Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Examining Employment and Export Figures in the Shipbuilding Industry – A Relational Analysis on Türkiye

Erdal Arlı
İstanbul Nişantaşı Üniversitesi
Umur Bucak
Kocaeli Üniversitesi
İlkay Sultan Güneş
igunes@iuc.edu.tr

Istanbul University-Cerrahpaşa

Research Article

Keywords: Shipbuilding, Employment, Export Figures, Relational Analysis

Posted Date: November 17th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11741209/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Examining Employment and Export Figures in the Shipbuilding Industry – A Relational Analysis on Türkiye

Abstract

The shipbuilding industry is a significant component of the four primary maritime transport markets. In line with recent regulations in the context of green shipping, the development of shipyards in terms of employment is highly valuable, as shipowners frequently turn to shipyards for both new construction processes and green conversion and maintenance-repair processes. The identification of factors influencing employment in the shipbuilding industry could serve as a guide for increasing quality production. The present study analyses the relationship between export figures and employment levels of shipyards in Türkiye between 2003 and 2023. Consequently, it was determined that exports in the Turkish shipbuilding sector have a positive impact on employment in both the long and short term. The study's findings yielded theoretical and practical conclusions, as well as policy recommendations for future research.

Keywords: Shipbuilding, Employment, Export Figures, Relational Analysis,

JEL classification: F16 J21, F14

1. Introduction

In the context of the recent global economic crises, macroeconomic discourse has assumed a central role both internationally and nationally. Concepts such as unemployment, employment, exports, and inflation have begun to be used with increased frequency. In the context of rising unemployment rates, the creation of new employment opportunities has emerged as a priority for policymakers. The shipbuilding industry, being a labour-intensive and order-based sector, is one of the key sectors in creating employment and reducing unemployment. Furthermore, given the high value of the products produced on an order-based basis, it provides significant capital flow to both the national economy and the sectoral economy. The shipbuilding industry, being a labour-intensive sector and an area that works with different industries in the supply chain, has the potential to provide high employment opportunities for the supporting industries. Furthermore, the shipbuilding sector provides a cash flow to its own sector in terms of exports with the construction of high value-added ships and yachts, as well as providing foreign exchange income to the national economy. Furthermore, it responds to the needs of countries' defence industries and contributes to their technological development (Duramaz, 2018). In this context, the shipbuilding industry has two valuable contributions to the macroeconomy. These are employment and foreign exchange inflows and capital flows based on exports. The objective of this study is to ascertain the existence of long-term and short-term cointegration, i.e. a balance relationship, between employment and exports in the shipbuilding industry in Türkiye. Türkiye was selected as a case study due to its significant global role in the shipbuilding sector, particularly with regard to exports and orders for ships on a global scale. A comprehensive analysis of the export statistics pertaining to "Ships and floating vessels and vehicles" across a global database comprising 89 GTIP codes reveals that in the year 2021, a total foreign trade value of $221 billion was realised, with exports accounting for approximately $120 billion of this figure. China is the leading exporter, with exports amounting to 22.47 billion dollars. It is followed by South Korea, which exported 22.02 billion dollars, and Japan, with exports totalling 9.68 billion dollars. Türkiye's ranking is 12th in terms of exports, with a value of 2.06 billion dollars. Türkiye's total export share is approximately 1.71% (DTO, 2024). With regard to the distribution of ship orders by country, China is in first position, with 2,532 units; South Korea is in second position, with 721 units; Japan is in third position, with 633 units; and Türkiye is in eighth position, with 62 units (Clarksons, 2024). Türkiye has been among the top countries in terms of tanker orders for many years and has risen to third place. However, it began to decline with the 2008 crisis. Presently, China holds the top position with 527 orders, while Türkiye is in sixth place with 12 orders (Clarksons, 2024). In Türkiye, the value of exports from the shipbuilding sector amounted to 1.626 billion USD in 2021 and increased to 1.941 billion USD in 2023. As of 2023, Türkiye has 85 shipyards, which provide employment for approximately 95,000 people (DTO, 2024).

The shipbuilding industry is a significant contributor to a nation's foreign exchange earnings, with high-value exports playing a pivotal role in this regard. In addition to direct employment opportunities within the shipbuilding sector, the industry's ancillary enterprises and other manufacturing sectors collectively generate a substantial number of employment opportunities, underscoring its multifaceted economic impact. Moreover, when a nation attains global competitiveness, it exerts a direct and substantial influence on the development of trade at the global, national, and regional levels. "Over 80% of global transportation is carried out via maritime transportation. In this context, the foreign exchange income and employment that maritime transport and shipbuilding contribute to

national economies are not insignificant figures (YCCI, 2013). The global economy exerts a substantial influence on the shipbuilding sector, determining the export and import ratios of ships. In accordance with the escalating demand for goods and services on a global scale, there is an observed concomitant increase in production. This, in turn, gives rise to a corresponding increase in the requirement for new ships. It is evident that an increase in global and national economic growth has a direct impact on the demand for maritime transport, which in turn results in an escalation in the rate of new ship production. It is evident that this scenario exerts a substantial influence on the employment growth rate. Consequently, the shipbuilding sector assumes a pivotal role in the global economy by facilitating international trade, promoting economic growth, and generating employment (Stopford, 2016). Globally, approximately 40% of the balance of payments surplus of around 1,780 is composed of transportation and commercial services (Harley, 2012). Even prior to the emergence of steamships, shipbuilding played a pivotal role in the development of exports and employment (Fischer and Nordvik, 1986). An examination of the preceding two decades reveals a consistent and gradual escalation in the global market share of non-WP6 economies. Furthermore, noteworthy developments in the shipbuilding market of these nine economies, including China, the Philippines, Vietnam, Indonesia, France, Chinese Taipei, the United States, Russia, and Spain, are worthy of attention (Daniel et al., 2021). The Chinese government has implemented policies to support the shipbuilding sector, thereby increasing both its global export share and regional employment. China has become the largest player in the shipbuilding sector (Daniel et al., 2022). The shipbuilding sector is an industry that provides foreign exchange income and capital inflows based on exports, attracts foreign capital, promotes the development of ancillary and manufacturing industries, and, most importantly, creates employment due to its labor-intensive nature. Therefore, it is an industry that requires careful attention (DTO, 2021). A review of the literature reveals that studies on the shipbuilding industry have mostly focused on engineering, technical aspects, and occupational health and safety. The number of studies on the shipbuilding industry economy is limited, and most of them are theoretical in nature. The number of studies examining the industry from a macroeconomic perspective and using econometric analysis is also limited. Although the number of studies examining the relationship between exports and employment, which is the subject of our study, has increased in recent years, no such study has been found for the shipbuilding sector. Therefore, it is believed that our study will fill this gap in the literature. In addition, it is expected that highlighting the contribution of the labor-intensive shipbuilding sector to employment will raise awareness. The main studies on the shipbuilding sector economy in the literature are as follows: Rujing and Rui (2008) analyzed the impact of the appreciation of the Chinese currency, the Yen, on the shipbuilding sector in their study. According to their findings, the appreciation of the Yen weakened the competitiveness of newly built ship prices and reduced the number of export ships. B. Altın (unpublished master's thesis, 2023) examined the relationship between country credit ratings and shipbuilding sector exports in developing countries. In his panel data analysis, he found that the ship exports of China, the Philippines, India, and Indonesia have a significant impact on Moody's credit ratings and that there is a positive relationship between them. He also found a similar relationship through Fitch credit ratings.

The present study examined the relationship between exports and employment, which are macroeconomic performance factors in the shipbuilding industry. In this sense, the present study aims to contribute to the extant literature on the shipbuilding industry economy. Furthermore, it is hypothesised that the event will underscore the significance of the sector in exemplifying the advantages that shipyard enterprises offer to the macroeconomy, with regard to both economic growth and the reduction of unemployment. A review of studies examining the relationship between exports and employment reveals a consistent finding in the literature: exports have a positive effect on employment. However, contradictory findings have been reported in certain studies, which have indicated an absence of correlation between the two. However, given the labour-intensive and order-based nature of shipyard operations, it was deemed appropriate to conduct this study in order to ascertain the impact of export performance on employment.

In the second section of the study, the relevant literature was reviewed, and prominent studies were presented. The subsequent section delineates the assumptions of economic theorists regarding employment. The methodology section delineates the analytical process employed and presents the findings. Finally, the discussion section compares the findings of this study with those of similar studies in the literature, and the conclusion section expresses the theoretical and practical contributions of the study considering the findings.

2. Literature review

In this study, the terms “employment” and “exports” were searched to present how the related concepts are addressed in the deep economic literature. First, the focal points of studies addressing the related concepts in the shipbuilding sample were stated, and then information was provided on the results of studies directly examining the relationship between export and employment levels.

In this study, the terms "employment" and "exports" were searched to present how the related concepts are addressed in the deep economic literature. Initially, the focal points of studies addressing the related concepts in

the shipbuilding sample were stated, and subsequently, information was provided on the results of studies directly examining the relationship between export and employment levels.

Li and J. Cheng (2015) posit that the shipbuilding industry is closely linked to macroeconomic factors in the country, irrespective of the prevailing economic policies, whether liberal or protectionist. Murphy (2015) examined the relationship between the economy, finance and maritime sectors, including the shipbuilding sector, and stated that countries with a competitive advantage in maritime transport are in a stronger economic and financial position. As Mello and Strandhagen (2011) asserted in their studies, a distinguishing feature of the shipbuilding sector is its global nature, setting it apart from other sectors. It was also noted that the shipbuilding industry is one of the sectors responsible for managing the global supply chain. As posited by Mandal (2017) in his study, the shipbuilding industry has been shown to make significant contributions to the global economic cycle. In the study conducted by Hossain and Zakaria (2017), it was posited that the primary factors contributing to the expansion of the shipbuilding industry are the gross domestic product, foreign trade volume, and economic growth. In his study on the Bangladeshi shipbuilding industry, Zakaria (2012) posited that it is imperative for the sector to direct its attention towards exports. In this context, he made recommendations to strengthen and consolidate its position in the global shipbuilding market. Duramaz (2018) conducted an examination of the Chinese and Turkish shipbuilding industries in terms of production capacity, employment rates, and contributions to international trade. The study evaluated the countries' Eximbank credit and policies, and made recommendations for diversifying medium and long-term financial support appropriate for Türkiye's shipbuilding industry structure. Dengov et al. (2019) posited that the shipbuilding industry is analogous to the nation's economy in its broader economic characteristics. Ergün (2024) utilised panel data analysis to ascertain the impact of the iron and steel sector on exports within the shipbuilding industry. The study established a positive correlation between the ship and yacht construction industry exports and the ratio of steel production and natural resource rents to GDP.

In their seminal study of the employment effects of exports in the United States and Canada, Abowd and Lemieux (1990) concluded that exports have a positive effect on employment. Conversely, Leichenko's (2000) study, conducted in four regions of the United States, posited a two-way causal relationship between exports and employment, particularly in the Northeast and West regions. In their 2007 analysis, Feenstra and Hong (2007) determined that exports have a significant impact on employment, a conclusion that was drawn from an analysis of the 1997-2005 period in China. Gül and Kamçı's (2012) studies determined a unidirectional causality from exports to employment. Kiyota's (2014) study, which encompassed the years 1995-2009, revealed a substantial increase in employment, attributable to the impact of exports on the economies of China, Indonesia, Japan and South Korea. In their 2014 study, Dijazi and Badri examined the effects of exports on total employment in Iran, concluding that export increases had a positive effect on employment in the long term (Dijazi & Badri, 2014). Altay and Yılmaz's (2016) study revealed a long-term and positive relationship between exports and employment in Türkiye between 2005M01 and 2015M09. In their study, Sasahara (2019) examined the employment impact of exports in the United States, China, and Japan. The study found that exports had a positive impact on employment in all three countries. Furthermore, it was established that this contribution exhibited variation according to sector, with exports exerting a more pronounced positive impact on employment in sectors characterised by high added value. Whang (2019) also found that exports have a positive effect on employment, but that this effect can vary depending on the production technique and the size of the relevant sector. Gerçeker's (2021) study on the industrial sector in Türkiye posits that fluctuations in exports are recognised as the catalyst for analogous shifts in employment. In their study on Germany, Görg and Görlich (2011) discovered a negative correlation between the export of services and employment levels. Greenway et al. (1999) also established that exports have a detrimental effect on employment.

3. The employment notion in economic theories

In the classical economic paradigm, the notion of full employment equilibrium is predicated on the principle of spontaneous market forces, as articulated by the principle that "every supply creates its own demand" (Pekin, 2013, pp. 110-115). Nevertheless, this perspective has become less efficacious over time, and economic models have proven incapable of effectively managing crises without external intervention. John Maynard Keynes, a seminal figure in the realm of modern economic thought, emerged as a prominent proponent in the aftermath of the Great Depression (1929). In his seminal work, The General Theory of Employment, Interest and Money, Keynes advanced the notion that government incentives and support for employment assume a pivotal role in the attainment of full employment equilibrium. Theorists espousing orthodox Keynesian economics concur with this perspective, contending that aggregate demand dictates aggregate output and employment levels. According to this perspective, public authorities exert influence over aggregate demand with a view to directing the economy towards full employment (Başoğlu et al., 2004). Conversely, within the framework of new classical macroeconomic theory, Lucas's Surprise Supply Function elucidates the transformative influence of information on employment and production levels. According to this theory, a state of full equilibrium in terms of employment

and production is represented by full information, while the disruption of this natural equilibrium is caused by firms with low information (Lucas, 1973). The uncertain structure of other markets in the maritime sector, which develop in line with fluctuations in freight markets, makes full information levels impossible. Consequently, it can be posited that the equilibrium between production and employment in the shipbuilding market evolves independently of the level of information. In accordance with the Real Business Cycle Theory, which has prevailed in recent years, fluctuations in employment can be directly associated with random large-scale changes in production technology. As is evident, employment has been persistently associated with production in economic theories and has been hypothesised to co-occur at specific points. In this study, the production function is represented by export data due to the outward-oriented structure of the sector in Türkiye. Consequently, the results of the analysis of the relationship between export data and employment data in the shipbuilding sector in Türkiye can be evaluated within the framework of basic economic theories.

4. Methodology and data

The shipbuilding industry is one of the sectors that contributes to the global economy and has an impact on the financial and economic growth of countries and the sector. The labour-intensive and order-based nature of the industry is evident, and it is therefore unsurprising that it has a significant contribution to employment. Notwithstanding the apprehensions that artificial intelligence and robotics may result in job losses in numerous sectors, the shipbuilding industry is distinguished by its contribution to economic growth and its capacity to maintain employment levels. The objective of this study is to ascertain the existence of a relationship between shipbuilding exports and employment in Turkey, as well as the direction of causality. In order to achieve the objective of the study, an econometric analysis was conducted. The natural logarithm of dollar-denominated exports in the shipbuilding industry in Turkey is denoted by 'Lnexport', and the natural logarithm of employment in the shipbuilding industry in Turkey is denoted by 'Lnemploymet'. The following equation (1) will be estimated:

$$Lnemployment_t=\beta_0 +\beta_1 Lnexport_t +\epsilon_t \quad (1)$$

A survey of extant literature on the subject reveals a paucity of studies in the field of shipbuilding that address both elements, thus underscoring the significance of the present study. In econometrics, the prerequisite for embarking on fundamental analyses that will provide answers to the research question is the satisfaction of a number of conditions. Two of these are unit root and autocorrelation tests. The purpose of unit root tests is to evaluate the stationarity of the variables under consideration in research. It is hypothesised that advanced analysis incorporating variables, such as unit root tests, i.e. non-stationary variables, does not yield meaningful and interpretable results. Consequently, in the initial phase, the stationarity of the variables should be evaluated through the implementation of unit root tests. In econometric analyses, if the variables do not exhibit stationarity at the level, their first-order differences are subjected to another unit root test. Subsequent to the implementation of first-order differences, the variables manifesting stationarity are prepared for further analysis.

In this study, we first analyzed whether our variables contained unit roots at the level. For this purpose, we used the Augmented Dickey Fuller (ADF) unit root test, which is frequently used in econometrics. After determining that they were not stationary at the level, we applied the Engle-Granger cointegration test to determine whether there was a long-term or short-term equilibrium relationship among our variables, which became stationary after taking first-order differences. We then sought to determine whether exports had an effect on employment by finding the long-term and short-term coefficient estimates. The data utilised in the present analyses is outlined in Table 1.

Table 1 Variables used in the analysis

Table 2 Descriptive statistics of variables

As illustrated in Table 2 above, the export values of Türkiye's shipbuilding industry from 2003 to 2023, the focal point of our research, are presented in addition to the mean, median, maximum, minimum, and standard deviation values associated with the employment data in the shipbuilding sector. Furthermore, the graphs pertaining to the variables utilised in the study are collated and presented in Fig. 1.

Fig. 1 Graphics related to data

The graph located in the upper left corner illustrates that employment within Turkey's shipbuilding sector has exhibited an upward trend since 2003, a period which forms the focus of the present research study. The graph situated in the upper right quadrant demonstrates that the data has been adjusted for the first-order difference and unit root. An examination of the graph situated in the lower left quadrant reveals that Turkey's shipbuilding sector exports did not demonstrate a stationary characteristic between the years 2003 and 2023. However, the graph in the lower right quadrant indicates that the exports became stationary subsequent to the implementation of the first-order difference. As stated in the methodology section, for econometric analyses, the series must be stationary in order to apply the analysis methods that will answer the research question. Furthermore, as demonstrated by the graphs, the presence of a unit root in the variables can be determined through the utilisation of numerically-based tests that have been developed for this specific purpose. The most frequently employed unit root tests in econometrics are principally the Augmented Dickey-Fuller (ADF) (1979) and Phillips-Perron (1988) tests. The ADF unit root test was employed in this study.

Table 3 ADF unit root test results

In unit root tests, the null hypothesis is formulated as follows: the variable under investigation contains a unit root. If the probability value is greater than 0.05, the null hypothesis is accepted. This result indicates that the variable is not stationary. For this reason, first-order differences are taken, and stationarity is tested again.

Upon examining Table 3, it is understood that the export and employment variables in the shipbuilding sector are not stationary at the level but exhibit stationary properties after first-order differences are taken. In Table 4, Breusch-Godfrey Serial Correlation LM (Lagrange Multiplier) Test had been applied and autocorrelation between variables was illustrated.

4.1 Autocorrelation test

Table 4 Autocorrelation test results

As with the unit root test, it is imperative to undertake the autocorrelation test to progress to more advanced stages and achieve interpretable results. Should an instance of autocorrelation be identified, it is generally accepted that the interpretation of the model is erroneous. The results of the autocorrelation test for the model are presented in the following section. In accordance with the findings of this study, it can be concluded that both p-values are greater than 0.05. Consequently, it can be deduced that there is an absence of autocorrelation in the model under consideration. In this context, it can be posited that the model under consideration, which has become stationary and is devoid of autocorrelation, is well-suited for advanced analysis.

4.2 Engle-Granger cointegration test

Engle Granger (1987) estimates the error correction model with the long-term equilibrium relationship between variables and the Granger causality theorem. In this test, the long-term equilibrium relationship is not vectorial but is calculated unidirectionally. In this context, one of the variables is considered dependent (endogenous), while the other is considered independent (exogenous). The model of the test performed on two variables is expressed as follows:

$$Yt = \beta_0 + \beta_1 X_t + \epsilon_t \quad (2)$$

Tablo 5 Engle-Granger cointegration test results

Upon examination of Table 5, the null hypothesis that there is no cointegration between employment and exports established for the model is rejected. It is evident that a long-term cointegration relationship exists between employment and exports in the shipbuilding industry in Türkiye between 2003 and 2023. This relationship is characterised by a dynamic interplay between the two variables, resulting in a state of equilibrium. Consequently, it can be posited that exports exert a statistically significant ($p=0.0090<0.05$) long-term effect on employment in Turkish shipyards, and conversely, employment exerts a statistically significant ($p=0.0000<0.05$) effect on exports. In this context, when the export variable is taken as the dependent variable, the long-term equation is expressed as follows:

$$\text{dlogexportt} = \beta 0 + \beta 1\ \text{dlogemploymentt} + \epsilon t \quad (3)$$

When the employment variable is taken as the dependent variable, the long-term equation is written as follows:

$$\text{dlogemployment}_t = \beta_0 + \beta_1 \text{dlogexport}_t + \epsilon_t \quad (4)$$

However, the answer to the question "What is the degree of this effect?" is obtained through the estimation of long-term and short-term coefficients. The results of the estimation of both long-term and short-term coefficients are presented hereafter:

Table 6 Long- and short-term forecast results for employment and exports

As demonstrated in Table 6, an increase in exports in US dollars within the Turkish shipbuilding industry has been shown to have a positive effect on employment in the shipbuilding sector. The observed effect was found to be statistically significant at the 1% level of confidence ($p=0.000<0.01$). Consequently, a 1% increase in exports has been shown to result in an approximate 0.50% increase in employment over the long term. As Mert and Çağlar (2019) demonstrate, in cases where the equation is in full logarithmic form, the coefficient is equivalent to the elasticity coefficient.

In evaluating the short-term forecast results, particular attention is paid to the error correction coefficient, which is found to be negative and significant. A negative and significant error correction coefficient is indicative of the efficacy of the error correction model, signifying that deviations from the equilibrium established in the short term will revert to equilibrium in the long term. Conversely, if equilibrium is not achieved in the long term, it can be deduced that no cointegration relationship exists. Consequently, when employment is considered the dependent variable, the short-term error correction coefficient is found to be negative (-0.423142) and statistically significant ($p < 0.05$). However, this is not the case for the export variable. It is evident that when the export variable is designated as the dependent variable and employment is considered the independent variable, the error correction coefficient ect(-1) attains a positive value. This is notable despite the coefficient's significance in the short-term estimation results. Consequently, it is acknowledged that a one-way cointegration relationship exists, and that the impact of exports on employment is substantial in both the long and short term. In this context, as illustrated in the table, the increase in export values in Türkiye's shipbuilding industry has a positive effect on employment in both the long and short term. It is evident that, in the long term, 1% increase in exports results in an employment increase of approximately 0.50%. Conversely, in the short term, this increase is approximately 0.51%. Once more, the table indicates that approximately 42% of imbalances between the two variables in the short term are rectified in the subsequent year. Furthermore, an imbalance that occurs in the short term will reach equilibrium in the long term after $1/0.423142 = 2.363$ periods, which is approximately 2 years and 4 months (28 months).

5. Discussion

Recent global economic crises have exerted a deleterious effect on the macroeconomies of countries worldwide. In the contemporary global context, nations are endeavouring to attain economic growth whilst concurrently

seeking solutions to the issue of unemployment. Exports are widely regarded as a primary indicator of economic growth for both nations and specific sectors. Moreover, the reduction of unemployment and the augmentation of employment are amongst the most salient social issues that policymakers must address. Moreover, the potential ramifications of Industry 4.0 on the labour market, specifically the possibility of increased unemployment, continue to be a subject of discourse. This state of affairs necessitates the implementation of measures by policymakers. It is imperative to provide support to emerging sectors and to identify and foster areas that contribute to employment. A review of the extant literature reveals numerous studies examining the relationship between exports and employment. However, no such study has been identified in the context of the shipbuilding industry, which is a labour-intensive and order-based industrial sector and is expected to require many years to transition to Shipbuilding 4.0. The objective of this study is to ascertain the correlation between exports and employment in the shipbuilding sector, and to raise awareness of the sector's contribution. The results obtained from the study indicate that exports in the Turkish shipbuilding sector have a positive effect on employment in both the long and short term. Indeed, as Stopford (2016) asserts, the shipbuilding sector exerts an active role in the global economy by facilitating international trade, promoting economic growth, and generating employment. In addition, Li and J. Cheng (2015) contend that the shipbuilding industry is closely associated with macroeconomic factors, irrespective of the economic paradigm, whether liberal or protectionist. Furthermore, Mandal (2017) asserts that the shipbuilding industry exerts a substantial influence on the macroeconomic cycle.

Moreover, the findings of the present study are analogous to those of studies undertaken in disparate fields. In their 2007 analysis, Feenstra and Hong (2007) determined that exports had a significant impact on employment. This analysis was based on the period 1997-2005 in China. Gül and Kamçı's (2012) studies revealed a unidirectional causality from exports to employment. Kiyota's (2014) study revealed a substantial increase in employment, attributable to the impact of exports on the economies of China, Indonesia, Japan and South Korea during the period 1995-2009. In their 2014 study, Dijazi and Badri examined the effects of exports on total employment in Iran, finding that export increases have a positive effect on employment in the long term (Dijazi & Badri, 2014). Altay and Yılmaz's (2016) research revealed a long-term and positive relationship between exports and employment in Turkey between 2005M01 and 2015M09.

6. Conclusion

The present study reveals that export figures, a significant dynamic within the field of macroeconomics, contributed to the employment level in the shipbuilding sector during the period under review. In this context, it can be concluded that labour-intensive jobs continue to have an impact on the Turkish shipbuilding industry. Moreover, the customisation of products manufactured in the Turkish shipbuilding industry, which is tailored to specific individuals and purposes, underscores the significance of the intellectual capital of those engaged in production. The strong correlation between employment levels in Turkish shipbuilding and export figures underscores the outward-looking orientation of the sector.

Given the labour-intensive and order-based nature of the shipbuilding sector, it is hypothesised that it should be a priority for policymakers, both in terms of its economic contribution and employment potential. Despite the present incorporation of a modest number of Industry 4.0 applications, it is anticipated that the demand for human resources within the shipbuilding sector will undergo a daily augmentation. Consequently, it is hypothesised that the shipbuilding sector has the capacity to provide solutions to the problems related to new investments that need to be made to reduce unemployment and increase employment. These issues are among those that policymakers need to address. Consequently, it is recommended that today's youth be encouraged and motivated to enter the shipbuilding sector, which is known to have a need for educated and qualified intermediate personnel. Furthermore, the quality and quantity of educational institutions should be increased. As demonstrated by Strandhagen et al. (2022), the implementation of specific Industry 4.0 technologies has been shown to enhance the sustainability of shipyards during operational activities. This enhancement is achieved through the utilisation of the following methodologies: The enhancement of ship design through the utilisation of simulation models, the facilitation of information dissemination by digital procedures, the augmentation of data visibility through the implementation of RFID technologies, the improvement of working conditions and safety procedures by equipping operators with wearable sensors and augmented reality (AR) technology, the application of the Internet of Things (IoT) to coordinate material and data exchange, and the use of big data analytics and sensor technology to provide information to manufacturers are all proposed. In this context, in a scenario where Industry 4.0 components dominate shipbuilding sector operations in the long term, the need for qualified personnel to use the relevant technologies will not decrease.

The present study makes an important contribution to the literature in that it is the only study to date that has theoretically linked export figures with shipbuilding employment. In this context, the study proposes a significant indicator for measuring the shipbuilding performance of countries. In contemporary global contexts, characterised by the predominance of the shipbuilding industry in Asia, this study undertakes an analysis of a pivotal

performance indicator for industries such as shipbuilding, wherein producers and consumers are geographically distant from one another. The study also emphasises the importance of public authority interventions in line with Keynesian views to support full employment in the shipbuilding industry. In this regard, the study posits that the shipbuilding sector can operate in full alignment with Keynesian theory in regulating employment.

The most significant limitation of this research is that it was conducted in a single country. A similar study could be conducted for countries such as China, South Korea and Japan, which are among the top three or top ten in the global shipbuilding industry, provided that data is available. Furthermore, an evaluation could be conducted using panel data analysis, and the results could be compared with each other. Moreover, a similar study could be conducted on a regional basis. A study conducted within the framework of countries that are influential in the shipbuilding industry in continental Europe would also contribute to the literature in terms of regional comparisons. Moreover, if data is available, the impact of steel processing capacity, which is one of the important performance indicators in the shipbuilding sector, on employment and other economic balances could be investigated.

References

Abowd, J. M., & Lemieux, T. (1990). *The effects of international competition on collective bargaining outcomes: A comparison of the United States and Canada* (NBER Working Paper No. 3352). National Bureau of Economic Research.

Akkuş, G. (2014). The effects of trade and productivity on employment in the manufacturing industry of Turkey. *İstanbul Üniversitesi İktisat Fakültesi Mecmuası*, *64*(2), 1–44. https://izlik.org/JA78MU97GE

Aksöz Yılmaz, H. (2021). İhracat ve istihdam ilişkisi üzerine panel veri modeli analizi: OECD ülkeleri örneği. *Journal of Economic Policy Researches*, *8*(2), 115–139. https://doi.org/10.26650/jepr.880876

Altay, H., & Yılmaz, A. (2016). Türkiye'de ihracat artışlarının istihdam üzerindeki etkisinin incelenmesi. *Finans Politik ve Ekonomik Yorumlar*, *53*(616), 75–86.

Ayhan, F. (2018). Türkiye Ekonomisinde İhracat, İthalat ve İstihdam Düzeyi İlişkisinin Uygulamalı Analizi. *Çankırı Karatekin Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, *8*(2), 115-135. https://doi.org/10.18074/ckuiibfd.398753

Baird, A. J. (2005). Maritime policy in Scotland. *Maritime Policy & Management*, *32*(4), 383–401. https://doi.org/10.1080/03088830500300404

Başoğlu, U., Parasız, İ., & Ölmezoğulları, N. (2015). *İktisatta devrimler karşı devrimler*. Ekin Yayınevi.

Bernard, A. B., & Jensen, J. B. (1999). Exceptional exporter performance: Cause, effect, or both? *Journal of International Economics*, *47*(1), 1–25. 10.1016/S0022-1996(98)00027-0

BRS Group. (2022). *Shipping and shipbuilding markets annual review 2022*. https://www.brsbrokers.com/annualreview2022.html

Clarksons. (2024). *Shipping & trade data analysis & research 03/2024*. https://www.clarksons.net/n/#/portal

Daniel, L., Lee, C., & Spieth, J. (2021). *Shipbuilding policy and market developments in selected economies 2022* (OECD Science, Technology and Industry Policy Papers No. 119). OECD Publishing.

Daniel, L., & Lee, S. (2022). *Shipbuilding policy and market developments in selected economies* (OECD Science, Technology and Industry Policy Papers No. 131). OECD Publishing. https://doi.org/10.1787/f3faeb3d-en

Dengov, V. V., Tulyakova, I. R., & Gregova, E. (2019). The positions of Russia and Croatia shipbuilding products on world markets and prospects of co-operation (analytical overview). *Naše More*, *66*(3), 13–21. https://doi.org/10.17818/NM/2019/3.9

Deniz Ticaret Odası. (2024). *Turkish maritime sector report 2023*. https://www.denizticaretodasi.org.tr/tr/yayinlarimiz/sektorraporu

Dijazi, M., & Badri, K. (2014). The effect of exports on employment in Iran's economy. *Merit Research Journal of Art, Social Science and Humanities*, *2*(6), 81–88.

Duramaz, S. (2018). Gemi İnşa Sanayi'nin Gelişiminde Eximbank Kredileri: Çin ve Türkiye'ye Yönelik Bir Karşılaştırma. *Maliye ve Finans Yazıları*, *1*(109), 145-164. https://doi.org/10.33203/mfy.380856

Edwards, L. (2004). A firm level analysis of trade, technology and employment in South Africa. *Journal of International Development*, *16*(1), 45–61. https://doi.org/10.1002/jid.1062

Ergün, Ü. R. (2024). Gemi İnşa Sanayi İhracatına Demir Çelik Sektörünün Etkileri: Panel Veri Analizi. *Manisa Celal Bayar Üniversitesi Sosyal Bilimler Dergisi*, *22*(2), 30-53. https://doi.org/10.18026/cbayarsos.1338965

Feenstra, R. C., & Hong, C. (2007). *China's exports and employment* (NBER Working Paper No. 13552). National Bureau of Economic Research. https://doi.org/10.3386/w13552

Fischer, L. R., & Nordvik, H. W. (1986). Maritime transport and the integration of the North Atlantic economy 1850–1914. In W. Fischer, R. M. McInnis, & J. Schneider (Eds.), *The emergence of a world economy 1500–1914* (pp. 519–544). Franz Steiner Verlag.

Gemi İnşa Sanayicileri Birliği. (2022). *Gemi inşaatı sektör raporu 2021: Gemi inşa, bakım-onarım sektörü 2021–2022 yılları istatistiksel verileri*. https://gisbir.org/istatistik/sektor-raporu/#sektor-raporu

Gerçeker, M. (2021). Sanayi Sektöründe İhracatın İstihdama Etkisi: Türkiye İçin Asimetrik Nedensellik Testi. *Aksaray Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, *13*(3), 127-136. https://doi.org/10.52791/aksarayiibd.941020

Göçer, İ., Mercan, M., & Peker, O. (2013). İhracat, doğrudan yabancı yatırımlar ve işsizlik: Türkiye örneği [Export, foreign direct investment and unemployment: The case of Turkey]. *Business and Economics Research Journal*, *4*(1), 103–120.

Görg, H., & Görlich, D. (2011). *Trade and labour market outcomes in Germany* (OECD Trade Policy Working Papers No. 125). OECD Publishing. https://doi.org/10.1787/5kg3nh94z5r8-en

Greenaway, D., Hine, R. C., & Wright, P. (1999). An empirical assessment of the impact of trade on employment in the United Kingdom. *European Journal of Political Economy*, *15*(3), 485–500. https://doi.org/10.1016/S0176-2680(99)00023-3

Gül, E., & Kamacı, A. (2012). Dış ticaretin istihdam üzerindeki etkileri: Bir panel veri analizi. *Anadolu University Journal of Social Sciences*, *12*(4), 23–32.

Harley, C. K. (2012). Shipping and staple economies in the periphery. In G. Harlaftis, S. Tenold, & J. M. Valdaliso (Eds.), *The world's key industry: History and economics of international shipping* (pp. 29–42). Palgrave Macmillan. https://doi.org/10.1057/9781137003751_3

Hoekman, B., & Winters, L. A. (2005). *Trade and employment: Stylized facts and research findings* (DESA Working Paper No. 7, ST/ESA/2005/DWP/7). United Nations Department of Economic and Social Affairs. https://doi.org/10.2139/ssrn.780467

Hossain, K. A., & Zakaria, N. M. G. (2017). A study on global shipbuilding growth, trend and future forecast. *Procedia Engineering*, *194*, 247–253. https://doi.org/10.1016/j.proeng.2017.08.142

Jenkins, R. (2004). Vietnam in the global economy: Trade, employment and poverty. *Journal of International Development*, *16*(1), 13–28. https://doi.org/10.1002/jid.1060

Karaçor, Z., & Saraç, T. B. (2011). Dış Ticaret ile Sanayi Sektörü İstihdam Oranı Arasındaki Kısa ve Uzun Dönem İlişkisi: Türkiye Örneği (1963-2009). *Yönetim Ve Ekonomi Dergisi*, *18*(2), 181-194. https://izlik.org/JA42JL54LE

Kiyota, K. (2014). *Exports and employment in China, Indonesia, Japan and Korea* (OECD Trade Policy Papers No. 166). OECD Publishing. https://doi.org/10.1787/5jxzqqw84vmp-en

Ko, K., Rangkakulnuwat, P., & Paweenawat, S. (2015). The effect of international trade on labor demand in ASEAN5. *Economics Bulletin*, *35*(2), 1034–1040.

Leichenko, R. M. (2000). Exports, employment, and production: A causal assessment of US states and regions. *Economic Geography*, *76*(4), 303–325. https://doi.org/10.2307/144389

Li, K. X., & Cheng, J. (2007). The determinants of maritime policy. *Maritime Policy & Management*, *34*(6), 521–533. https://doi.org/10.1080/03088830701695172

Lucas, R. E. (1973). Some international evidence on output-inflation tradeoffs. *The American Economic Review*, *63*(3), 326–334.

Mandal, N. R. (2017). Characteristics of shipbuilding industry. In *Ship construction and welding* (Springer Series on Naval Architecture, Marine Engineering, Shipbuilding and Shipping, Vol. 2, pp. 15–28). Springer. https://doi.org/10.1007/978-981-10-2955-4_2

McMillan, M., & Verduzco, I. Jansen, M., Peters, R.H., & Salazar, J.M. (2011). New evidence on trade and employment: An overview. In M. *Trade and employment: From myths to facts* (pp. 23–60). International Labour Office.

Mello, M. H., & Strandhagen, J. O. (2011). Supply chain management in the shipbuilding industry: Challenges and perspectives. *Proceedings of the Institution of Mechanical Engineers, Part M: Journal of Engineering for the Maritime Environment*, *225*(3), 261–270. https://doi.org/10.1177/1475090211406836

Murphy, M. N. (2015). Triple barrels: The economic, financial and maritime warfare nexus in the twenty-first century. *The RUSI Journal*, *160*(2), 12–18. https://doi.org/10.1080/03071847.2015.1031520

Pekin, T. (2013). *Makro ekonomi*. Zeus Kitabevi.

Sasahara, A. (2019). Explaining the employment effect of exports: Value-added content matters. *Journal of the Japanese and International Economies*, *52*, 1–21. https://doi.org/10.1016/j.jjie.2019.02.004

Stopford, M. (2016). *Denizcilik ekonomisi* (O. Y. Ertaş, E. Bulut, G. Ç. Ceyhun, İ. Kılıç, O. Duru, S. İncaz, & S. Esmer, Çev.). Nobel Akademik Yayıncılık.

Strandhagen, J. W., Buer, S.-V., Semini, M., Alfnes, E., & Strandhagen, J. O. (2022). Sustainability challenges and how Industry 4.0 technologies can address them: A case study of a shipbuilding supply chain. *Production Planning & Control*, *33*(9–10), 995–1010. https://doi.org/10.1080/09537287.2020.1837940

Tandoğan, D. (2019). The impact of export on employment: Panel data analysis for regional base in Turkey. *Bingöl Üniversitesi Sosyal Bilimler Enstitüsü Dergisi (BUSBED)*, *9*(18), 799–814. https://doi.org/10.29029/busbed.559856

The Shipbuilders' Association of Japan. (2022). *Shipbuilding statistics March 2022*. https://www.sajn.or.jp/files/view/articles_doc/src/ee4f8d4545f55997ea857338ab8fc4fb.pdf

Trade Map. (2025). *Trade statistics for international business development*. https://www.trademap.org/Country_SelProductCountry.aspx?nvpm=1

United Nations Conference on Trade and Development. (2022). *Merchant fleet by country of beneficial ownership*. UNCTADstat. https://unctadstat.unctad.org/wds/TableViewer/tableView.aspx

Whang, U. (2019). Exports and job creation in South Korea: Industry-level analysis. *Journal of Korea Trade*, *23*(1), 2–18. https://doi.org/10.1108/JKT-05-2018-0042

Zakaria, N. M. G. (2012). Moving forward with export oriented shipbuilding industries in Bangladesh. *Journal of The Institution of Engineers (India): Series C*, *93*(4), 373–382. https://doi.org/10.1007/s40032-012-0034-0

Table 1 Variables used in the analysis

Variables	Type	Reference	Period to which the Data Pertains
Employment in the Turkish Shipbuilding Industry	Dependent Variable	https://tkygmistatistikleri.uab.gov.tr/gemi-ve-su-araclari-dis-ticareti (SHIPBUILDING EXPORT VALUE) **Data from 1995 to 2010** Website quoting the Ministry of Maritime Affairs as its source: https://gisbir.org/wp-content/uploads/2011_sektor_raporu.pdf **Data from 2011 to 2023** https://tkygmistatistikleri.uab.gov.tr/gemi-insa-sanayi-istihdami	2003-2023 (Annually)
Exports in the Turkish Shipbuilding Industry ($)	Independent Variable		2003-2023 (Annually)

Table 2 Descriptive statistics of variables

Variable / Data Type	Export ($)	Employment
Mean	1410000000	45349.62
Median	1270000000	39847.00
Maximum	2650000000	94057.00
Minimum	450000000	14300.00
Std. Dev.	511000000	23255.97

Table 3 ADF unit root test results

	At Level	**Ship Export**	**Employment**
With Constant	t-Statistic	-1.9873	0.6533
	Prob.	0.2899	0.9881
With Constant & Trend	t-Statistic	-2.2901	-1.3242
	Prob.	0.4223	0.8556
Without Constant & Trend	t-Statistic	0.1053	2.9502
	Prob.	0.7063	0.9984
	At First Difference	**d(shipexport)**	**d(employmet)**
With Constant	t-Statistic	-5.0716	-4.7079
	Prob.	0.0005***	0.0012***
With Constant & Trend	t-Statistic	-4.9337	-4.8202
	Prob.	0.0036***	0.0046***
Without Constant & Trend	t-Statistic	-4.9723	-3.4244
	Prob.	0.0000***	0.0016***

***: 99% significance level

Table 4 Autocorrelation test results

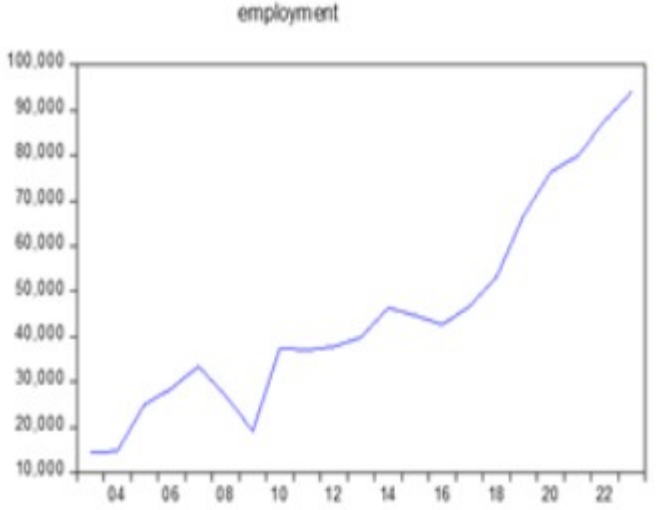
F-statistic	0.016310	Prob. F(1,17)	0,8999
Obs*R-squared	0.019170	Prob. Chi-Square(1)	0,8899

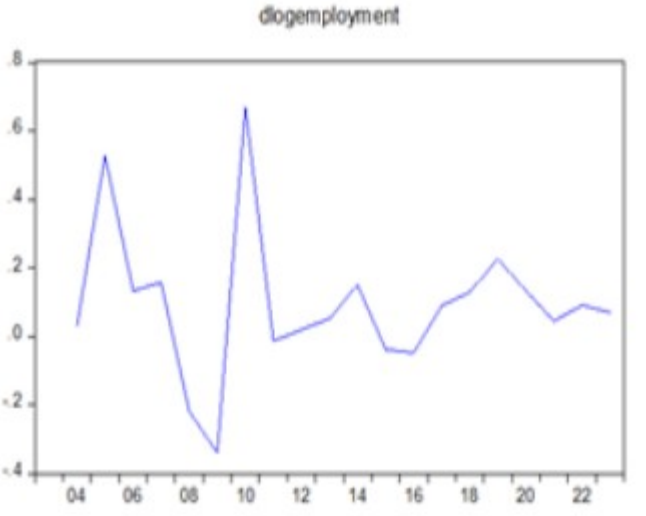
Tablo 5 Engle-Granger cointegration test results

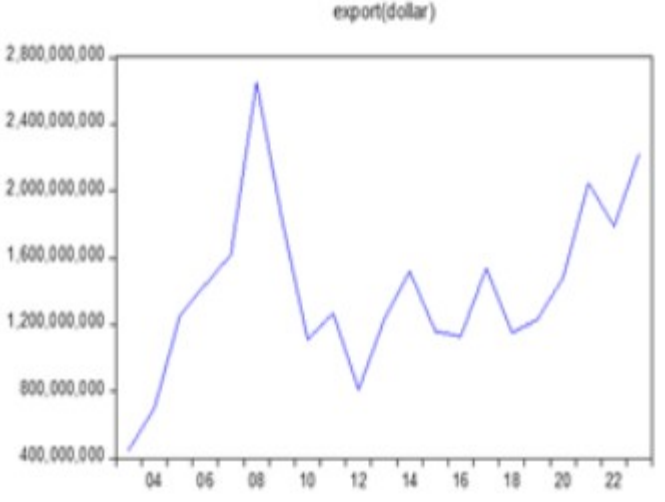
Dependent	**tau-statistic**	**Prob.***	**z-statistic**	**Prob.***
DLOGEXPORT	-4.505514	0.0106	-19.58544	0.0090
DLOGEMPLOYMENT	-4.534346	0.0108	-36.46481	0.0000

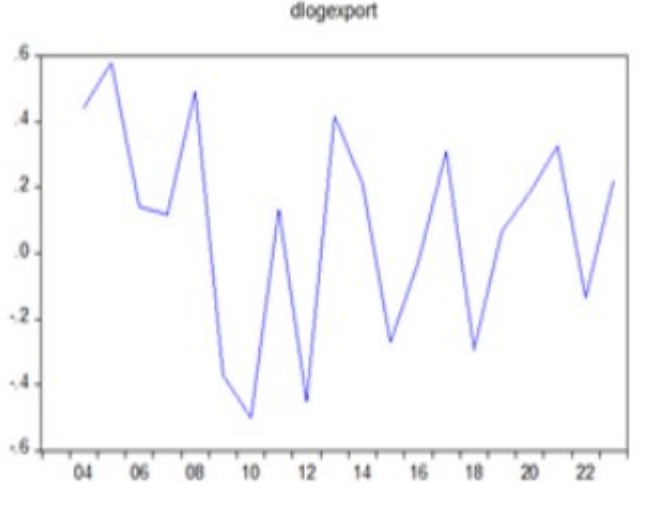
Table 6 Long- and short-term forecast results for employment and exports

Long-Term Forecast Results for Employment as a Dependent Variable				
Variable	Coefficient	Std. Error	t-Statistic	**Prob**
logexport	0.504467	0.004831	104.4259	0.0000
Short-Term Forecast Results for Employment as a Dependent Variable				
logexport	0.507494	0.002879	176.3048	0.0000
ect (-1)	-0.423142	0.068464	-6.180527	0.0000
Long-Term Forecast Results for Exports as a Dependent Variable				
Variable	Coefficient	Std. Error	t-Statistic	**Prob**
logemployment	1.978660	0.018948	104.4259	0.0000
Short-Term Forecast Results for Exports as a Dependent Variable				
Logemployment	1.969324	0.011170	176.3048	0.0000
ect (-1)	0.834805	0.134432	6.209847	0.0000


employment
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
04
06
08
10
12
14
16
18
20
22


dlogemployment
.8
.6
.4
.2
.0
-.2
-.4
04
06
08
10
12
14
16
18
20
22


export(dollar)
2,800,000,000
2,400,000,000
2,000,000,000
1,600,000,000
1,200,000,000
800,000,000
400,000,000
04
06
08
10
12
14
16
18
20
22


dlogexport
.6
.4
.2
.0
-.2
-.4
-.6
04
06
08
10
12
14
16
18
20
22