuruluş yeri, liman kapasitesi, elleçleme ekipmanları, yükleme boşaltma operasyonları, lojistik hizmetler depolama faaliyetleri, otomasyon, karayolu ve demiryolu bağlantıları, liman tarifeleri, iletişim olanakları vb.)

Katılımcı Bilgi Formu:

Cinsiyetiniz: □Erkek □Kadın
Yaşınız: ……………….
Eğitim durumunuz: □Doktora □Yüksek Lisans □Lisans □Lise
Bu kurumdaki göreviniz: ………………..
Kurumdaki çalışma süreniz: ……………………

Şirket Bilgi Formu:

Şirket adı: ……………………
Şirket kuruluş yılı: ……………………
Şirket kuruluş yeri: ……………………
Temel hizmetler: ……………………
Gemi sayısı/ Yük cinsi: ……………………

APPENDIX 11. Data Collection Tool of Field Study in English

QUESTIONNAIRE ON INVESTIGATION OF DOMESTIC DRY CARGO SHIPPING DEMAND

This questionnaire will be evaluated for PhD dissertation entitled "Domestic Dry Cargo Shipping Market: Using Models to Develop Forecasts" under the guidance of Prof. Dr. A. Güldem CERİT at Dokuz Eylül University Social Sciences Institute Maritime Business Administration Department. The information obtained within the scope of the research will be used only within the relevant scientific research. The results of this survey will be shared with the participants and company and all specific information provided by the participants will be treated as confidential and results will be presented without reference to individual organizations.

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A. Profile Questions

Education Status: ☐Higher School ☐Bachelor ☐Master ☐PhD
Period of employment in industry: Metin girmek için buraya tıklayın veya dokunun.
Position in the company: Metin girmek için buraya tıklayın veya dokunun.
Year your company began operations: Metin girmek için buraya tıklayın veya dokunun.
How many dry Cargo carrying ships do you have in your company? Metin girmek için buraya tıklayın veya dokunun.
Please specify the tonnage of these ships: Metin girmek için buraya tıklayın veya dokunun.
What are the most used routes at domestic dry cargo shipping in Turkey? Please specify? Metin girmek için buraya tıklayın veya dokunun.

B. Scenario Information and Questions

In 11th Strategic Development Plan of Turkey, Logistics and Transportation part indicated the share of cabotage shipping to total loaded and unloaded cargo as 12.8% at 2018. The plan constitutes a forecast for this share as 18% for the 2023.

B1. In the light of this information, the share of domestic (cabotage) dry cargo transportation is calculated as 6%, and it is 8% for 2023. Do you agree this forecast and increase rate? (Please specify the number that best approximates the extent to which you agree or disagree with the statements below) (**(1) Strongly Disagree, (2) Disagree, (3) Neutral (4) Agree and (5) Strongly Agree**)

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

B2. How much do you expect the share of the cargo handled in domestic (cabotage) dry cargo for 2023 in total handling?

%1☐ %2☐ %3☐ %4☐ %5☐ %6☐ %7☐ %8☐ %9☐ %10☐

C. Effects of Country Variables on Domestic Dry Cargo Shipping Demand

Following statements aim to investigate the effects of country variables to the domestic dry cargo shipping. Please indicate the best option that states your level of agreement.
(1) Strongly Disagree, (2) Disagree, (3) Neutral (4) Agree and **(5) Strongly Agree**

……………………, affects the domestic dry cargo shipping demand of Turkey.	**Strongly Disagree**				**Strongly Agree**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
1. Gross Domestic Product	()	()	()	()	()
2. Export	()	()	()	()	()
3. Import	()	()	()	()	()
4. Restrictions on foreign trade	()	()	()	()	()
5. Population	()	()	()	()	()
6. Inflation rate	()	()	()	()	()
7. Interest rate	()	()	()	()	()
8. Investments	()	()	()	()	()
9. Customer income level	()	()	()	()	()
10. Unemployment	()	()	()	()	()
11. Exchange rate	()	()	()	()	()
12. Wars and political crises	()	()	()	()	()
13. Legal regulations	()	()	()	()	()
14. Marine environmental rules (The Global 2020 Sulphur Limit, Balast Water Management ect.)	()	()	()	()	()
15. International trade agreements	()	()	()	()	()
16. Custom tariffs	()	()	()	()	()
17. Seaborne trade volume	()	()	()	()	()
18. Trade value	()	()	()	()	()
19. Fuel prices	()	()	()	()	()
20. Electricity consumption	()	()	()	()	()
21. Commodity prices	()	()	()	()	()
22. Expenditures of building and construction	()	()	()	()	()
Other (Please specify) …………………………………………………………………					

D. Effects of Industry Variables on Domestic Dry Cargo Shipping Demand

Following statements aim to investigate the effects of industry variables to the domestic dry cargo shipping.
Please indicate the best option that states your level of agreement.
(1) Strongly Disagree, (2) Disagree, (3) Neutral (4) Agree and **(5) Strongly Agree**
.

……………………, affects the domestic dry cargo shipping demand of Turkey.	**Strongly Disagree**				**Strongly Agree**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
1. Demand to the shipping goods….	()	()	()	()	()
2. Price of the shipping goods….	()	()	()	()	()
3. Value of the shipping goods…	()	()	()	()	()
4. Seasonality of the shipping goods….	()	()	()	()	()
5. Transit time….	()	()	()	()	()
6. Number and size distributions of shippers and shipowners...	()	()	()	()	()
7. Market size….	()	()	()	()	()
8. Fleet size….	()	()	()	()	()
9. Added value….	()	()	()	()	()
10. Cargo volume….	()	()	()	()	()
11. Investments to the market….	()	()	()	()	()
12. Innovations at the market…..	()	()	()	()	()
13. Market growth ….	()	()	()	()	()
14. Number of the competitors….	()	()	()	()	()
15. Chartering rates….	()	()	()	()	()
16. Freight rates….	()	()	()	()	()
17. Freight competition….	()	()	()	()	()
18. Non freight competition….	()	()	()	()	()
19. Port tariffs….	()	()	()	()	()
20. Number of ports…	()	()	()	()	()
21. Efficiency of ports…	()	()	()	()	()
22. Restrictions of ports (draft, tonnage ect.)	()	()	()	()	()
23. Congestion of ports…	()	()	()	()	()
24. Security levels of ports…	()	()	()	()	()
25. Port storage facilities…	()	()	()	()	()
26. Qualifications of port personnel…	()	()	()	()	()
27. Place of the ports (proximity to the industrial facilities)…	()	()	()	()	()
28. Rail and road connections of ports, multimodal transportation…	()	()	()	()	()
29. Number of the distribution channels (freight forwarders, brokers)....	()	()	()	()	()
30. Substitutes of the domestic dry cargo shipping (road transport, rail transport ect.)	()	()	()	()	()
31. Prices at road transport…	()	()	()	()	()
32. Order book….	()	()	()	()	()
33. New building prices….	()	()	()	()	()
34. Second-hand prices….	()	()	()	()	()
35. Ship demolition volume….	()	()	()	()	()
36. Demolition prices….	()	()	()	()	()
37. Expenditures of shipping companies....	()	()	()	()	()
38. Profitability of shipping companies….	()	()	()	()	()
39. Expenditures of shippers….	()	()	()	()	()
40. Profitability of shippers….	()	()	()	()	()
41. SCT incentives in fuel prices…	()	()	()	()	()
42. VAT at shipping companies that have Turkish flag….	()	()	()	()	()
43. Social security premiums of shipping crew that operates under Turkish flag ….	()	()	()	()	()
44. Port State Controls….	()	()	()	()	()
Other (Please specify) ……………………………………………………					

E. Effects of Company Variables on the Demand for Shipping Company

Following statements aim to investigate the effects of company variables on the demand for shipping company that operates at domestic dry cargo shipping market. Please indicate the best option that states your level of agreement.
(1) Strongly Disagree, (2) Disagree, (3) Neutral (4) Agree and **(5) Strongly Agree**

……………… of the shipping company that operates at domestic dry cargo shipping market of Turkey affects the company demand.	**Strongly Disagree**				**Strongly Agree**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
1. Market information….	()	()	()	()	()
2. Expertise….	()	()	()	()	()
3. Service rate/ punctuality….	()	()	()	()	()
4. Service continuity….	()	()	()	()	()
5. Service quality….	()	()	()	()	()
6. Class of the ships…	()	()	()	()	()
7. P&I of the ships…	()	()	()	()	()
8. Tonnage of the ships….	()	()	()	()	()
9. Break down rate of ships….	()	()	()	()	()
10. Regular ship repair and maintenance…	()	()	()	()	()
11. Condition of the hatches….	()	()	()	()	()
12. Qualification of the personnel….	()	()	()	()	()
13. Freight rate….	()	()	()	()	()
14. Sales quantity….	()	()	()	()	()
15. Reputation….	()	()	()	()	()
16. Market share….	()	()	()	()	()
17. Investments….	()	()	()	()	()
18. Financial status….	()	()	()	()	()
19. Profitability….	()	()	()	()	()
20. Operation costs….	()	()	()	()	()
21. Collaborations….	()	()	()	()	()
22. Ability to differentiate ….	()	()	()	()	()
23. Innovativeness….	()	()	()	()	()
24. Culture….	()	()	()	()	()
25. Communication skills….	()	()	()	()	()
26. Efforts to increase demand (promotions /advertising) ….	()	()	()	()	()
27. Pricing policies (cost-oriented, profit-oriented, competitive-oriented ect.) ….	()	()	()	()	()
28. Giving importance to the shippers' involvement to the dry cargo shipping service….	()	()	()	()	()
29. Ability to respond shippers' expectations….	()	()	()	()	()
30. Produce available response alternatives….	()	()	()	()	()
31. Creating customer value (offering additional benefits beyond the expectations of shipper) ….	()	()	()	()	()
32. Shipper or market interface and social interactions….	()	()	()	()	()
33. Supporting shipper on logistics activities (storage, packaging, ect.)….	()	()	()	()	()
34. Safe shipping capabilities….	()	()	()	()	()
35. Risk management capabilities….	()	()	()	()	()
36. Supporting on damage claim….	()	()	()	()	()
37. The income of the shipper…	()	()	()	()	()
38. Dry cargo type of shipper…	()	()	()	()	()
39. Period of payment of shipper…	()	()	()	()	()
40. Financial status of the shipper…	()	()	()	()	()
41. Place of the shipper…	()	()	()	()	()
Other (Please specify) …………………………………………………………….					

APPENDIX 12. Data Collection Tool of Field Study in Turkish

YURTİÇİ DENİZYOLU TAŞIMACILIĞI TALEBİNİN İNCELENMESİNE YÖNELİK

ANKET FORMU

Bu anket formu Dokuz Eylül Üniversitesi Sosyal Bilimler Enstitüsü Denizcilik İşletmeleri Yönetimi Anabilim Dalı'nda **Prof. Dr. A. Güldem CERİT** danışmanlığında yürütülmekte olan "**Yurtiçi Kuru yük Deniz Taşımacılığı Pazarı: Model Kullanımı ile Tahmin Geliştirme**" başlıklı doktora tezinin uygulama bölümünde değerlendirilecektir. Araştırma kapsamında elde edilen bilgiler sadece ilgili bilimsel araştırma dahilinde kullanılacaktır. Araştırma sonuçları katılımcılarla paylaşılacak olup şirket ve kimlik bilgileri kesinlikle açıklanmayacaktır. Zaman ayırıp ankete katıldığınız için teşekkür ederiz.

Cemile SOLAK FIŞKIN
Ordu Üniversitesi Deniz Bilimleri Fakültesi
Evkaf Mah. Sahil Cad. No:239/C 52400 Fatsa/Ordu
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F. Katılımcı ve Şirket Profil Bilgileri

Eğitim durumunuz: ☐Lise ☐Lisans ☐Yüksek Lisans ☐Doktora
Sektördeki deneyim süreniz: Metin girmek için buraya tıklayın veya dokunun.
Şirketinizdeki pozisyonunuz: Metin girmek için buraya tıklayın veya dokunun.
Şirketinizin faaliyete geçme yılı: Metin girmek için buraya tıklayın veya dokunun.
Şirketinizde faaliyet halinde kaç adet kuru yük ve genel yük gemisi vardır? Metin girmek için buraya tıklayın veya dokunun.
Şirketinizde faaliyet halindeki gemilerin tonajlarını lütfen belirtiniz. Metin girmek için buraya tıklayın veya dokunun.
Yurt içi kuru yük taşımacılığını en çok gerçekleştirdiğiniz rotalar nerelerdir? Lütfen belirtiniz? Metin girmek için buraya tıklayın veya dokunun.

G. Senaryo Bilgileri ve Soruları

Türkiye'nin 2019-2023 yıllarını kapsayan 11. Kalkınma Planı'nın Lojistik ve Ulaştırma Bölümü'nde kabotaj hattında elleçlenen yükün toplam elleçleme içerisindeki payı 2018 yılı için %12,9 olarak belirtilmiş olup 2023 yılı için de %18 olarak hedeflenmiştir.

B1. Verilen bu bilgiler ışığında, yurt içi (kabotaj) kuru yük taşımacılığının payı % 6 olarak hesaplanmış olup, 2023 yılı için de %8 olarak oranlanmıştır. Belirtilen bu tahminlere ve artış oranlarına katılıyor musunuz? (Lütfen aşağıda katılma derecenizi en iyi ifade eden seçeneği işaretleyiniz. (**(1) Kesinlikle KATILMIYORUM, (2) Katılmıyorum, (3) Kararsızım (4) Katılıyorum** ve **(5) Kesinlikle KATILIYORUM'** u ifade etmektedir.)

1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐

B2. 2023 yılı için yurt içi (kabotaj) kuru yük taşımacılığında elleçlenen yükün toplam elleçleme içerisindeki payının kaç olmasını bekliyorsunuz?

%1☐ %2☐ %3☐ %4☐ %5☐ %6☐ %7☐ %8☐ %9☐ %10☐

C. Ülke Değişkenlerinin Yurtiçi Denizyolu Kuru Yük Taşımacılığı Talebine Etkileri

Aşağıdaki ifadeler, ülke değişkenlerinin yurtiçi denizyolu kuru yük taşımacılığı talebine olan etkisinin araştırılmasını amaçlamaktadır.
Lütfen aşağıda yer alan ifadelere katılma derecenizi en iyi ifade eden seçeneği işaretleyiniz. **(1) Kesinlikle KATILMIYORUM, (2) Katılmıyorum, (3) Kararsızım (4) Katılıyorum** ve **(5) Kesinlikle KATILIYORUM'** u ifade etmektedir.

……………………, Türkiye'nin yurtiçi denizyolu kuru yük taşımacılığı talebini etkiler.	**Kesinlikle Katılmıyorum**				**Kesinlikle Katılıyorum**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
1. Gayri Safi Yurtiçi Hasıla	☐	☐	☐	☐	☐
2. İhracat	☐	☐	☐	☐	☐
3. İthalat	☐	☐	☐	☐	☐
4. Döviz kuru	☐	☐	☐	☐	☐
5. Uluslararası ticaret anlaşmaları	☐	☐	☐	☐	☐
6. Dış ticarete getirilen kısıtlar	☐	☐	☐	☐	☐
7. Gümrük tarifeleri	☐	☐	☐	☐	☐
8. Petrol fiyatları	☐	☐	☐	☐	☐
9. Emtia fiyatları (kömür, demir vb.)	☐	☐	☐	☐	☐
10. Enflasyon oranları	☐	☐	☐	☐	☐
11. Faiz oranları	☐	☐	☐	☐	☐
12. Nüfus	☐	☐	☐	☐	☐
13. Tüketici gelir düzeyi	☐	☐	☐	☐	☐
14. İşsizlik	☐	☐	☐	☐	☐
15. Yatırımlar	☐	☐	☐	☐	☐
16. Elektrik tüketimi	☐	☐	☐	☐	☐
17. İnşaat maliyetleri	☐	☐	☐	☐	☐
18. Ticaretin değeri	☐	☐	☐	☐	☐
19. Deniz taşımacılığının hacmi	☐	☐	☐	☐	☐
20. Savaş ve siyasi krizler	☐	☐	☐	☐	☐
21. Yasal düzenlemeler	☐	☐	☐	☐	☐
22. Denizcilikte çevresel kurallar (kükürt limiti, balast suyu yönetimi vs.)	☐	☐	☐	☐	☐
Diğer (Lütfen Belirtiniz) ……………………………………………………………………….					

D. Endüstri Değişkenlerinin Yurtiçi Denizyolu Taşımacılığı Talebine Etkileri

Aşağıdaki ifadeler, endüstri değişkenlerinin yurtiçi denizyolu kuru yük taşımacılığı talebine olan etkisinin araştırılmasını amaçlamaktadır.
Lütfen aşağıda yer alan ifadelere katılma derecenizi en iyi ifade eden seçeneği işaretleyiniz. **(1) Kesinlikle KATILMIYORUM, (2) Katılmıyorum, (3) Ne Katılıyorum Ne Katılmıyorum (4) Kısmen Katılıyorum** ve **(5)Kesinlikle KATILIYORUM'** u ifade etmektedir.

……………………, Türkiye'nin yurtiçi denizyolu kuru yük taşımacılığı talebini etkiler.	**Kesinlikle Katılmıyorum**				**Kesinlikle Katılıyorum**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
1. Taşınan yüke olan talep….	☐	☐	☐	☐	☐
2. Taşınan yükün fiyatı….	☐	☐	☐	☐	☐
3. Taşınan yükün değeri…	☐	☐	☐	☐	☐
4. Taşınan yükün mevsimselliği….	☐	☐	☐	☐	☐
5. Denizyolu taşıma mesafesi….	☐	☐	☐	☐	☐
6. Yük sahibi ve gemi sahiplerinin sayı ve büyüklük bakımından dağılımları….	☐	☐	☐	☐	☐
7. Yurtiçi denizyolu taşımacılığı pazarının büyüklüğü….	☐	☐	☐	☐	☐
8. Yurtiçi denizyolu taşımacılığı pazarındaki büyüme oranı….	☐	☐	☐	☐	☐
9. Yurtiçi denizyolu taşımacılığı pazarına yapılan yatırımlar….	☐	☐	☐	☐	☐
10. Yurtiçi denizyolu taşımacılığı pazarındaki yenilikler…..	☐	☐	☐	☐	☐
11. Filo büyüklüğü….	☐	☐	☐	☐	☐
12. Sağlanan katma değer….	☐	☐	☐	☐	☐
13. Yükleme boşaltma miktarları….	☐	☐	☐	☐	☐
14. Rakiplerin sayısı….	☐	☐	☐	☐	☐
15. Gemi kiralama fiyatları….	☐	☐	☐	☐	☐
16. Navlun oranları….	☐	☐	☐	☐	☐
17. Navlun rekabeti….	☐	☐	☐	☐	☐
18. Navlun dışı rekabet….	☐	☐	☐	☐	☐
19. Liman tarifeleri….	☐	☐	☐	☐	☐
20. Limanların sayısı…	☐	☐	☐	☐	☐
21. Limanların etkinliği…	☐	☐	☐	☐	☐
22. Limanların kısıtları (draft, tonaj vs.)	☐	☐	☐	☐	☐
23. Limanların sıkışıklığı…	☐	☐	☐	☐	☐
24. Limanlarda güvenlik seviyeleri…	☐	☐	☐	☐	☐
25. Limanlarda depolama hizmetleri…	☐	☐	☐	☐	☐
26. Liman personelinin yetkinliği…	☐	☐	☐	☐	☐
27. Limanların konumu (sanayi alanlarına olan yakınlığı)…	☐	☐	☐	☐	☐
28. Limanların karayolu demiryolu bağlantıları, çoklu taşımacılık olanakları…	☐	☐	☐	☐	☐
29. Dağıtım kanalı üyelerinin (navlun komisyoncuları, brokerlar) sayısı....	☐	☐	☐	☐	☐
30. Deniz taşımacılığı yerine geçebilecek taşıma türleri (karayolu, demiryolu, vb.).	☐	☐	☐	☐	☐
31. Karayolu taşımacılığındaki fiyatlar…	☐	☐	☐	☐	☐
32. Yeni gemi siparişleri….	☐	☐	☐	☐	☐
33. Yeni gemi inşa fiyatları….	☐	☐	☐	☐	☐
34. İkinci el gemi fiyatları….	☐	☐	☐	☐	☐
35. Geri dönüşüme giden gemi tonajı….	☐	☐	☐	☐	☐
36. Gemi geri dönüşüm fiyatları….	☐	☐	☐	☐	☐
37. Denizcilik işletmelerinin maliyetleri....	☐	☐	☐	☐	☐
38. Denizcilik işletmelerinin karlılığı….	☐	☐	☐	☐	☐
39. Taşıtanın maliyetleri….	☐	☐	☐	☐	☐
40. Taşıtanın karlılığı….	☐	☐	☐	☐	☐
41. Yakıt fiyatlarındaki ÖTV indirimleri…	☐	☐	☐	☐	☐
42. Türk Bayraklı gemiye sahip denizcilik işletmelerine uygulanan KDV…	☐	☐	☐	☐	☐
43. Gemi personelinin SGK primleri….	☐	☐	☐	☐	☐
44. Liman Devleti Kontrolleri….	☐	☐	☐	☐	☐
Diğer (Lütfen belirtiniz) …………………………………………………					

E. İşletme Değişkenlerinin Denizcilik İşletmelerinin Talebine Olan Etkileri

Aşağıdaki ifadeler, kuru yük taşımacılığı yapan denizcilik işletmelerinin talebine etkisi olan işletme değişkenlerinin araştırılmasını amaçlamaktadır.
Lütfen aşağıda yer alan ifadelere katılma derecenizi en iyi ifade eden seçeneği işaretleyiniz. **(1) Kesinlikle KATILMIYORUM, (2) Katılmıyorum, (3) Ne Katılıyorum Ne Katılmıyorum (4) Kısmen Katılıyorum** ve **(5)Kesinlikle KATILIYORUM'** u ifade etmektedir.

Türkiye'de yurt içi denizyolu kuru yük taşımacılığı yapan denizcilik işletmesinin ………………., işletmeye olan talebi etkiler.	**Kesinlikle Katılmıyorum**				**Kesinlikle Katılıyorum**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
1. ….pazar bilgisi….	☐	☐	☐	☐	☐
2. ….uzmanlığı….	☐	☐	☐	☐	☐
3. ….hizmet hızı/dakikliği….	☐	☐	☐	☐	☐
4. ….hizmet sürekliliği….	☐	☐	☐	☐	☐
5. ….hizmet kalitesi….	☐	☐	☐	☐	☐
6. ….gemilerinin klası…	☐	☐	☐	☐	☐
7. ….gemilerinin P&I sigortası…	☐	☐	☐	☐	☐
8. ….gemilerinin tonajı….	☐	☐	☐	☐	☐
9. .....gemilerinin arıza yapma sıklığı….	☐	☐	☐	☐	☐
10. ….gemilerinin düzenli bakım tutumu…	☐	☐	☐	☐	☐
11. ….ambarlarının durumu….	☐	☐	☐	☐	☐
12. ….personelinin yetkinliği….	☐	☐	☐	☐	☐
13. ….navlunu….	☐	☐	☐	☐	☐
14. ….satış hacmi….	☐	☐	☐	☐	☐
15. ….prestiji/markası….	☐	☐	☐	☐	☐
16. ….pazar payı….	☐	☐	☐	☐	☐
17. ….yatırımları….	☐	☐	☐	☐	☐
18. …. finansal yapısı….	☐	☐	☐	☐	☐
19. …. karlılığı….	☐	☐	☐	☐	☐
20. ….operasyon maliyetleri….	☐	☐	☐	☐	☐
21. ….oluşturdukları işbirlikleri….	☐	☐	☐	☐	☐
22. ….rakiplerden farklılaşabilmesi….	☐	☐	☐	☐	☐
23. ….yenilikçiliği….	☐	☐	☐	☐	☐
24. ….kültürel yapısı….	☐	☐	☐	☐	☐
25. ….iletişim becerileri….	☐	☐	☐	☐	☐
26. ….talebi arttırmaya yönelik çabaları (tutundurma/tanıtım faaliyetleri) ….	☐	☐	☐	☐	☐
27. ….fiyatlandırma politikaları (maliyete dayalı, karlılık amaçlı, rekabetçi vb.)….	☐	☐	☐	☐	☐
28. ….kuru yük taşımacılığı hizmeti sürecinde taşıtanların katılımına önem vermeleri…	☐	☐	☐	☐	☐
29. ….taşıtanların ihtiyaç ve beklentilerine cevap verebilme yetenekleri….	☐	☐	☐	☐	☐
30. ….taşıtanlara uygun alternatif çözümler üretebilmeleri….	☐	☐	☐	☐	☐
31. ….müşteri değeri yaratması (taşıtanların beklentisinin üstünde ek yararlar sunabilmesi)..	☐	☐	☐	☐	☐
32. ….taşıtan ve pazar ile etkileşimleri ve sosyal ilişkileri….	☐	☐	☐	☐	☐
33. ….taşıtanların lojistik gereksinimlerine destekleri (depolama, paketleme, vs.)…	☐	☐	☐	☐	☐
34. ….emniyetli çalışma yeteneği….	☐	☐	☐	☐	☐
35. ….risk yönetebilme yeteneği….	☐	☐	☐	☐	☐
36. ….hasarların tazminini sağlaması….	☐	☐	☐	☐	☐
37. ….taşıtanlarının satın alma gücü…	☐	☐	☐	☐	☐
38. ….taşıtanlarının yük tipi…	☐	☐	☐	☐	☐
39. ….taşıtanlarının ödeme süresi…	☐	☐	☐	☐	☐
40. …taşıtanlarının finansal yapısı…	☐	☐	☐	☐	☐
41. …taşıtanlarının konumu…	☐	☐	☐	☐	☐
Diğer (Lütfen belirtiniz) …………………………………………………………					