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Slow Steaming and Its Impact on Fruit and Vegetable Exporters in Türkiye[1]

Yavaş Seyirin Türkiye'deki Meyve ve Sebze İhracatçılarınnın Üzerindeki Etkisi

Araştırma Makalesi / Research Article

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Özet

Konteyner taşımacılığı, küresel taşımacılığa daha hızlı, güvenilir ve maliyet açısından daha uygun bir taşıma seçeneği sunmuştur. Ancak 2008 finansal krizi Denizcilik sektörünü sarsmış, konteyner hatlarının yakıt maliyetlerini düşürmek ve aşırı kapasiteyi yönetmek amacıyla gemi hızlarını azaltarak yavaş seyir stratejisini benimsemelerine yol açmıştır. Bu çalışma, yavaş seyrin, meyve ve sebze ihracatçıları üzerindeki etkisini incelemektedir. Karma bir yöntem yaklaşımı kullanılarak yapılan bu araştırma, Türkiye limanlarına hizmet veren konteyner gemilerinin hızlarını değerlendirmiştir. Çalışmada AIS verileri kullanılarak nicel bir analiz yapılmıştır. Ardından, bir konteyner hattının operasyon yöneticisi de dahil olmak üzere meyve ve sebze ihracatçılarıyla görüşmeler yapılmıştır. Bulgular, yavaş seyrin konteyner hatlarının operasyonel maliyetlerini düşürmeye yardımcı olurken, çabuk bozulan ürünlerin ihracatçıları için önemli zorluklar getirdiğini, uzayan transit sürelerinin ürün kalitesini ve pazar rekabetçiliğini olumsuz etkilediğini göstermiştir. Bu zorluklara rağmen, Türkiye'nin meyve ve sebze ihracatı 2010 yılında 1,5 milyar dolardan 2023'te 3,1 milyar dolara yükselerek dayanıklılığı ortaya koymuş, ancak aynı zamanda sevkiyat gecikmelerinin etkili bir şekilde yönetilmesinin kritik önemini vurgulamıştır. Bu çalışma, yavaş seyrin ekonomik açıdan önemli ancak savunmasız bir sektör üzerindeki etkilerini inceleyerek, maliyet etkinliği ile küresel ticarette zamanında teslimat gereksinimi arasındaki dengeyi sağlamaya yönelik olarak politika yapıcılara ve sektör paydaşlarına içgörüler sunarak literatüre katkıda bulunmaktadır.

Anahtar Kelimeler: Yavaş Seyir, Denizcilik İşletmeleri Yönetimi, Uluslarası Ticaret, Stratejik Yönetim.

Abstract

Containerization has transformed global shipping, offering a faster, more reliable, and cost-effective transportation option. However, the 2008 financial crisis disrupted the industry, leading container liners to adopt slow steaming—a strategy to reduce fuel costs and manage overcapacity by reducing vessel speeds. This study examines the impact of slow steaming on Türkiye's fruit and vegetable exporters, whose perishable goods are highly sensitive to shipping delays. Using a mixed-method approach, this research begins with a quantitative analysis of container vessels serving Turkish ports, using the AIS data to assess their operating speeds. This is followed by qualitative interviews with key stakeholders, including an operations manager of a container liner. The author further interviewed fruit and vegetable shippers to understand the impact of slow steaming on their businesses. Findings indicate that while

[1] This article is based on the author's master's degree dissertation.

slow steaming helped reduce operational costs of the container liners, it introduced significant challenges for perishable goods exporters, with longer transit times affecting product quality and market competitiveness. Despite these difficulties, Türkiye's fruit and vegetable exports grew from $1.5 billion in 2010 to $3.1 billion in 2023, demonstrating resilience but also highlighting the critical importance of managing shipping delays effectively. This study contributes to the literature by exploring the effects of slow steaming on a vulnerable yet economically vital sector, offering insights for policymakers and industry stakeholders on balancing cost efficiency with the need for timely delivery in global trade.

Keywords*:* Slow Steaming, Maritime Business Administration, International Trade, Strategic Management.

1. Introduction

The advent of containerisation has reshaped the global shipping industry, making maritime transportation faster, more reliable, and more cost-effective than ever before; containerisation also continues to drive advancements in the industry (İnanli and Yorulmaz, 2021). Compared to traditional methods, such as break-bulk shipping, container shipping is more reliable (Nielsen et al., 2014), cost-effective and time-efficient due to factors such as intermodal transport options and reduced cargo handling times (Ducruet and Itoh, 2021).

For decades, fast and reliable maritime transportation was the hallmark of container liners. However, the 2008 financial crisis disrupted the shipping industry (Porter, 2008), contributing to the supply and demand mismatch and leading the shipping industry to experience a vicious cycle (Howard, 2016; Meyer et al., 2011). In response to the changing economic landscape, container liners were forced to adapt their business models; the traditional focus on rapid cargo delivery was no longer sustainable. Container liners had to review their business models, as rapid cargo delivery was no longer standard practice. As a result, shipping companies began adopting slow steaming[2]- a deliberate strategy to reduce fuel consumption and operate more efficiently, driven by rising costs and excess shipping capacity following the crisis.

The development of slow steaming into a 'new normal' brought several novel challenges to the industry; the novelty of slow steaming introduced uncertainty into business operations (Lee et al., 2015). There were attempts to explore and understand what this 'new normal' had in store for the future of the shipping industry and its stakeholders. For instance, soon after slow steaming's implementation by container liners like Maersk Line and others, several maritime entities like the Federal Maritime Commission (FMC) reached out to shippers around the globe

[2] A common definition of slow steaming is "the operation of a ship at a lower speed than normal one in order to save fuel on ballast voyage or when fuel is expensive" (Babicz, 2015: 568). However, container liners adopted slow steaming despite the inexpensive fuel to further decrease "the capacity supplied in order to assure a more efficient fleet deployment" (Ferrari et al., 2015: 636).

to get a sense of the impact of slow steaming on their businesses. One finding was that the longer sailing duration was one of the novel and challenging issues for the shippers. While FMC reported that shippers raised concerns regarding slow steaming and its negative impact on the transportation of perishable/short life cycle products (Federal Maritime Commision, 2011), this was contrasted with another survey conducted by MAN PrimeServ (2012). One explanation for the different findings could be that the geographical location of the study respondents. Slow steaming was implemented on some shipping routes and later expanded on others (Bonney, 2010).

Despite some contrasting findings, the consequences of container liners' decision to implement slow steaming worldwide were more likely pronounced on the fruit and vegetable exporters given the short life cycle of the items they shipped compared to the non-perishable or long life-cycle cargoes. About the time slow steaming was gaining pace across the globe following the 2008 financial crisis, Türkiye's vegetable and fruit exports amounted to approximately 1.5 billion US Dollars in 2010 and 1.6 billion US Dollars in 2011 (TÜİK, 2012). Since then, Türkiye's vegetable and fruit exports to total exports ratio has increased 1.2% (TÜİK, 2012). The exports amounted around 2.1 billion US Dollars in 2014 and 2015 (TÜİK, 2016) which later increased to approximately 3 billion and 3.1 billion US Dollars in 2022 and 2023, respectively (TÜİK, 2024).

Türkiye's fruit and vegetable exporters, whose perishable goods are highly sensitive to shipping delays, were particularly vulnerable to the longer transit times introduced by slow steaming. Understanding the impact on this critical sector offers key insights into the broader implications of this strategy. Accordingly, this study aims to investigate the impact of slow steaming on a vulnerable group of shippers: the fruit and vegetable exporters. Given the high economic contribution, the experience of fruit and vegetable shippers in Türkiye is the focus of the study. This study seeks to answer two key questions: 1) *To what extent has slow steaming been implemented on container routes serving Turkish ports?* and 2) *What impact has slow steaming had on fruit and vegetable exporters in Türkiye?*

A mixed method design guided the study, where the research design started with a quantitative approach followed by a qualitative inquiry. This mixed-method design allowed for a comprehensive understanding, where the quantitative data provides insight into shipping routes and speeds, while the qualitative interviews reveal the lived experiences of key stakeholders. First, the container vessels that call Turkish ports and their sailing speeds were identified to answer the first research question. The vessel data were gathered from Sea-web™ as the database made identifying the container vessels possible. After that, the AIS data of identified vessels were obtained from the MarineTraffic AIS database. The vessels' operating and service speeds were gathered and analysed.

Second, the focus of the study moved away from the speed of the vessels and the accompanying descriptive analysis findings and changed to the industry stakeholders' experience. Through that, the author was able to 1) triangulate the findings with a leading container liner company's operations manager's experience and 2) inquire into the shippers' experience regarding the impact of slow steaming on their businesses and provide answers to the second research question. A thematic analysis was conducted on the interview data collected from the relevant industry stakeholders, e.g., an operations manager of a container liner and fruit and vegetable shippers. By triangulating vessel data, industry stakeholder interviews, and relevant literature, this study ensures a robust examination of how slow steaming has reshaped the logistics of perishable goods exports.

The study contributed to the literature by offering novel knowledge regarding the container liners' slow steaming practices. Despite extensive research on slow steaming's impact on global trade, its effects on perishable goods exporters—particularly in regions like Türkiye—have been largely overlooked. This study addresses this gap by exploring how slow steaming impacts vulnerable sectors, offering critical insights for both industry stakeholders and policy makers. During the slow steaming expansion period, Türkiye's fruit and vegetable exports grew steadily, from 1.5 billion USD in 2010 to 3.1 billion USD in 2023, indicating the critical role these exports play in the national economy and highlighting the importance of understanding how slow steaming affects this sector.

The following section explores the existing literature on slow steaming and its broader implications for container liners and shippers. The first part of the literature review presents slow steaming from the container liners' perspective. The second part focuses on the shippers, concluding the review by presenting the implications of slow steaming.

2. Literature Review

Slow steaming has been one of the measures that ship operators use to control supply and adapt to varying market conditions (Mason and Nair, 2013). Even before the 2008 financial crisis, slow steaming was a known option for shipping companies (Psaraftis and Kontovas, 2013; Voorde and Vanelslander, 2008). Following the crisis, Maersk Line promoted and applied slow steaming on their container routes (Burnson, 2012). The company further invested in trialling its first slow-steaming kit on the Axel Maersk in late 2009 (Barnard, 2010b). Four years after the financial crisis, slow steaming was a common practice among both container and bulk shipping operators[3] (MAN PrimeServ, 2012); Maersk Line's slow steaming practices were clearly followed by rival liner shipping companies such as CKYH Alliance members (Leach, 2010) and COSCO.

Although the term 'slow steaming' is commonly used in the literature, it serves as an umbrella term covering various levels of slower sailing speeds of the vessels. For instance, consider a ship that sails 24 knots at full speed. In slow steaming mode, it would sail at 21 knots, while in extra-slow and super-slow steaming modes, it would sail at 18 and 15 knots, respectively (Liang, 2014). The slower sailing speeds affect container liners, shippers, and the environment.

Research on slow steaming has slowly increased over the years. Despite this, however, most slow steaming-related studies have focused primarily on topics such as speed optimisation, carrier profitability, voyage cost optimisation (Mallidis et al., 2018), largely overlooking the perspectives of shippers on the matter (Finnsgård et al., 2020). Accordingly, this literature review seeks to provide a more balanced view of the impact of slow steaming on both shippers and carriers. The following section outlines the benefits that container liners gain from implementing slow steaming. This is followed by an examination of the impact of slow steaming on shippers, with a particular focus on fruit and vegetable exporters.

2.1. Impact of Slow Steaming on Container Liners

Several reasons led the container liners to implement slow steaming at a large scale. One reason was the fuel cost savings (MAN PrimeServ, 2012). Considering that fuel costs make up approximately half of the operational costs of some types of vessels (Ferrari et al., 2015), slow steaming was one way to reduce costs. Not long after slow steaming was picked by several other container liners, such as Maersk, CMA CGM and MSC, the container liners saved around $264m yearly on the Asia-Europe route (Nightingale, 2014).

The capacity utilisation benefit was another reason behind container liners' willingness to embrace slow steaming. Slow steaming functioned to reduce the overcapacity issue (Knowler, 2014) by absorbing the oversupply (Faber et al., 2012; Ferrari et al., 2015). To illustrate the function of slow steaming as an overcapacity reduction tactic, by estimation, only Maersk Line

[3] 149 of more than 200 respondents were practising slow steaming by the end of 2011 according to a survey conducted.

itself absorbed more than 220,000 TEU, which equaled 8.5% of its fleet from 2008 to 2012 (Burnson, 2012). Similarly, research by Psaraftis and Kontovas (2015) on the container vessel capacity and slow steaming relationship revealed that the total number of absorbed container vessel capacity was 1.27 million TEU from 2009 until 2013.

The container liners also reported reduced idle/waiting time due to slow steaming. The time spent at ports costs the shipping companies regardless of the type of vessel. Despite the efficiency of container handling efficiency, the container liners are not exempt from idle/waiting time. Several events cause and contribute to idle/waiting time, for instance, port and terminal congestions, terminal operating and weather-related delays, to name a few (Lind et al., 2018). Accordingly, the container liners saw slow steaming as an opportunity to avoid the waiting times at the ports. Maersk Line reported that slow steaming helped avoid port congestion (Barnard, 2010c).

The final benefit of implementing slow steaming was related to the emission levels generated by the seaborne trade (Notteboom, 2012). Between 2008 and 2011, when slow steaming was turning into a ‘new normal’, international shipping accounted for approximately 3% of the global CO2 emissions. More precisely, the contribution of international shipping to global emissions was 3.5% in 2008, 3.1% in 2009 and 2.7% in 2010 (Smith et al., 2014). The observed decrease in shipping emissions from 2008 to 2010 was partly due to slow steaming; a study by Cariou (2011) revealed that 11% of the emissions decrease was due to slow steaming. Fast forward three years, another research by Woo and Moon (2014) revealed that the current voyage speed in application on the Asia-Europe route has already reduced emissions by 90%.

However, not every ship operator implemented slow steaming at the same level, and therefore, the decrease in CO2 emissions varied across the companies and the shipping routes. According to Maloni et al. (2013), slow steaming reduced CO2 emissions by approximately 26.1%, whereas extra slow steaming and super slow steaming accounted for a 43.32% and 46.66% decrease in CO2 emissions, respectively.

In addition to varying sailing speeds, slow steaming was not implemented on all shipping routes at the same level either. In 2010, Alphaliner announced it was becoming a common practice on all strings of the Asia-Europe and trans-Pacific routes, 78% and 53%, respectively (Barnard, 2010a). Regarding the Europe- South America route, slow steaming was implemented in only around 30% of the services (Cheaitou and Cariou, 2012).

As predicted (Tavasszy et al., 2011), slow steaming was picked up by most container carriers and became the new normal (Burnson, 2014; Meyer et al., 2011; Porter, 2015). As a result, this raised quite a few complicated legal and commercial issues (Campbell, 2013). For instance, decreasing bunker prices in 2015 raised questions regarding this practice. Some container liners started easing on slow steaming on some routes (Lin, 2016). Ferrari et al. (2015) described this practice as a strategy for shipping companies, apart from the same old cost leadership they have had. Slow steaming is especially relevant to shipping companies that pursue the cost-focused strategy.[4]

Despite the usefulness of slow steaming for container liners, the practice also raised concerns from the shippers' point of view (Maloni et al., 2013). Since the beginning of slow steaming practices, transit time, schedule reliability, inventory, and freight rates have been shippers' most discussed issues.

2.2. Impact of Slow Steaming on Container Liners

Slow steaming was expected to impact shippers in four areas: transit time, schedule reliability, inventory, and freight rates. While some of these areas were desirable, others were not welcomed by the shippers.

2.2.1. Transit Time

Slow steaming caused longer transit time (Burnson, 2015; Yin et al., 2014). For several reasons, shippers did not welcome longer transit times. First, an increase in shippers' in-transit inventory cost adversely affected their operations (Woo and Moon, 2014) and the whole supply chain (Harrison and Fichtinger, 2013; Woo and Moon, 2014). Second, the time cost of slow steaming through longer transit time was reflected on the shippers in the form of expenses like insurance and interest (Healy and Graichen, 2019). Third, longer transit time could also adversely affect the cargo by decreasing the shelf life. A decrease from 24 knots to 18 knots might potentially decrease the shelf life of a product by a week (Carson et al., 2015).

2.2.2. Schedule Reliability

One of the reasons Maersk Line decided to continue slow steaming was its contribution to the schedule reliability enhancement (Barnard, 2010c). Though, different opinions regarding such alleged enhancement also flourished. For instance, Ronen (2011) discussed slow steaming as a

[4] See Lorange (2001) for their conceptualisation of strategy development in shipping companies, e.g., vision and cost focused strategies.

factor that created schedule flexibility and, as a result, argued that slow steaming provided shipping companies with an opportunity to enhance their schedule reliability. In contrast, Harrison and Fichtinger (2013) stated that although slow steaming can function to boost schedule reliability, this is only possible if the carrier is eager to increase the speed. Research by Hagens (2014) investigated the SS and schedule reliability relationship by analysing one of the shipping routes Maersk Line operates - the Asia-Europe loop. Hagen's (2014) findings showed that the slow steaming implementation increased the schedule reliability on that particular route. However, Hagen (2014) also noted that schedule reliability had been one of the main goals of Maersk Line. This indicated that the relationship between slow steaming and enhanced schedule reliability cannot be claimed without taking other factors into account, e.g., strategic and marketing-related decisions have an influence on how container liners offer services. Lee et al. (2015) followed suit, supporting the previous findings and asserting that slow steaming functioned as a contributing factor in reducing the undesired impact of schedule irregularities on port arrival times, which enhanced service quality.

2.2.3. Inventory

Despite the benefits of slow steaming for the container liners, the tables appeared to turn for the shippers as slow steaming caused shippers extra inventory costs (Van Elswijk (2011). Htutt (2014) examined the impact of slow steaming on shippers' inventory levels, concluding that the practice led to an increase in inventory to meet customer demand. Additionally, the just-in-time inventory system and safety stocks of the shippers were heavily affected by slow steaming. Another research undertaken by Maloni et al. (2013) noted that the shippers with higher-value cargo, in comparison to the shippers whose cargo value is lower, endure increased investment in pipeline inventory. Thus, they ascertained that the incremental pipeline inventory costs are insignificant for the low-value cargoes. For high-value cargoes, the cost rises (Maloni et al., 2013).

2.2.4. Freight rates

Freight rates have been the most discussed issue since the beginning of slow steaming (Bonney, 2011a, 2011b). APL (Leach, 2011) announced in 2011 that it would introduce a new calculation method that would also demonstrate the impact of slow steaming. But it was only exclusive to trans-Pacific trade. Along a similar vein, Notteboom and Cariou (2013) looked into any potential impact of slow steaming on fuel surcharges, concluding that the bunker adjustment factor as a revenue-making strategy was stronger on some routes and weaker on others. They also noted that there was not a gap between the actual fuel costs the companies paid and the bunker adjustment factor they presented to their customers due to the necessity of more vessels operating to provide the weekly services. Beyond the immediate financial implications, slow steaming has attracted the attention of regulatory bodies such as the Federal Maritime Commission due to its broad impact on the shipping industry.

2.3. Inquiries on Container Liners' Slow Steaming Implementation

While the financial implications of slow steaming have been extensively discussed, regulatory bodies like the Federal Maritime Commission have also raised important inquiries into its broader impacts. In 2011, the Chairman of the Federal Maritime Commission announced that the impact of slow steaming was planned to be assessed (Edmonson, 2011). The commission sought public comments regarding the impact of slow steaming on the operation of the shipping companies, the international supply chains of the shippers, the cost/or prices of the ocean liner services and greenhouse emissions (Federal Maritime Commision, 2011).

Despite ocean carriers benefiting financially from slow steaming, these gains were not shared with shippers. The practice led to longer transit times, higher inventory costs, and container shortages, negatively impacting supply chains, especially for perishable goods. Opinions on the availability of faster shipping services varied; while some respondents reported no alternative faster options, others noted that services without slow steaming were available.

Another notable investigation related to the impact of slow steaming on the shippers was conducted by CENTRX, BDP International and St. Joseph's University (2011). In the research, they asked the shippers if their supply chain had been affected by slow steaming. 90% of the respondents stated that it had been affected. The other question asked to shippers revealed that most affected aspect of their business was inventory levels which was followed by customer service and production scheduling. The regional distribution of the respondents indicates that Europe and the Middle East were the most affected regions in terms of cash flow, while the Asia-Pacific region was most impacted in terms of customer service.

2.4. The Impact of Slow Steaming on Shippers and Perishable Goods

Two recent studies produced unique findings due to their focus. First, recognizing the emphasis typically placed on carriers' perspectives regarding slow steaming, Finnsgård et al. (2020) investigated its impact on shippers. Their study included shippers from different industries, e.g., fashion retailer, equipment manufacturer, home furnishing retailer, and revealed that the shippers experienced longer transit times, lower freight rates and increased inventory costs. Most participants emphasised the importance of higher reliability and increased speed levels for their businesses. Some participants reported they were willing to pay higher freight rates for faster services. While Finnsgård et al. (2020) offered fresh insights into the shippers' experience of slow steaming, none of the case studies were primarily involved in perishable good transportation. Second, Vakili et al. (2023) reviewed the slow steaming-related research pointed out the scholarly research indicating the while slow steaming can reduce operational costs, it also results in longer lead times within the supply chain. Preliminary findings also revealed that the cost reduction achieved through slow steaming were unevenly distributed among maritime stakeholders. Shipping companies were the primary beneficiaries of substantial cost savings; however, these savings were not consistently passed on to shippers.

Nowadays, countless products and services are produced, transported and consumed internationally, and their supply chains are increasingly time-sensitive (Nagurney et al., 2013). As illustrated, one of the effects generated by slow steaming is longer transit times. According to De Langen (1999), different goods have various value-of-time, which, as a result, generates a different degree of willingness to pay for shorter transport time. Increased transport duration establishes not only inventory but also depreciation costs, which include the spoilage of the goods (Hummels and Schaur, 2012).

The common difficulty of fresh produce is that product value declines crucially over time in the supply chain since they are highly vulnerable to temperature and humidity (Blackburn and Scudder, 2009). In their research, Vanek and Sun (2008) describes the product p of agricultural material (Please refer to Figure 1). In the figure it is illustrated that, grown agricultural raw material is moved to a food processing plant and after that transported to retailer as a final product. Once the product is purchased before its expiration date, it completes its life cycle successfully. Otherwise, the product is directed to a disposal facility and the product's life cycle, in this case, wasted.

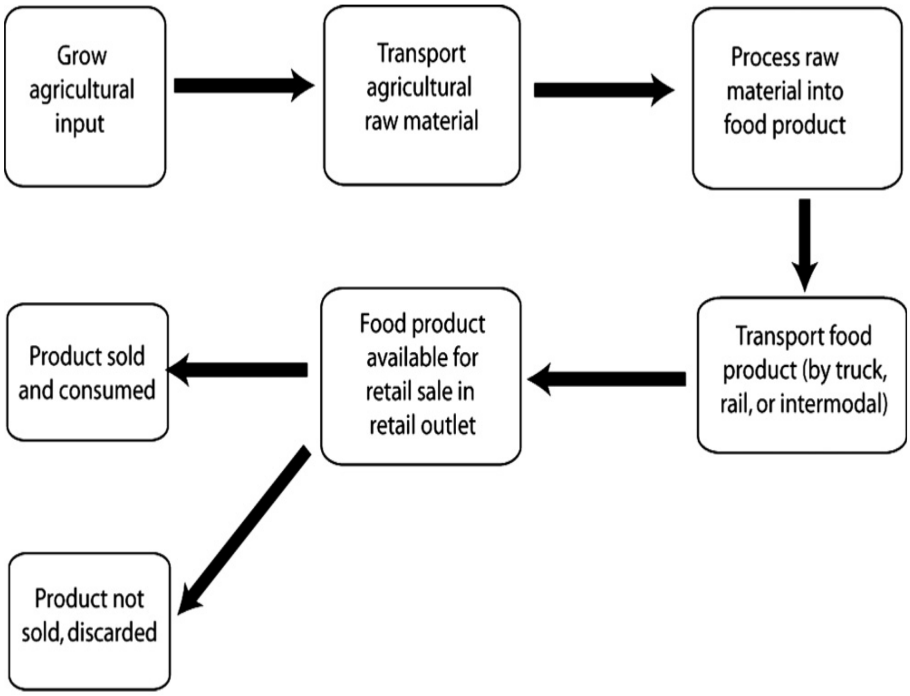

Figure 1: Flowchart of food product movements
Source: Reproduced from Vanek and Sun (2008)

The Federal Maritime Commission's (FMC) inquiry allowed shippers express their concerns. Several respondents such as National Chicken Union and Tyson Foods raised concerns about the impact of slow steaming on perishable/ short life cycle products. The FMC's survey results contrasted with of MAN PrimeServ (2012) which reported that shippers were not concerned about the transportation of perishable goods.

The impact of slow steaming received attention from academics and researchers. Many aspects of its effect have been researched both from carrier's and shipper's perspectives. It is still widely applied to seaborne trade and as stated by the shipping companies and academics, slow steaming is here to stay.

Abovementioned longer transit times raised several concerns from the shippers' side, especially regarding perishable good transport. Since slow steaming in liner shipping was relatively a new application, academic work regarding the effect of it on the transportation of perishable goods is absent (Karampampa, 2014; Maloni et al., 2013). Therefore, the status of sailing speeds and its impact on the perishable good shippers are investigated in this study. Interviews provided additional insights to the study by including the perishable good shippers' experience as well as the container liners' perspectives on the issues. Given the limited research on the specific impact of slow steaming on perishable goods, this study aims to fill that gap by investigating how Turkish exporters of fruits and vegetables have been affected. The insights from both container liners and shippers will provide a holistic understanding of the broader implications of this practice.

3. Method

This study is aimed to answer the following research questions:

1. To what extent has slow steaming been implemented on container routes serving Turkish ports?
2. What impact has slow steaming had on fruit and vegetable exporters in Türkiye?

Given that these questions encompass both the physical and social dimensions of shipping, a mixed-methods approach was selected to offer a comprehensive understanding of the phenomenon. Specifically, the first research question addresses the quantifiable, physical aspect of shipping (vessel speeds), while the second question focuses on the social impact of these operational changes on stakeholders.

This dual focus draws from both positivist and constructionist epistemologies (Crotty, 1998; Thorpe et al., 2021), thereby justifying the use of a mixed-methods approach. Mixed method designs expand the research extensively and thoroughly (Morse, 2003: 195) as they combine the qualitative and quantitative approaches (Creswell et al., 2003: 152). Consequently, this study employed a sequential explanatory design, carried out in two distinct phases. The quantitative method provides a foundational understanding of the research problem, while the qualitative approach offers a nuanced exploration and interpretation of the results, ultimately addressing the research questions.

3.1. Quantitative stage

The sampling process began by selecting appropriate container terminals in Türkiye. First, ten container terminals with the highest container throughput were identified based on the TÜRKLİM (2024) report. Ambarli ranked highest, handling 3,444,926 containers followed by Mersin, Kocaeli, Gemlik, Izmir, Aliaga, Antalya, Iskenderun, Istanbul, and Samsun. For the identification of liner operators, Alphaliner (2016) top 30 report was consulted (see Table 1).

Table 1. Alphaliner Top 30 Container Operators/Liners

Rank	**Operator**	TEU	Ships
1	APM-Maersk	3,194,051	624
2	Mediterranean Shg Co	2,784,251	491
3	CMA CGM Group	2,310,505	528
4	COSCO Container Lines	1,562,611	287
5	Evergreen Line	959,381	188
6	Hapag-Lloyd	914,873	163
7	Hanjin Shipping	611,682	98
8	Hamburg Süd Group	610,554	119
9	OOCL	578,703	104
10	Yang Ming Marine Transport Corp.	570,440	103
11	UASC	541,146	56
12	MOL	520,908	83
13	NYK Line	494,766	95
14	Hyundai M.M.	435,523	60
15	K Line	379,594	66
16	Zim	349,320	77
17	PIL (Pacific Int. Line)	346,763	137
18	Wan Hai Lines	235,920	94
19	X-Press Feeders Group	138,902	89
20	KMTC	122,349	60
21	IRISL Group	100,580	48

[1] This article is based on the author's master's degree dissertation.

22	SITC	89,632	71
23	Arkas Line / EMES	81,917	47
24	TS Lines	73,622	39
25	RCL (Regional Container L.)	54,902	29
26	Quanzhou An Sheng Shg Co	53,888	43
27	OEL / Shreyas (Transworld Group)	52,150	32
28	Simatech	51,639	18
29	Zhonggu Shipping	49,152	42
30	Grimaldi (Napoli)	46,547	42

Source: Alphaliner (2016)

After identifying the container operators, the author reviewed their port schedules on their websites, focusing on the top ten container terminals in Türkiye where data was available. Port schedule information was successfully obtained from Maersk Line, CMA CGM, COSCO Container Lines, Evergreen Line, Hapag-Lloyd, Hamburg Süd Group, Hanjin Shipping, OOCL, Yang Ming Marine Transport, UASC, Mitsui O.S.K. Lines, Hyundai Merchant Marine Co., ZIM Integrated Shipping Services Ltd, Pacific International Lines Pte Ltd, and Sea Consortium Pte Ltd. However, port schedule was not available on the Mediterranean Shipping Company website, and no relevant information was provided on the websites of NYK Line, K Line, IRISL Group, and Arkas Line. Following this process, a total of 250 container vessels were identified, including 200 non-Turkish vessels and 50 vessels registered in Türkiye.

The Automatic Identification System (AIS) is a self-operating device that transmits ship data, such as the ship's name and type (IMO, 2009). In this study, AIS data gathered by shore-based receivers are used instead of satellite-based (S-AIS) systems due to data availability constraints. AIS data were collected via MarineTraffic as it allows users to obtain 60 days of voyage history (Tichavska et al., 2015). This timeframe was sufficient for the purposes of this study. MarineTraffic was selected for its reliability and user-friendly interface, which simplified the data collection process. Unlike other data sources, accessing data from MarineTraffic did not require programming skills for data retrieval and processing (Smestad, 2015).

During the AIS data collection process, the sample size of container vessels was reduced from 250 to 211. This reduction occurred because 39 vessels, initially scheduled to call at Turkish ports, ultimately did not make the call. The study aimed to compare each vessel's operating speed with its service speed, and this service speed information was acquired from Sea-Web (2016). Additionally, details about container liners domiciled in Türkiye were also obtained from the same database.

The assumption of “ships moving at less than 3 knots are assumed to be at anchorage” (Smith et al., 2014: 71) is applied in the study due to AIS data constraints. The author did not restrict the data source to noon-report data due to reliability concerns raised by the maritime researchers (see for example Smith et al., 2013) Additionally, conducting an analysis based on the noon-report data only would disallow considering full days’ steaming, which, as a result, could skew the outcomes (IMO, 2015: 208). Therefore, the operating speed data of the selected vessels are included fully and prepared for data analysis. IBM SPSS 22 software was used to analyse the data.

The container vessels in the sample were categorised based on their TEU capacity according to Stopford (2009). The categorisation revealed 5 Feeder, 12 Feeder Max, 71 Handy, 40 Sub-Panamax, 16 Panamax, 38 Post-Panamax and 29 Neo-Panamax container vessels in the sample.

MarineTraffic (2016) listed 153 different academic records containing peer-reviewed technical papers, conference proceedings and technical reports that used their data. Given this evidence, the author considered the data quality appropriate for the study. Reliability is ensured by obtaining quality data and meticulously applying descriptive statistics so that the same results can be gathered in a repeating study (Saunders, 2015). Validity was established by sampling all container vessels that called at one of the top ten container terminals in Türkiye. Overall, the study's quality was maintained through the use of reliable data and the careful execution of statistical analyses.

3.1. Qualitative stage

The qualitative stage involved both unstructured and semi-structured in-depth interviews. The unstructured interview approach was selected to gather comprehensive insights from respondents regarding the phenomenon (Morse, 2003), with a focus on addressing the central research question. Specifically, the interview focused on the question: "To what extent has slow steaming been implemented on container routes serving Turkish ports?" Allowing interviewees to share their knowledge freely without interruption facilitated a deeper exploration of their perspectives and made efficient use of interview time.

To collect data from the perspective of container liners, a senior manager from one of the largest container liner companies worldwide agreed to participate in the study. Prior to the interview, the participant was informed about the scope of the research and the general themes of the research questions.

For the perspective of fruit and vegetable exporters, the author collaborated with the Exporters' Union. In Türkiye, all exporters are legally required to be registered with an exporters' union ("Türkiye İhracatçılar Meclisi ile İhracatçı Birliklerinin Kuruluş ve Görevleri Hakkında Kanun," 2009). An inquiry was made to the Turkish Sector of Fresh Fruit and Vegetables, requesting a list of the top 100 companies. Given the study's exploratory nature, snowball sampling was employed as it provided a practical method for identifying representatives within the targeted population (Saunders, 2015: 296).

The characteristics of those who participated in the research were as follows:

- Export activities by container shipping to the Far East, North and South America, Europe and the Middle East.
- Financially strong, competitive companies.
- High number of exports
- Owners of Facilities

Telephone interviews were utilized for data collection. Prior to each interview, informed consent was obtained from participants, and permission to record the sessions was granted. All interviews were subsequently recorded and transcribed verbatim to maintain accuracy and ensure data integrity. Data were analysed using thematic analysis (Braun and Clarke, 2012).

Thematic analysis involved systematically identifying, organising, and offering insights into patterns of meaning (themes) across a data set (Braun and Clarke, 2012). Theme refers to "recurrent and distinctive features of participants' accounts, characterising particular perceptions and/or experiences, which the researcher sees as relevant to the research question" (King and Brooks, 2018). In this study, the author chose thematic analysis due to its flexibility in analysing data (Braun and Clarke, 2012) and the purpose of the research. More specifically, the author followed the semantic approach to analysis; by doing so, the author was able to gain insights into participants' experiences within their organizations and identify meaningful patterns to summarize and interpret their perspectives (Patton, 1990 in Braun and Clarke, 2006).

The following phases were followed: Familiarising yourself with the data, generating initial codes, searching for themes, reviewing potential themes, defining and naming themes and producing the report (Braun and Clarke, 2012).

3.3. Limitations

Despite the author's best efforts to produce a research output that presents a comprehensive view of the research question and provides an in-depth understanding of the issue and findings, the study has certain limitations. The author's collection of AIS data for the sampled vessels resulted in a comprehensive and rich dataset. However, the type of AIS data used in this study had certain limitations. The chosen AIS system operates by transmitting information to and from shore-based stations, with a coverage limit of approximately 40 nautical miles (Tichavska et al., 2015). Consequently, the author's data collection was restricted to vessel positions near the shore, limiting the available speed data for vessels traveling to and from the Atlantic and Pacific Oceans. The author's qualitative data collection was sufficient to produce insights from the perspectives of fruit and vegetable exporters. However, conducting additional interviews could further enrich the study and provide guidance for additional future research directions.

4. Results

4.1. Quantitative Stage Results

The analysis revealed that the average sailing speed of vessels was 12.54 knots, while the average service speed was 20.89 knots. Observed sailing speeds ranged from a low of 6.74 knots to a high of 16.64 knots. Table 2 presents the descriptive statistics for the 212 container vessels included in the sample.

The vessels in the sample were categorized by TEU capacity. The sample included 5 Feeder vessels, 12 Feeder Max vessels, 71 Handy vessels, 40 Sub-Panamax vessels, 16 Panamax vessels, 38 Post-Panamax vessels, and 29 Neo-Panamax container vessels. In terms of service speed, Feeder vessels exhibited the lowest design speed, while Neo-Panamax vessels had the highest. The data also revealed that Feeder, Feeder Max, and Neo-Panamax vessels operated approximately 40% below their design speeds. Handy-sized ships experienced a 37% reduction, while Sub-Panamax and Post-Panamax ships operated 32% slower than their design speeds. Panamax vessels exhibited the largest reduction, operating at 54% of their design speed (See Table 3).

The slowest service observed was at 11.31 knots, and it was a single ship on the Black Sea—North America route. Although one more vessel sailed from the Black Sea to North America, the first one that sailed via Gibraltar, the latter crossed the Suez Canal with an average of 12.91 knots. Forty-four vessels sailed between the Black Sea and the Mediterranean Sea with an average of 11.57 knots, whereas seventy-six vessels sailed only in the Mediterranean Sea with an average of 11.80 knots.

Table 2: Descriptive Statistics of Vessel Speeds

Statistics	Sailing Speed (Knots)	Service Speed (Knots)
Mean	12.53	20.89
Median	12.62	21.00
Mode	11.76	22.00
Standard Deviation	1.71	2.84
Variance	2.95	8.10
Minimum	6.74	10.00
Maximum	16.84	26.30

Source: Author's data collection (AIS data)

Table 3: Speed of container vessels according to categories

Container Ship Category	Number of Ships Observed	Average TEU Capacity	Operating Speeds Mean	Service Speeds Mean	Operating Speed/Service Speed Ratio
Feeder	5	210	7.46	12.03	60%
Feeder Max	12	779	10.39	17.23	60%
Handy	71	1421	11.92	18.87	63%
Sub-Panamax	40	2590	12.62	21.62	58%
Panamax	16	3354	12.48	22.76	%54

Post-Panamax	38	4852	13.63	23.50	%58
Neo-Panamax	29	9699	14.07	23.41	60%

Source: Author's data collection (AIS data)

The highest detected speed was 14.47 knots between the Mediterranean Sea and Europe, followed by the Black Sea and Europe route with an average of 14.08 knots and the Mediterranean Sea—Far East route with an average of 14 knots. Even though it constitutes a single vessel, the Europe-Mediterranean—India service was the fourth highest service observed.

The analysis clearly showed that services to/from European countries maintained the highest operating speeds, while Black Sea inbound outbound services supplied much slower (see Figure 3).

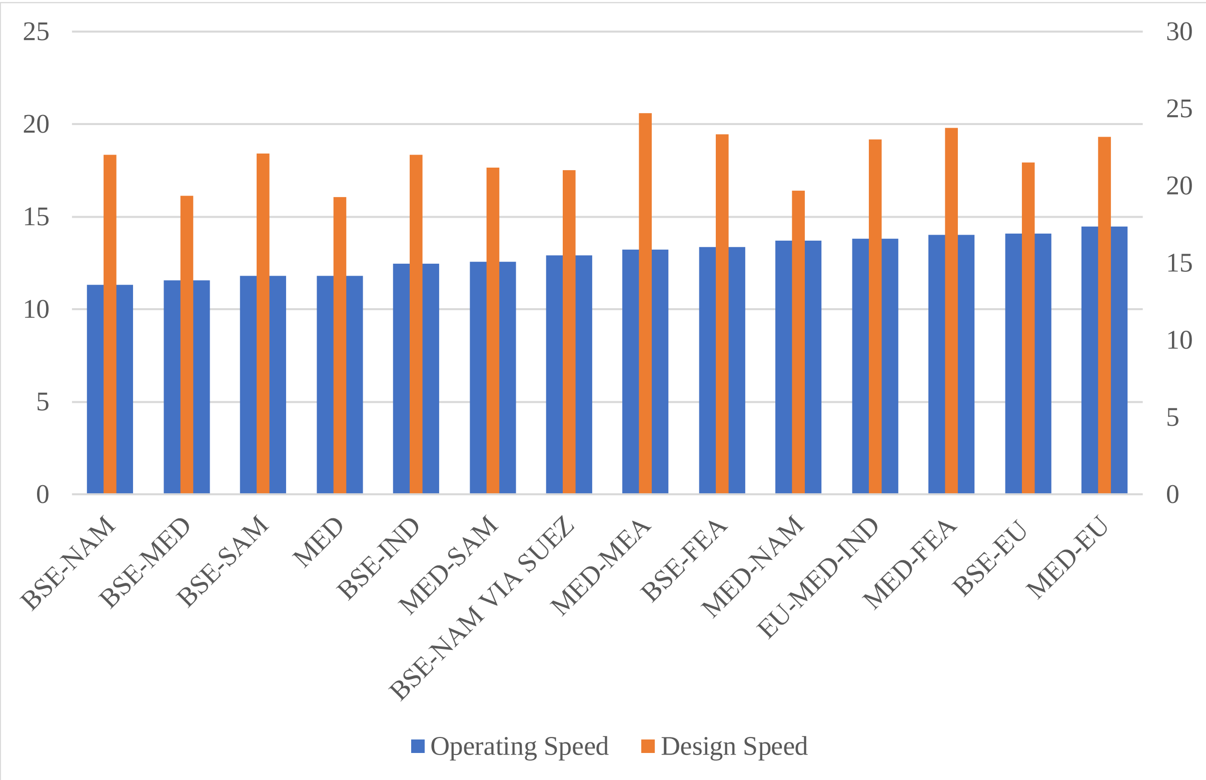

Figure 3: Average Operating and Design Speed per Route

Source: Author's analysis of AIS data

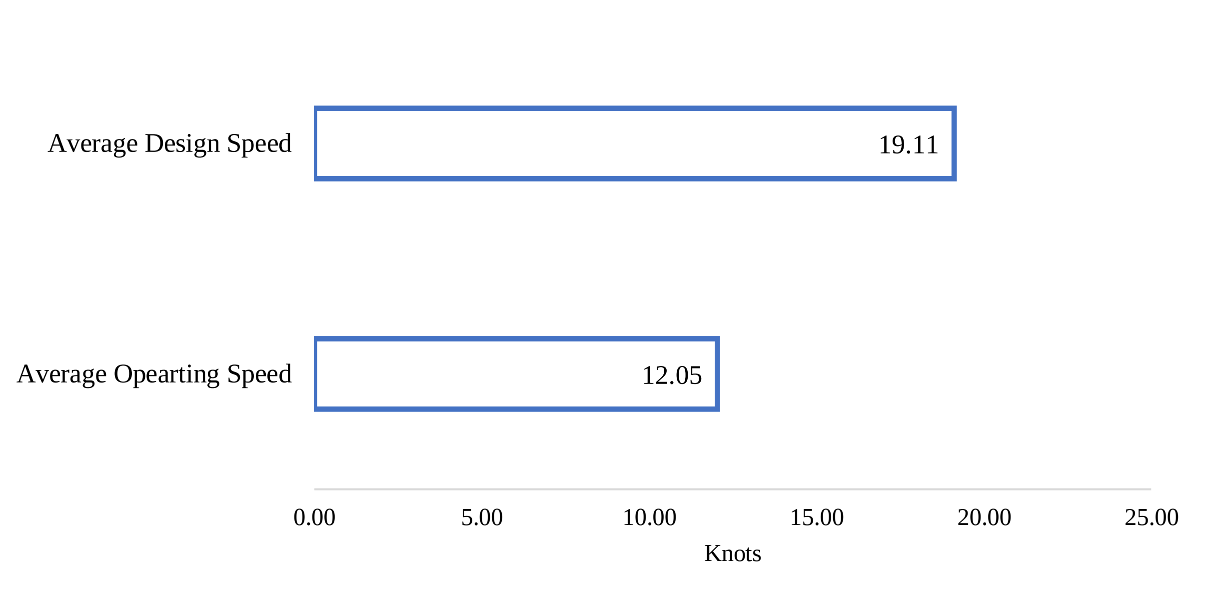

Figure 4. Average Operating and Design Speed Comparison of Turkish Liner Shipping Companies

Source: Author's data collection (AIS data)

48 vessels operated by Turkish domiciled liner operator companies were observed in sample. Operating speed and design speed mean value ratio was 63% (see Figure 4). The mean operating speed was 12.95 knots, and the mean design speed was 19.11 knots.

The quantitative analysis findings revealed the various operating speeds of the sampled container vessels. Their implications for the shippers are further investigated by conducting interviews. The next section presents the qualitative analysis findings.

4.2. Qualitative stage results

The findings from the qualitative phase served to triangulate the results of the quantitative analysis, providing a deeper understanding of the perspectives of key stakeholders. From the container liners' perspective, six themes emerged from the interviews. The benefits of slow steaming were discussed most frequently, while alliances and cargo types were mentioned the least.

The benefits of slow steaming were described as economic and environmental advantages, higher schedule reliability, decreased inventory costs for shippers, an increased number of port calls, and greater flexibility for ship operators in managing operational matters. The second most frequently discussed theme was routes. In terms of slow steaming practices, Maersk Line was found to employ different sailing speeds on different routes. Even on the same route, the backhaul and headhaul speeds of vessels varied. Maersk Line often practiced slower speeds on backhauls than on headhauls. This practice was influenced by the type of cargo onboard. For example, on the Black Sea-South America route, headhaul speeds were faster than backhaul speeds due to the perishable nature of the goods, such as bananas. European shippers were in a more advantageous position, as more vessels provided direct services to European countries. This situation was attributed to economic factors, with consignors and consignees willing to pay higher freight rates.

The third theme was the rivals. In comparison to Maersk Line's fleet's operating speeds, MSC and Turkon Line followed different patterns. MSC was sailing their fleet much slower and much higher than Maersk Line. Turkon Line, however, positioned itself to serve a niche market in which customers were willing to pay quite expensive freight rates to get much faster services. In line with these, Maersk Line was not providing direct services where MSC and Turkon Line did.

The senior manager of Maersk Line stated that the company started slow steaming trials in 2007. In 2008, it was officially practised on some routes. However, until 2010, the company spent time enhancing slow steaming applications to reach its peak. Seago Line, a company operating under Maersk Line, was established in 2011. Only after a year did Seago Line also start slow steaming on its services.

While some interview findings aligned with the existing literature and corroborated the AIS data analysis, additional novel insights were also obtained. Notably, the interviews helped pinpoint the onset of slow steaming's influence on trade routes, specifically Turkish imports and exports. Since 2010, slow steaming has had a significant impact on Turkish foreign trade. However, these practices proved insufficient in mitigating the economic challenges brought on by the 2008 financial crisis, as container liners continued to experience financial difficulties. In response to these challenges, liner operators increasingly formed alliances as a strategy to navigate this financially demanding period.

From the fruit and vegetable exporters' perspective, the interviews revealed the intricate nature of the cargoes and their shipment practices. Accordingly, the analysis revealed that the main difference in the impact of slow steaming on exporters lay in the nature of the products being exported. The interviewees provided a variety of product types. The two distinct categories of exported goods were fresh and dried fruits and vegetables.

Fresh fruits were identified as the most perishable products. Cherries were consistently cited as the most perishable, followed by apricots and figs. Dried fruits and vegetables, in comparison, were considered less perishable (see Table 4).

Table 4. Perishability of Products

	Fresh Produces		**Dried Products**
	Fruits	Vegetables	Fruits
Highly perishable	Cherry, Apricot, Fig, grape	N/A	N/A
Moderately perishable	Mandarin, Peach, Watermelon, Nectarine	Tomato, Carrot, Leek	Slow Roasted Tomato
Least Perishable	Orange, Lemon	N/A	Apricot, plum, grape, Dried Tomato

Source: Author's data collection (Interview data)

The perishability of goods emerged as the main factor influencing exporters' choice of transport mode. Due to the highly perishable nature of cherries, apricots, and figs, these were transported by land and air. Mandarins, peaches, watermelons, nectarines, tomatoes, carrots, and leeks were considered moderately perishable and were shipped by sea. Citrus fruits such as oranges and lemons, as well as dried fruits like apricots, plums, grapes, and dried tomatoes, were regarded as the least perishable. These products were the most suitable for sea transport.

Regarding export destinations, 'moderately perishable' goods were primarily shipped to the Middle East, India, and Russia, while the least perishable goods were exported to the Far East, Europe, South Africa, North America, and Australia.

All respondents indicated that their businesses were affected by the container liners' slow steaming strategies. The effects of slow steaming on shippers were detailed in Table 5.

Table 5. Shippers' Experience of Slow Steaming

Company Name	Yerin Tarım	Sunak Tarım	Ate Foods
Transit Time	Increased	Increased	Increased
Schedule Reliability	Has improved	Has improved	Has not improved
Inventory Levels/Costs	No Affect Observed	Slightly increased inventory costs	Slightly increased inventory costs
BAF Surcharge	No Information	No Information	No Information
Cash Flow	Worsened	Worsened	Worsened
Production Scheduling	No Production	Slightly affected	Highly affected
Customer Service	Customer complaints have increased.	Customer complaints have increased.	Customer complaints have increased.
Competitive Position	More difficult to compete.	No Affect Observed	More difficult to compete.

Source: Author's data collection (Interview data)

All respondents noted increased transit times, with Yerin Tarım and Ate Foods observing an average delay of one week, while Sunak Tarım reported a delay of two days. Responses concerning schedule reliability varied: Yerin Tarım and Sunak Tarım noticed improvements, but Ate Foods did not. In terms of inventory costs, Yerin Tarım did not experience any changes, whereas Sunak Tarım and Ate Foods reported slightly higher inventory costs since the implementation of slow steaming.

None of the respondents provided information about BAF surcharges, explaining that they did not track BAF surcharges separately but as part of an all-inclusive freight rate. Regarding production scheduling, since Yerin Tarım was not a producer, the company did not respond to this question. Sunak Tarım reported a slight impact, while Ate Foods claimed to be significantly affected. All respondents reported an increase in customer complaints related to shipments since slow steaming began. In terms of competitive positioning, both Yerin Tarım and Ate Foods found it more difficult to compete, while Sunak Tarım observed no change.

Due to slow steaming, exports from Türkiye took longer to reach their destinations than those from European countries. Respondents noted that exporters from Spain, Greece, and Italy had a competitive advantage, as their shipments arrived faster, leading to fewer customer complaints. Finally, Maersk Line, Turkon Line, and Hapag-Lloyd were evaluated as the most reliable container operators in terms of schedule reliability, while MSC was rated the worst.

5. Conclusion and Future Research Directions

The quantitative analysis revealed that container liner operators implemented slow steaming on routes calling at Turkish ports. This was an expected outcome considering the container liners' expansive slow steaming practice. When comparing the average design speed of the sample vessels to their actual operating speed, a 40% speed reduction was observed, indicating that this reduction has become the "new normal." Sub-panamax and post-panamax vessels were found to be operating slightly below this new standard, while Panamax vessels were even slower. In terms of route distribution, services to and from the Black Sea were the slowest, whereas services to and from the EU were the fastest. Speed patterns for Mediterranean services fell in between these two extremes.

Another key finding of the study was that Turkish-domiciled liner operators had higher operating speeds compared to the sample average. This result is particularly noteworthy, although it cannot be explained only with quantitative data analysis. The vessels operated on diverse routes, mostly between the Mediterranean Sea and South America or within the Mediterranean itself. Qualitative research provided complimentary insights: Turkon Line positioned itself to serve a niche market where customers were willing to pay high freight rates for significantly faster services.

The author's investigation into slow steaming practices among container liner companies and their impact on fruit and vegetable exporters revealed varying effects depending on the perishability of the products. Highly perishable goods, typically transported by land or air, were not directly affected by slow steaming. Moderately perishable goods were mainly shipped by sea to the Middle East and Europe, while less perishable products were exported to farther destinations, such as the Americas, Canada, Australia, and the Far East.

The findings indicated that slow steaming resulted in longer transit times, with schedule reliability differing across routes. This led to increased inventory levels and costs for shippers, although Turkish exporters seemed to be less impacted compared to findings from CENTRX, BDP International and St. Joseph's University (2011). Notably, while the BAF surcharge policy caused concern in Western countries, Turkish exporters were largely indifferent to these changes, as they did not closely monitor surcharge fluctuations.

Slow steaming also disrupted exporters' cash flows, as payments were often delayed until the consignee received the cargo. This was especially problematic for dried fruit exporters using Trans-Atlantic services, who faced significant production scheduling challenges. Exporters shipping to Europe and the Far East were comparatively less affected, though they still faced issues with schedule reliability. The lack of reliable express services on the Mediterranean-Trans-Atlantic routes further exacerbated production and scheduling problems, a challenge that was uncommon before the implementation of slow steaming.

Customer satisfaction was another area negatively impacted. The difficulties that Turkish exporters faced can be attributed to the fewer and slower direct shipping services available on routes to and from Turkish ports, as compared to European routes. As highlighted by the respondent Yerin Tarım, Turkish exporters were disadvantaged by slower shipping times to destinations like Lebanon, despite Türkiye's closer geographic proximity compared to other European countries like Italy, Greece, and Spain. Given that faster and more reliable services require higher freight costs, it is unlikely that Turkish exporters will be able to overcome this issue without significant changes in shipping strategies.

These findings share similarities with Finnsgård et al. (2020), providing additional insights into the shippers’ negative experience of longer transit times, increased inventory costs and inadequate reliability of the container liners. The experiences of the Swedish shippers resonate with those of Turkish shippers.

Slow steaming is a useful approach for reducing emissions (Farkas et al., 2023) and has supported the industry's transition to low-carbon practices (Mander, 2017), leading to the adoption of green shipping practices (Zanne et al., 2013). However, policymakers have not introduced supportive tools to help shippers balance the negative impacts of slow steaming, such as longer transit times and increased costs. This paper highlights the requirement of policy support, especially in the context of perishable good shippers in Türkiye.

Future research could explore the sailing speed options of container liners and examine the implications of different speeds on shippers and end customers. Another approach would be exploring the future of the industry. Various global economic trends are likely to influence container liners to choose either higher or slower sailing speeds. These differing scenarios could be investigated, and their implications for supply chains analysed.

Another research direction would involve exploring alternative fuel types and examining the choice of sailing speeds when these fuels are adopted, particularly in relation to environmental concerns, regulatory standards, and their impact on supply chains.

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