The Influence of International Sanctions on the Efficiency of Iranian Ports Using DEA Window Analysis

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This dissertation, which is an original work undertaken by Salman Zarbi in partial fulfillment of the requirements for the degree of Doctor of Philosophy of Business Administration, is in accordance with the regulations governing the preparation and presentation of dissertations at the Graduate School in the Korea Maritime and Ocean University, Republic of Korea.

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Abstract

The economic sanctions are defined as the practices of pressure by the first country against a second country in order to force a change in the political behavior of the second country. Iran is one of the countries that became the target of sanction imposed by the USA in early 1979 after the Iran revolution. However in 2010, by UN, US, and EU increased pressure by imposing new sanction against Iran's economy and trades. This sanctions expanded to different sectors of Iran economies such as energy, oil and gas, petrochemical, shipping, ports, insurance, shipbuilding, transportation, business, trade, transaction, and financial bans.

Todays the effect of sanctions from all three major imposers (i.e., UN, USA and EU) on Iran's economy are more visible and intensive. Iran economies still is suffering in many sectors due to lack of international investment, transaction, raw material and technology. The sanction influences are huge and its damage to Iran's economy is over 110 Bellion Dollars. Earliest and hardest sanction was targeted sea trade, especially shipping and ports business.

Ports performance and productivity were down, it's ranking fallen down 43 steps in world ranking, the sanctions influenced and damaged ports business and it was inevitable because the whole Iranian port business owning by government. Moreover, the productivity of Iran’s ports was reduced under the influence of imposed sanctions. Nevertheless, after implementation of various policies like the establishment and use of feeder shipping companies, the ports’ productivities were improved and ports’ relative efficiencies were increased.

To compare and evaluate these ports efficiencies, the ports data from 2000 to 2018 will be used which was published by the Iran Port and Maritime Organization (PMO), especially data from 2009 to 2018 will be studying and analyzing. By analyzing those data, it was found that the sanction had a huge impact on the container segment and it affected the general cargo ports activities. This effect was

shown 38% deduction on container port throughput and 10% on general cargo port. Furthermore, to evaluate the ports efficiency under sanction, the DEA window methodology has been applied.

The efficiency of both container and general cargo ports has analyzed using the DEA –SOLVER-LV8 (2014-1-18) program and the result are plotted by the efficiency charts and tables in chapter 5. According to analysis result, all of the container ports efficiency for two years after sanction are decreased. However, when ports managers has adapted a set procedure, the ports efficiency are improved.

Both container and general cargo ports analysis result in CCR-model showed that the ports of SHR and BUS have a higher source of efficiencies with the level of 0.86 and 0.97 for SHR port; and 0.76 and 0.96 for BUS port for container and general cargo, respectively. However, the lowest efficiency from container port belongs to CHB with efficiency source 0.086 and for general cargo ports belongs to the KSH port with efficiency source 0.85. While the result of analysis through BCC-model indicates that two highest efficiency levels of container ports belong to the BIK with efficiency source 0.87 and SHR with efficiency source 0.86; and those belong to SHR with efficiency source 0.98, CHB with efficiency source 0.98 and BIK with efficiency source 0.97 for general cargo ports. The container ports least efficiency belongs to CHB with efficiency 0.089 and for general cargo the ports least efficiency belongs to the KSH port with efficiency source 0.86.

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Chapter 1. Introduction

1.1. Introduction

The economic sanctions are defined as the practices of pressure by the first country against a second country in order to force some changes in the political behavior of the second country. The traditional economic sanctions are directed at the entire population of the sanctioned state or country. While targeted sanctions are directed at the state's government and/or individuals (Shamghli, 2012). The sanctions have been becoming an important part of the United States of America (hereafter called as USA)'s diplomacy. Today's more than 70 countries and 65% of the world's population is under their influence (Alikhani, 2000).

Iran is one of the countries that became the target of sanction imposed by the USA in early 1979 after the Iran revolution. As Iran's students seized the American embassy and captured 52 Americans in Tehran, the USA froze about 12 billion US$ of Iran's asset and banned trade as well as travel to Iran [Sen, 2018]. Those sanctions were lifted after Iran released the Americans on Jan 21, 1981 (Askari, 2003). While this was not the end. In 1992, USA again imposed sanctions against Iran, those that Iran is still struggling with. For the next years, Iran and the USA were in dispute in political and foreign policy. So still the USA government is pushing Iran to change political behaviors and choose different policies. In 2007, USA convinced the United Nations (hereafter called as UN) to adopt a resolution against Iran, when Iran did not accept to stop Uranium enragements. Iran emphasized that the uranium processing is for peaceful and energy production aims. However in 2010, after adopting a resolution by the EU that increased pressure on Iran's economy and trades, USA sanctions enforced and expanded to different sectors of Iran economies such as energy, oil and gas, petrochemical, shipping, ports, insurance, shipbuilding, transportation, business, trade, transaction, and financial bans.

This sort of USA sanctions which called "Comprehensive Iran Sanctions

Accountability, and Divestment Act" (CISADA) also prohibited investment in Iran and came in to force from 2011. Still, strife between Iran and USA is ongoing and the effects of the sanctions on Iran's economy are more visible and very intensive. Although the negotiation with EU high-level representative was ongoing but it was not so effective. Then Iran new government took position after election and they continued negotiations. Now USA also is participating in the negotiations and at the end 2015; the world powered countries (i. e. United State, England, France, Germany, Russia and China), EU high-level representative and Iran after long negotiations agreed to remove, all three major sanctions (UN, USA and EU) instead of limitation for Iran nuclear programs, and instead, Iran's nuclear program will be supervised by IAEA. For the years of 2016 and 2017, all parties enjoyed by the result of the important agreement, and IAEA monitored the implementation of the agreement and during 2 years, they issued at least 12 reports that Iran complies with the agreed commitments. When the new government of the USA came to the position, they criticized the agreement and finally they withdraw that, by re-imposing the sanctions against Iran and pushing other states to stop collaboration with Iran in those sanctions area. Although the new sanctions has applied by only the USA government, but due to the influence of economic power of USA, many countries are following USA sanction regimes. Therefore, Iran economy is still suffering from sanctions in many sectors due to lack of international investor, transaction, raw material, and technology etc. Therefore the influence of sanctions is huge and varies in different sectors. In order to estimate the total damage and loss, it is necessary to study its effect in different sectors. Some researchers estimate that the amount of sanction damages to Iran's economy is over 110 Billion Dollars. These values of economic effect need more investigation, besides the non-economic effects. One of the most important areas that became under the three major sanctions was sea trade, especially shipping and ports business. It seems that the Iranian ports are facing with a big challenges due to the sanction impact on the shipping and ports sectors. Since ports performances

and productivities were decreased and it's rank fallen down, it is important to study and find out why and how the sanctions influenced this much the Iran ports business and what was Iranian ports authorities remedial action facing with these changes. This study will focus on imposed sanctions on the marine business. To do so, we aim to investigate the effect of sanctions on the Iranian port performance and evaluate the ports relative efficiencies.

1.2. Objective of the Study

This study is meaningful in this context as it aims to evaluate the Iranian ports performance and the influence of sanctions on the Iranian ports' business, shipping, and container and general cargo volume during the sanction period in order to better prepare for the countermeasures.

Furthermore, the port business market is so sensitive and more competitive because of its internationalization. So the sanctions have influenced ports throughput and its efficiencies. In order to calculate the effect of sanctions on the ports efficiencies, the Data Envelopment Analysis (DEA) Windows approaches will be used. To compare and evaluate these ports efficiencies, the ports data from 2000 to 2018 will be used which was published by the Iran Port and Maritime Organization (PMO), especially data from 2009 to 2018 will be studying and analyzing.

1.3. Methodology of the study

The study about the influence of international sanction on Iranian ports and maritime business and investigation of the sanction elements would be useful and beneficial for all stockholders, which related to the firm of shipping and port and other relative industries. The challenges of Iranian port managers and port authorities and policymakers will be evaluated facing to the sanction and its restrictions. The DEA window tools will be used to calculate the port's efficiency and indicated results before, during and after sanctions will be compared. Since

the sanction was imposed for a period and due to the few DMUs, the DEA window methodology will be applied carefully to have the proper results.

1.4. Structure of the Study

This structure of the present study are in 6 chapters. Chapter 1 introduces the aim of study and its importance and the applied methodology. Chapter 2 deals with the literature review and the study background. In Chapter 3, the international sanction against Iran will be discussed. Chapter 4 will introduce the Iranian ports. Chapter 5 contains the DEA concept and DEA window methodology and the analysis result of the influence of sanction on the Iran container and General Cargo ports performance and relative efficiencies. And finally in chapter 6, the conclusions including the summery and implication are discussed.

Chapter 2. Literature Review

2.1. Study Background

There are few studies related to the Iran sanctions and its consequences, compared to the other economic studies. These studies are categorized in two groups. In the first group, the researchers focus on modeling theoretical problem under sanctions using the general equilibrium theory and the aim of their study is to understand the effectiveness of imposed-sanctions in the target countries. The second group, which are more than first, mostly concentrate on the evaluation of the impact of the imposed sanctions on the economy of sender and participant agent countries. Some of these studies result are given in the following.

Hufbaur and Schott (1985) argued that the foreign policy objectives achievements significantly cannot be supported and guaranteed by economic sanctions. They emphasized that the implementation of those objectives can occur when the sanctioned country or the aims of sender are mild. Ling Lam (1990) believes that the methodology which has been used by Hufbaur and Schott (1985) were not correctly applied, so it may not show the proper results. Lam (1990) has applied the Probit model and performed a 114 import effect under Iran sanctions. The results showed that the economic sanctions had significantly affected the sanctioned country and supported the achievements of the foreign policy objectives. Dollery (1993) studied a General Theoretical Equilibrium model and found that the import, exports, and financial sanctions on small economy-scale countries is against the welfare effect. According to the result of the study, the impact of economic sanctions on import sectors is considerable. In contrast, trade sanctions are showing an adverse effect on labor-intensive export sectors. Hufbaur et al. (1997) by using a gravity model in order to examine the effect of USA and participant agents' economic imposed sanctions against Iran, Libya, and Cuba for 1985, 1990 and 1995 using the least-squares method. In these studies, they divided

the sanctions to limited, moderate, and severe types based on the extent of their severity. For the sanctions imposed in all three types, the result showed moderately reduction for 27%, 35%, and 91%, respectively. Moreover, the effect of the sanctions for the USA economies was missing about 19.031 Billion Dollars. It is equal to 260,000 job positions that the USA lost as a sender of these sanctions. Bigdeli et al. (2013) studied a gravity model by collecting 30 Iran, trade partners, and evaluate the USA economic sanctions impacts from 1973 to 2007. They reported that the negative effect of the sanctions was 0.08%, and its impact against Iran's economy was small and had negligible influence on bilateral trade with partners. While when the CISADA came in to force in 2010, the provision of the act prohibits USA entities and individuals from exporting, re-exporting, selling, supplying goods, equipment's, materials, services, providing ships and shipping service, maritime transportation-related services, insurance, protection and indemnity (P&I) insurance and technology to Iran, participating in any transactions including transportation, financing or brokering deals; and servicing of accounts of individual Iranian banks (Shamghli, 2012). Furthermore, Iran ports operator that are operating seven ports of Iran became the target of USA sanctions to cut Iran government exports and imports arms (Linderman and Rose, 2011). UN sanction includes provisions to prevent Iran's use of the international financial system and EU sanctions ban the export to Iran of essential equipment and technology for refining petroleum product and uranium enrichment purpose, and all three major UN, USA, and EU targeted Iran's shipping industry, insurance, banking, energy sectors, ship-owners, ship charters, insurers, brokers, the shipping industry in general (Shamghli, 2012). Based on the results, the economic sanctions that imposed by the USA against Iran showed a significant and negative impact on all of the Iran's export trade partner. In all the periods, Iran's export value ranking of coefficients showed that for 2012, 2013, and 2014 it has shrunk annually by 33% on average and totally, Iran economy lost has been 104 Billion Dollars for three years (Sherazi et al., 2016).

According to the study by Faraji and Dizaji (2014), economic sanctions that led to the limitations of government revenue from oil exports could affect government spending as an important factor in Iran's economic growth. (Farzanegan and Parvari, 2014) studied the impact of economic sanctions on oil prices. This study considered the time from 1965 to 2012. Their result indicated that for the first two years, the reduction of oil export had significant negative effect on the oil price and global income. While controlling the oil supply by other countries after two years, the global oil prices reduced and justified due to over suppliers and filling the markets. Devarjan and Mottaghi (2015) conducted a study to evaluate the effect of imposed sanction against Iran on the trade with 28 trade partners for the period of 2000 to 2014. They found that Iran export income reduced by 17 Billion US$. The main issue here is that these studies are using the theoretical methods to estimate or predict the effect of imposed sanction. While it is clear that researches needs real effect of sanction on different sectors. Therefore, this study will attempt to recognize the area of sanction effects and will provide some evidences to examine the real effect of the imposed sanction, since the case studies results are more reliable than theoretical studies.

2.2. The Concept of Sanction

The economic sanctions are defined as the practices of pressure by the first country against a second country in order to force some changes in the political behavior of the second country. The traditional economic sanctions are directed at the entire population of the sanctioned state or country while targeted sanctions are directed at the state's government and/or individuals (Shamghli, 2012). The sanctions have been taken in different forms or may be exercised in several ways. Generally, sanction can be define as:

- Tariffs, duties or taxes imposed on goods imported from another country.

- Embargoes – Restriction on the trade and prevents a country for sending or receiving from others countries. For example, countries can prohibit its citizens or person from providing goods or services to another country.
- Asset freezes or seizures – Prevent the assets which owning by a country from changes, sold or moved.
- Quotas – limited goods can be exported or imported from/ to another country.
- Non-Tariff Barriers (NTBs) – This is a kind of restriction on importing from a country it can be applied to packaging, standard, and other requirements.

Sanctions are used for different purposes, such as a retaliatory purpose for another country's economic activities. For example, a car factory of a country might use a sanction if another country tries to protect the car industry by putting an import quota or tax on the car import. Sanctions may also be used as a tool in order to support human rights abuses. Sometimes countries impose sanctions against the others as a penalty. Sometimes the threat of a sanction is practical in changing the target country's policies. A threat shows that the country issuing the threat is an intention to go through economic tools to reprimand the target country if the policies do not change. The cost of the threat cost for the sender is less than that of military action, but it is accountable economic weight. At times, a government may consider practicing a sanction for internal reasons rather than international ones. Sometimes the nationalism is recognized, and one country may use the sanction to resolve or create a problem. Because of this problem, international organizations like the World Trade Organization (WTO) are working to reduce some of the pressure and open the panels to review disputes between countries to find the best solutions objectively. This is especially helpful to bring tensions down because sanctions can damage the trade and create economic wars that can cause more significant disputes between countries.

2.3. Types of Sanctions

The Sanctions can be categorized in two different types. First category of sanctions related to the number of parties issuing it. A "unilateral" only one country imposing the sanction (USA sanction), while a "multilateral" sanction means that a group of countries imposing or supporting that (NU and EU Sanction). Whereas multilateral, they can be considered less risky for enacting country, because no country face the sanction's result. Unilateral sanctions are effective if imposed by an economically powerful country. Another category of sanctions is related to type of trade that they limit. Export and import sanctions block goods flowing out or in the country. It is important to consider that blocking import from the country have higher economic impact than export. Export sanctions can create an incentive to substitute blocked goods for something else. Like blocking sensitive technological know-how from entering the target country. It is harder for the target country to create this high-tech good in-house. Blocking import through an import sanction, will experience a substantial economic burden. For example, on July 31, 2013, USA imposed sanction against Iran, which blocked Iran from selling any oil to abroad because of its nuclear program. It cut Iran's oil exports to half by international sanctions and Iran economy faced with industry collapse and unemployment, which could put significant political pressure on Iran government.

While the aims of sanctions are to force a country to change its political behavior, there is much variation, how and whom are targeted. Sanctions can target a country as a whole, as in case of an embargo on a country’s exports (e.g. USA sanctions on Cuba). Sanctions can target specific industries, like Iran oil industry. Since 1979, USA and EU have prohibited the imported or exported goods and services to Iran.

2.4. Content of Sanctions

Sanctions content can be a variety of different targets in an attempt to influence the activities of a particular state, regime or group of individuals. The

content of sanction that has been frequently applied are:

- Embargoes exporting and supplying goods and arms or associated technical assistance, training and financing.
- A prohibition on sending or transporting equipment that might be used for internal repression.
- Asset seizure from targeted state or government.
- Asset freezes from companies and other entities, or terrorist groups and individuals associated with those groups.
- Travel and transportation bans, stop service for ships and aircraft vessels/aircraft may be blacklisted.
- Bans on imports of raw materials or goods from the sanctions target.
- Many other measures can be applied according to individual circumstances.

Moreover, the sanction can be applied on:

- **Industries:** Restrictions can be implemented against industries linked to a particular state. For example, aspects of EU sanctions on Russia specifically target (inter alia) certain Russian financial and credit institutions, deep water oil exploration and production, Arctic oil exploration and production, and shale oil projects in Russia
- **State-wide:** Comprehensive sanctions are sometimes implemented against an entire state. For example, USA sanctions prohibit USA people from engaging in almost any transactions with Iranians, or in Iran.

2.5. Impact of a Sanction

The impact of a sanction on the target country can be seen in the export of the country immediately rather than purchased from abroad. Depending on the economic power, international partner, and trade share of the target country on the exported goods or services, this could have a huge effect on the economy of target country. The sanction may create the political and economic issues for the countries because of the failed state due to a power vacuum.

Sanctions sometimes show unintended consequences. For example, when the Organization of Arab Petroleum-Exporting Countries (OAPEC) imposed sanction against the USA in 1973 as a punishment for re-supplying Israel with arms, OAPEC used oil and its power as a tool of foreign policy, but the oil market has been crashed during 1973 and 74 due to the effect of the same sanction. It created a worldwide crises and economic instabilities, which were not the aims of the sanction. That sanction resulted that many embargoed countries reduced oil consumption and looking for a stable energy source instead of petroleum products, further cutting demand (Adcliffe, 2019).

Sanctions also increase business costs of the sanctioned countries. Depending on the number of business partners, the cost may be different for the target country. In some cases regardless of price, they may be unable to purchase goods, resulting in economical lost through increasing unemployment, as well as reduction of production. In addition, the supplier will reduce the choice of goods and services as well as the quality of services will be an issue for the country, and may increase the cost of business for private sector, government companies that must find elsewhere for supplies. The impact will be bigger when the sanctions are made multilaterally because purchasing or importing and exporting through the third-party country will be very difficult.

Both the sanction sender and its agent and sanction target countries economy may be damaged by imposing sanctions, the sender not only create bans for the

target countries resulting economic issues by receiving good or services, but also by making limitation for the sender companies and individuals for sending goods and selling services. As the economy of Iran, Cuba and Libya have suffered from bans of exporting goods and service under the influence of sanctions, the USA economy also faced with difficulties, estimated exports reduction about 19 Billion Dollars in 1995, which is equal to about 200,000 to 260,000 job positions (Hufbauer, 1997).

In general, despite such an increasing demand for the application of sanctions, sufficient insight into the effects and effectiveness of these instruments is still lacking. Moreover, there is no denying the fact that sanctions imposed against Iran have adversely affected the whole population, depriving it in principle of all those goods for which there is a domestic need, but which are not produced locally in sufficient quantity and must therefore be imported. So the social and economic human rights are violated seriously. In addition, the costs associated with the use of sanctions must also be gauged, so that the utility of sanctions (whether the sanctions achieved their goals at reasonable price) can be determined. In this case, despite their ineffectiveness, the price tag sanctions carried was not few. Sanctions harmed USA and other European countries interests in the energy, economic and political realms. Furthermore, sanctions against Iran tend to decrease world energy supply, thereby maintaining a higher price for oil than would otherwise be the case.

To sum up, the sanction influence can be vary from the economic sectors such as limitation for transportation, industries, labor wage, and increase of unemployment and cut infrastructures development. For the business and trade sectors, sanction may block the country gate for international business. It can ban travel, and consequently, cut the nations cultural interest. In addition, the most importantly, it can influence the ordinary people lives by bringing up the life costs and limitation in health and hygiene essential.

Chapter 3. International Sanction on Iran

3.1. Overview and Objectives

Iran is one of the countries that became the target of sanction imposed by the U.S.A in early 1979 after the Iran revolution. As Iran's student seized the American embassy and captured 52 Americans in Tehran, the U.S.A froze about 12 billion US$ of Iran's asset and banned trade as well as travel to Iran [Sen, 2018]. Those sanctions were lifted after Iran released the Americans on Jan 21, 1981 (Askari, 2003). But during Iran and Iraq War (1980-1988), the USA again imposed another economic sanctions to Iran which prohibited any help and assistance from the USA to Iran and banned any import/export goods and services from/to the Iran, which were expanded later in 2007 when The United Nations Security Council (UNSC) passed Resolution 1696 in 2007 and then the sanctions were imposed. Next, Iran refused to stop its Uranium enrichment program because they emphasized that their nuclear plan is for the civilian, electricity and medical needs (Shamghli, 2012). Consequently, United Nations (UN) exercised the economic sanction against Iran in order to change the Iran's policy including Uranium enrichment program. Following that, new sanctions which targeted the oil and gas firms, refined petroleum investment and productions were imposed in 2009 and finally; the Comprehensive Iran Sanctions Accountability, and Divestment Act of 2010 (CISADA) was defined by USA on 24th June 2010. On the top of that, the USA has forced international efforts to support the sanctions to change the behavior of Iran (CISADA, 2010). These sanctions initially targeted the investments in oil, gas, petrochemical, exports of petroleum products, economical dealings with Iran, banking and insurance transactions, shipping, shipbuilding as well as port operators (Holman, 20110). However, the European Union (EU) along with the USA had also applied sanctions on the Iran's nuclear program. The focus of EU sanctions were mainly limited to the trading with Iran such as the investments in oil and gas sectors or even the relevant industries, insurance as well as shipping and port sectors too. On 26th July 2010, the Council of EU approved Decision 2010/413/CFSP. This Decision confirmed the restrictions taken by EU

against the Iran since 2007, which were set forth in the Regulation No.423/2007. The restrictions contained in the July 2010 Decision mainly focused on the oil and gas, transportation, financial and insurance sectors. Then on 2nd December 2011, the scope of Regulation 961/2010 was greatly expanded by Regulation 1245/2011, which added 143 entities and 37 entities to Annex VIII with a particular focus on the 116 entities with a connection to the Islamic Republic of Iran Shipping Line (IRISL), some of which were linked to the vessels by means of reference to an IMO number (EU 1245/2010, 2010). The list included many companies based on outside of Iran, such as Germany, Malta, Turkey, Singapore, Hong Kong, China and Dubai. If Iran's nuclear negotiations with the "P5+1"[1] were not conclusive, they pointed out that they were therefore preparing to impose the new economic sanctions to Iran.

But the "P5 +1" and Iranian governments agreed on a long-lasting talk in Lausanne, Switzerland on 2nd April 2015 and they concluded that the Iran's sanctions will be removed instead of limiting the expansion of the Iran's nuclear facilities for at least 10 years. The "P5+1" and Iran then agreed on a joint comprehensive plan of action (JOCAP). As a result, the UN passed resolution 2231 and the sanctions were lifted on 16th January 2016 (S/RES/2231, 2015). Despite so, those sanctions had caused many different sectors of Iran nation like energy, petrochemical, transportation, ports, health, etc. to run afoul with economic ramifications. Worse still, it seems that the USA will still force the world to cut trading with the Iran as recently, the USA just issued a series of guidance for dealing with Iran shipping lines and financial products (BAFT/TEC, 2017). As can be seen from Figure 3.1, during the recent years, many countries became under USA sanctions. Those sanctions have been used as tools by USA foreign Department to implement their policies in many countries in the world.

[1] The "P5+1" group of world powers - the United States, United Kingdom, France, China, Russia and Germany.

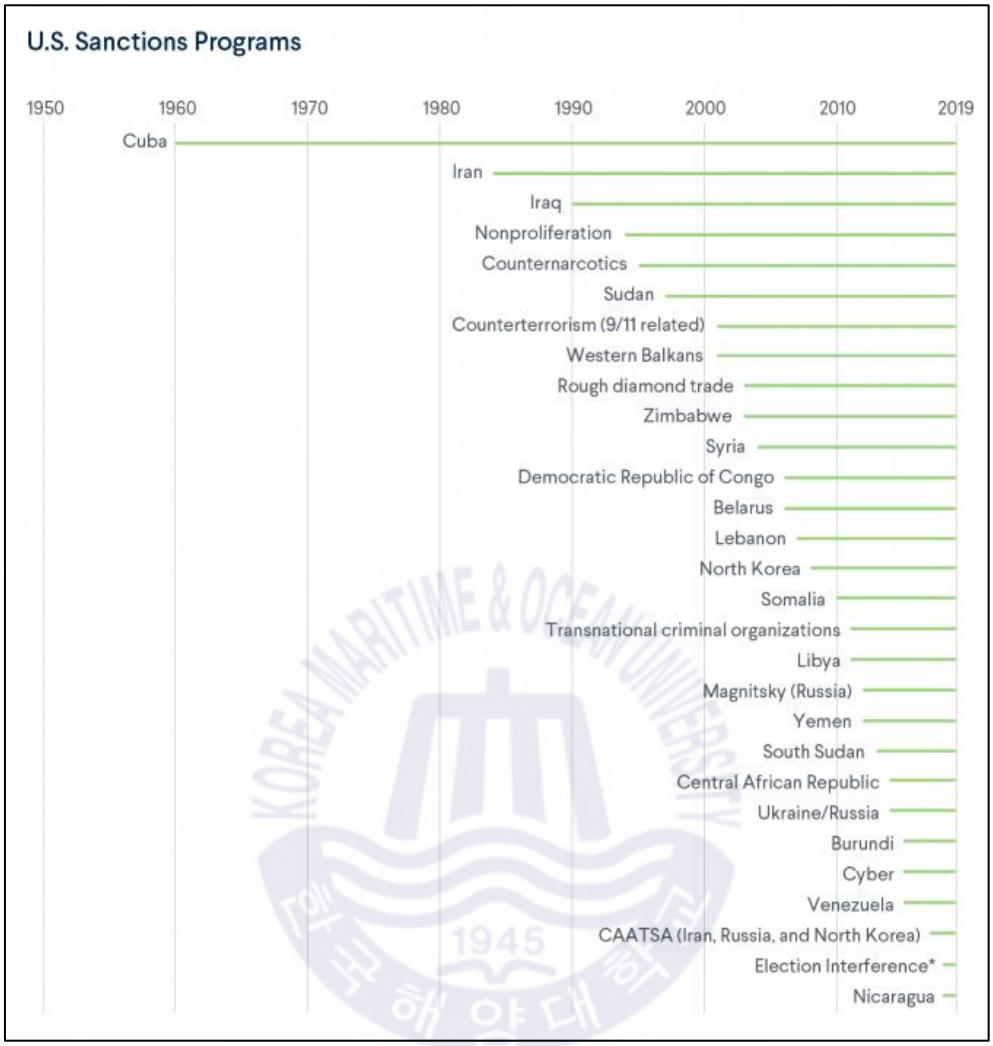

Figure 3.1. The sanctioned countries
Source: USA Treasury Department

3.2. Categories of Sanctions

Nowadays sanctions are targeting many of countries. As it is seen from Figure 3.2, there are mainly three major sanctions. This section discusses the categories of sanctions imposed to Iran, namely restrictions of UN, EU and USA will be presented and finally the other nation sanction against Iran will be reviewed.

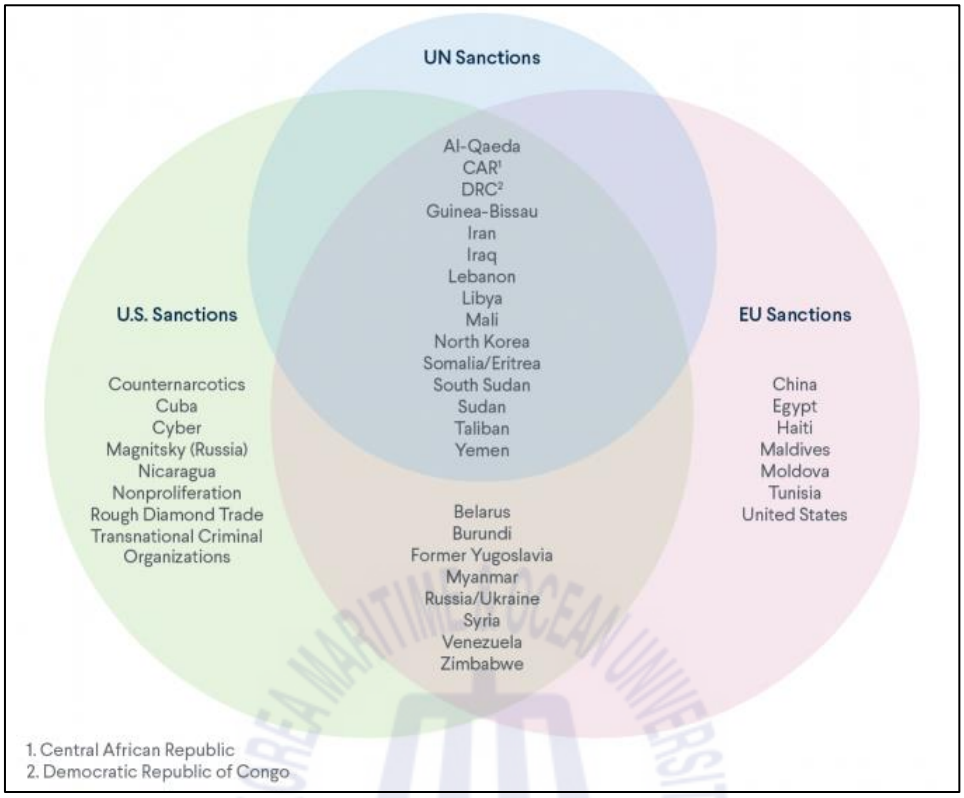

Figure 3.2. Global sanction regimes
Source: council of the European Union.

3.2.1. UN Sanctions

On 9th June 2010, the UN Security Council passed Resolution 1929/2010 which targeted 41entities and individuals. Owned, controlled or acting on behalf of the Iran Shipping lines (Resolution 1929, 2010).

This added to the previous adopted sanction by UN which imposed to Iran are still in place, including the restrictions on supplement and sending of goods and technology which could be applicable for nuclear activities and any financial support[2]. In addition, the new sanctions targeted the maritime industry perspective including:

- Prohibition on providing any kind of financial support or services, such as

[2] United Nations Security Council Resolution 1737 - passed on 23 December 2006

insurance cover to Iranian assets and ships.

- Prohibition on providing bunkers or other services to Iranian owned or chartered vessels.
- Inspection of ships, cargo handling to or from Iran and of ships on the high seas if sanctioned cargo is suspected to be on board.
- Prohibition on business with the Islamic Revolutionary Guard Crops (IRGC) or designated IRISL related entities.
- Prohibition on opening any branch or subsidiary of an Iranian bank in a UN Member State.

3.2.1.1. Restrictions

The UN new sanction, which adopted on 9 June 2010 targeted different firms affiliated with the IRGC firms, added them to the list of sanctioned entities. Moreover, banned travel for Iranian individual named in it, including those Iranians for whom there was a nonbinding travel ban in previous resolutions. In addition, new Resolution provided the authorization to states to evaluate and inspect any cargo shipments to Iran which suspected to carry contraband items and it may allow Iran to increase the capability of uranium mining and related technologies or ballistic missile technology.

The Council banned sales of most categories, which was possible to use for lunching of missiles Furthermore, it requested form member states to insist and control their companies refrain from dealing with Iran if there is a possibility that such deal could help Iran's Weapons of Mass Destruction (WMD) programs[3]. The Council pushed the states to close Iranian banks in their countries, and their banks stop working in Iran[4]. In addition, the Resolution has not shown a mandatory measures that were considered, including banning any foreign investment proposal,

[3] Text of Resolution: http://www.un.org/sc/committees/1737/resolutions.shtml
[4] Text of Resolution: http://www.un.org/sc/committees/1737/resolutions.shtml

banning insurance service for Iran transport and vessels and banning international investment in Iran's energy sector; banning the trade credits to Iran, and banning all financial deal with Iranian banks.

3.2.1.2. Enforcement and Penalties

The UN requested all member states to apply penalties through the national legislation instead of putting in place penalties apply to all member states.

According to the scale of breach of the UN sanctions, results in criminal prosecution, fines or blacked of assets. Any authorized power persons or different states have extensive powers for checking and enforcing in order to help the UN sanctions against Iran.

For instance, the most state of members, authorized persons has been introduced police or customs officers and other persons authorized by the Secretary of State. Authorized person will investigate when there is a reasonable sign that shows ships or cargos are going to/from Iran including sanctioned good that can be used or increase in Iran military powers or weapons (Woolich and Morrison 2011).

The power of authorized persons include the power to:

- Stop and board a ship, divert it into national waters and detain it there;
- Search the ship, and anyone and anything on it, including its cargo;
- Arrest without warrant anyone believed to be guilty of the carriage of prohibited goods;
- Seize, detain and/or dispose of prohibited cargos.

3.2.2. The EU Sanctions

The EU imposed sanctions were passed by the EU Foreign Affairs Council in order to target the energy, insurance, transport and financial sectors and it has been applied since 27th July 2010. This Council Decision followed and supported

reinforcement of UN Security Council Resolution 1929 on 9 June 2010 by the UN Security Council.

The EU sanctions are considerably broader and more accurate than those sanction that imposed by the UN, which were concentrated on stopping the sale and supply of goods use in nuclear production and missile development to Iran and the sanction regime are applicable to all EU member states[5].

The EU member state has followed UN Resolutions; the latest is adoption of UN Resolution 1929/2010 by means of Regulation 532/2010 on 18th June 2010. On 26th July the European Council Decision showed that EU intention are stringent than the UN which had two main consequences:

- Implementing Regulation 668/2010 on 26 July applied restrictions on various persons and entities with immediate effect. This added to the list in an earlier Regulation (Regulation 423/2007) and included 25 companies connected with Iranian Shipping Line.

- The Council Decision banned and restricted business with Iranian entities. This includes forbiddance on insurance and re-insurance and on supply of important tools and technology to the oil and natural gas industry. Before this part of the Council Decision came into force an Implementing Regulation was required. After undergoing several drafting amendments, the Implementing Regulation was adopted by the EU Foreign Affairs Council on 25 October. The regulation came into force in all EU member States on 27th October 2010.

3.2.2.1. Restrictions

The EU Sanctions Regulation seeks restriction on investment and trade with

[5] Clyde & Co, *EU Sanctions: Iran, An overview of sanctions adopted by the EU Foreign Affairs Council*, (27 July 2010), p 1, available online at: https://www.clydeco.com/uploads/Files/Publications/2010/Iran%20EU%20sanctions%20update%20July%202010.pdf (last visited 19 October 2019)

Iran with a consideration on the Iranian oil and gas industry. The regulation also showed restrictions relating to the provision of insurance/reinsurance to Iranian entities; limited transfers and transaction from/to Iranian entities; limited the provision of financial services and limitation on transportation. Some of the important provisions that has been restricted are commented below:

3.2.2.1.1. Insurance

Under the EU Regulation No 961/2010, the provision of insurance and re-insurance to the following is banned:

- The Government of Iran;
- Entities incorporated in Iran;
- Anyone incorporated in Iran;
- Individuals and entities acting on behalf of Iran:
- Entities owned and controlled by Iran, including through illicit means.
- Even deployment or renewal of insurance or re-insurance contract concluded before to entry into force of Regulation (EU) 916/2010 is also banned. However, compliance with agreements concluded before that date, is not banned[6].

3.2.2.1.2. Export / Import restriction

Based on to the EU Council Decision, it is banned to sale, send or supply to Iran of dual-use goods, technology and facilities, which might be used for military purposes. In addition, there are restrictions on dealing important equipment and technology which could be used to uranium enrichment, reprocessing or heavy water-related activities, or possible to use in development of nuclear weapons

[6] Clyde & Co, *EU Sanctions: Iran, An overview of sanctions adopted by the EU Foreign Affairs Council*, (27 July 2010), p 1, available online at: https://www.clydeco.com/uploads/Files/Publications/2010/Iran%20EU%20sanctions%20update%20July%202010.pdf (last visited 19 October 2018)

systems. The prohibition also included arms and all other related equipment's and goods and technology listed in the Common Military List. Any export to Iran of items indicated above whether or not originating in the EU, is subject to prior authorization by the competent authorities of the exporting Member State identified according to the EU Regulation, who shall not grant authorization if they have reasonable grounds to determine that these items will contribute to enrichment, reprocessing or heavy water-related activities or to the development of nuclear weapon delivery systems, providing technical assistance, brokering services, financing or financial assistance (including grants, loans and export credit insurance) is also prohibited. It is also forbidden to import and transport from Iran of the listed banned products.

3.2.2.1.3. Transport

All goods from/to a Member State to/from Iran are now required to have additional pre-arrival or pre-departure information. Also all Member States are required to inspect all cargo, air and sea to and from Iran if they have reason that the cargo include items, the sale, supply, send or export of which is banned under these sanctions.

EU States may request survey and investigation, with the consent of the flag State. Member States are required to co-operate with inspection requests by other Member States. Any prohibited items will be seized and disposed by the Member States and the costs of this disposal are to be met by the exporter/importer or any other responsible person for the attempted supply, sale or transfer. The bunkering service or ship supply or servicing of vessels by nationals of Member States to Iranian ships or hired vessels, including chartered ships is prohibited if that national has reasonable grounds to believe that the vessel carries items prohibited under the sanctions with the exception of services necessary for humanitarian

purposes or if the cargo has been inspected and if necessary, seized and disposed of[7].

Furthermore, The EU sanctions also included provisions about travel and education bans, asset freezes, air transportation sector, finance etc.

3.2.2.1.4. Scope of Sanctions

The EU Regulation applies:

- Within the EU member State territory, including its airspace;
- On board any ships or airplane or any ship under the legislation of a Member State;
- To any person at the territory of the member state who is a national of a Member State;
- To any person, entity or body which is working and or organized under the law of a Member State;
- To any legal person, entity or body which is doing any business in whole or part within the EU.

The Regulation also implements a defense of ignorance or due diligence. Article 31 states that the prohibitions on insurance and reinsurance set out in Article 26 (among other prohibitions) shall not give responsibility of any kind on the part of natural or legal persons or entities if they did not know, and there is no special reason to suspect, that their actions would infringe them[8].

3.2.2.1.5. Implementation and Compliance

The EU Regulation 961/2010 is in force as of October 27, 2010. As EU

[7] Common Military List of the European Union, adopted by the Council on 15 February 2010, available online athttps://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2010:069:0019:0051:EN:PDF (last visited 19 October 2019)

[8] Common Military List of the European Union, adopted by the Council on 15 February 2010, available online athttps://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2010:069:0019:0051:EN:PDF (last visited 19 October 2019)

regulations in general are of direct effect, they must be observed by companies and any other person subject to the jurisdiction of the EU and its Member States.

It is upon the individual EU Member States to decide on the penalties applicable for violation of the EU sanctions regime, and to take all measures necessary to ensure that the measures are implemented.

3.2.3. United States

The latest act of the USA on imposing sanction against Iran was on 14 December 2011, which, the House of Representatives approved two detailed and far reaching bills. The aim of these bills is to tighten sanctions against Iran and other countries. HR 2105, the Iran, North Korea, and Syria Nonproliferation Reform and Modernization Act[9], would have a far reaching effect on shipping to the USA. Section 11 of the Bill would amend the Ports & Waterway Safety Act by requiring owners, operators, charterers or the master to certify before arrival at USA ports that their vessel has not permitted to call port in Iran, North Korea, or Syria for the 180 days. This measure would significantly disrupt to the global oil trade.

The second bill is the Iran Threat Reduction Act of 2011 (HR 1905) which aims at stricter implementation of the Iran Sanctions Act, including the measures affecting Iran's refined petroleum sector. Section 301 would target, inter alia, insurance for shipment of petroleum, oil or Liquefied natural gas (LNG) if the IRGC involved to manage directly or indirectly to product or transport.

Both Bills are not in force yet and need to be signed by the President after approval of the Senate. However it is obvious that the aim is tightening and that new measures will be far reaching and come into force rapidly.

[9] Text of H.R. 2105: Iran, North Korea, and Syria Nonproliferation Reform and Modernization Act of 2011: https://www.govinfo.gov/content/pkg/BILLS-112hr2105rfs/pdf/BILLS-112hr2105rfs.pdf

3.2.3.1. SDN List

The USA Treasury Office of Foreign Assets Control maintains a list of over 6,000 Specially Designated Nationals and Blocked Persons (the SDN List). Particular reference should be made to the list of vessels on pages 459 to 463 and the entities subject to Iran sanctions on pages 470 to 474[10]. Moreover, sanctions extend to not only the listed persons or entities but also persons or entities acting on their behalf.

On 17 August 2010, the USA treasury designated three more companies with links to IRISL (Marble Shipping Ltd, Bushehr Shipping Co and ISI Maritime Ltd.). Later on 27 October, the SDN List was updated by the addition of 5 individuals and 37 companies with addresses in Germany, Iran and Malta, which are said to have connections with IRISL.

The SDN List was further updated on 30 November 2010 by the addition of 5 individuals and 8 companies with addresses in the Isle of Man and said to be connected with IRISL. The SDN List was updated on 21 December 2010 as well by the addition of a number of companies involved in shipping and marine insurance, including a Tehran based company providing P&I cover, Moallem Insurance. Again on 13 January 2011 the list was updated with 20 Hong Kong based shipping companies and four based in the Isle of Man[11].

Another important update was made on 31 March 2011 entries for 21 vessels owned Iranian Shipping Lines (IRISL) that have since been renamed by IRISL and its affiliates. OFAC is also identifying three additional vessels as blocked property due to their affiliation with IRISL.

[10] Text of SDN List available online at : https://www.treasury.gov/resource-center/sanctions/SDN-List/Pages/default.aspx (Last visited at 20 October 2019)
[11] US Department of the Treasury, *Addition to OFAC's SDN list*, 13 January 2011, available online at: https://www.iranwatch.org/library/government/united-states/executive-branch/department-treasury/additions-ofacs-sdn-list- (last visited at 20 October 2019)

The last update was on 19 January 2012, which added 4 individuals and 4 entities to the list.

3.2.3.2. The Comprehensive Iran Sanctions, Accountability and Divestment Act 2010

The CISADA came into force on 1 July 2010 (formerly known as the Iran Refined Petroleum Sanction Act). The provisions of the Act prohibits USA entities and individuals from exporting, re-exporting, selling or supplying goods and technology to Iran, participating in any transactions including transportation, financing or brokering transactions and the servicing of accounts of certain Iranian banks[12].

The enabling act passed on 1 July 2010 amends the Iran Sanctions Act of 1996, and prohibits the provision of refined petroleum or support related to the production of refined petroleum to Iran. It includes in its definition of "person" financial institutions, insurers, underwriters, guarantors and any other business organization including foreign subsidiaries, parents or affiliates. The effects of the Act are already being felt. Lloyd's of London no longer provides cover to owners of ships taking refined petroleum products to Iran. In addition, by 14 July 2010 there had been no reported spot fixtures in July involving Iran-bound product tankers. Iranian air carriers were refused fuel at airports even though it was uncertain as to whether that action would be prohibited under the new sanctions. Early in 2010, insurers Allianz and Munich Re announced their plans to exit Iran. The available sanctions under CISADA against insurers, ship owners and charterers who engage in the CISADA-offending activities described above are:

- Prohibition within U.S. jurisdiction of foreign exchange transaction in which a sanctioned person (sanctions target) has any interest;

[12] 13Text of CISADA, available online at:
https://www.treasury.gov/resource-center/sanctions/Pages/default.aspx

- Prohibition within USA jurisdiction of payments and other transactions which involves any interest of a sanctioned person (sanctions target);
- The blocking of the property (freezing of the assets) within USA jurisdiction of a sanctioned person (sanctions target).
- Denial of U.S Export-Import Bank Loans or credit facilities for U.S exports to the sanctioned person;
- Denial of U.S bank loans exceeding $10 million in one year;
- Prohibition on U.S. government procurement from the sanctioned person; and
- Restriction on imports into the United States from the sanctioned person.

Furthermore, if sanctions are triggered, CISADA requires the imposition of at least 3 of the 7 sanctions described above (Eren, 2010).

3.2.3.2.1. Exception

CISADA provides that no sanctions are to be imposed on an underwriter, insurer or re-insurer if the President determines that a person has showed practice to enforce the policies, method and controls to ensure that the person does not underwrite, insure or re-insure the sale, lease or provision of goods, services, technology, information or support that could directly and significantly contribute to Iran's ability to import refined petroleum products[13].

3.2.3.2.2. Scope of CISADA

CISADA expands the scope of the Iran Sanctions Act 1996 and targets Iran's refined petroleum supply through several new provisions, which requires the USA President to impose at least three of the seven above- referenced sanctions on who has knowingly been involved in the:

[13] SEC. 102. CISADA

- Sale, lease or provision of goods, services, technology, information or support—worth at least $1,000,000—that could directly and significantly facilitate Iran's domestic production of refined petroleum;
- Provision to Iran of refined petroleum worth at least 1 Million Dollar or an aggregate value of 5 Million Dollars or more during a 12-month period; or
- Provision of goods, services, technology, information or support worth that have total value of 5 Million Dollars or more during a 12-month period that facilitates Iran's importation of refined petroleum.
- Goods, services, technology, information or support including:
- Underwriting or entering into a contract to provide insurance or reinsurance for the sale, lease or provisions of such goods, services, technology, information or support;
- Financing or brokering such sale, lease or provision; or
- Providing ships or shipping services to deliver refined petroleum products to Iran[14].

3.2.4. National Sanctions

Many States are introducing their own domestic laws, in many instances based on UN resolutions: Norway, Canada, United Kingdom, South Korea[15], Japan, and Russia:

- These state has introduced sanctions trying to balance them close relationship with the USA while trying to minimize damages to its extensive trading links to Iran.
- They listed Iranian entities and individuals for economic sanctions including a major banking operation. Trade with Iran, new investment, technical services, financial services and building contracts for Iran's petroleum and

[14] SEC. 102. Expansion of sanctions under the Iran Act of 1996

[15] Sang-Hun, C, *South Korea Aims sanctions at Iran*, the New York Times, September 8, 2010

gas industries is prohibited.

3.3. Joint Comprehensive Plan of Action (JOCAP)

On 2nd April 2015 Iran and world five powerful country Russia, England, United Stated, China and France plus Germany agreed after long-lasting talk in Lausanne Switzerland, on a joint comprehensive plan of action (JOCAP). They concluded that the Iran's sanctions would be removed instead of limiting the expansion of the Iran's nuclear facilities for at least 10 years. As a result, the UN adopted resolution 2231 on 20 July 2015, and EU council adopted the legal acts and the sanctions were lifted on 16th January 2016 (S/RES/2231, 2015). In particular, these acts determined that sanctions no longer were applied related to Iran Civil nuclear program. Despite so, those sanctions had caused many different sectors of Iran nation like energy, petrochemical, transportation, ports, health, etc. to run afoul with economic ramifications. Worse still, it seems that the U.S.A will still force the world to cut trading with Iran; as recently, the U.S.A just issued a series of guidance for dealing with Iran shipping lines and financial products (BAFT/TEC, 2017).

In January 2016, the IAEA acknowledged that Iran had accomplished the nuclear agreement requirements. Further, the IAEA for three years issued verification and monitoring reports, which certified Iran’s ongoing compliance with JOCAP. Most significantly, the USA stopped enforcing related sanctions oil sector, shipping and business, which allowed Iran to increase its oil exports to the level that it had been before sanctions. In addition, The USA released certain funds seize from Iran. Nevertheless, when the new government took position in USA, they criticizing the agreement and discouraged trade and investment with Iran. Finally the USA withdraw the JOCAP and discouraged foreign governments and companies from trading with or investing in Iran and re-imposed all the previous sanction and consequently the EU and many other national company and firms kept out from Iran markets.

3.4. The Impact of Sanction in Iran Marine and Port Business

The sanctions imposed by the international entities and various nations have a great impact on companies and private individuals who charter ships and transfer negotiable documents relating to maritime trade in Iran. Firstly, all parties, such series of transactions. In such a system where charterers, consignors and freight forwarders are in danger because unauthorized vessels will seek to evade being recognized by concealing ship ownership or the identity of said ship reliable far-reaching vessel-vetting procedures are required.

3.4.1. Shipping and Charter Party Business

Imposed sanction affected the shipping lines and Ship-owners, and consignees of cargo, all parties must be consistently identified to a transaction or series of transactions. According to all three major sanctions, a ship-owner or operator cannot be directed to carry out prohibited shipment or transport unlawful goods from Iran ports or discharge at the Iranian ports (Thomas, et al. 2010). Charterers are also at risk to order ships to carry refined petroleum products for discharge in Iran or carry out shipments that violate sanctions since such charter parties have been concluded before the relevant sanctions have come into effect. Such an order will or will not be refused depending on the charter party provisions.

3.4.2. Insurance

P&I Clubs are always at risk in relation with sanctioned targets. They might unintentionally insure prohibited cargo or ships carrying sanctioned cargo and its Members may engage in illegal activities through business contact with unauthorized agencies[16]. For this reason, sanction compliance clauses are often included into policies, which for example stipulated that if the assured violates sanctions the coverage is suspended and the assured must then cover the insurer for losses sustained. To avoid violating sanctions regulations, clubs have changed

[16] Insurance Insider, P&I Clubs Nervous Over Fresh Iran Sanctions, 23 February 2010

their rules that once a Member vessel is exposed to the risk of infringement cover is loss or membership is terminated.

P&I Clubs provided sanctions development information in circulars and encourage their Members to pay close attention to such information. Lloyd's of London, the world's largest insurance market, in a move to support the USA sanction has restricted insurance on shipments to Iran. Lloyd's Market Association (LMA) has drawn up a sanction clause for its members that can be applied to both marine and non-marine insurance market[17].

Furthermore, it should be noted that there are restrictions on insurance sector in all three major sanction regimes (UN, EU and USA) which require P&I clubs, entities and individuals who are in trade with Iran, to distinguish the scope of each regime.

Regarding the complexity of international trade and corresponding marine insurance, it is the policy of many international shipping insurers to refuse to insure any vessel that is scheduled to stop at, load, or unload at Iran.

Insured parties with trade and finance connections to Iran will come under more scrutiny as sanctions' legislation enacts and, there is the probability for more coverage restrictions.

Other likely sanctionable activities include, for example, maritime transport (ship-owners and charterers) and related ship services (operators and technical managers), ship brokering (sale, charter, and container), ship suppliers (for sale of ships both used and new), and financial services related to maritime transportation services (including insurance and reinsurance). Cargo insurance and reinsurance, protection and indemnity (P&I) insurance and reinsurance, hull insurance and reinsurance, contract frustration insurance and reinsurance, and any other

[17] Lloyd's Sanction Limitation and Exclusion Clause

insurance or reinsurance associated with the shipment of refined petroleum products to Iran may also be sanctionable.

According to all three major sanction regimes, a ship-owner or operator cannot be directed to carry out a prohibited shipment or transport unlawful goods. Transported products will be unlawful if it contravenes laws at the port of loading, the port of discharge, the Flag of the ship or the governing law of the charter.

3.4.3. Financing of Maritime Trade

If most contracts require for business to be conducted in US$, there would be the ongoing risk that international trade and financial dealing will breach USA sanctions and experience significant penalties. Generally, however, business conducted in US$ passing through the USA banking system under the USA legislation may be at risk of being frozen if they can be traced to Specially Designated Nationals. There are already a number of banks that have paid the price of past non-cooperation with USA sanctions. One bank recently settled a claim for over 200 million US$ because of breaching that took place in relation to non-USA banks outside the USA but where funds passed through the USA and were related to illegal transactions. Other banks have also recently been subjected to pay considerable fines because of USA sanctions violations that are related to various countries including Iran. These violations include those committed several years in the past back (Linderman, et al., 2010)

To protect themselves, some financial institutions have begun taking pre-emptive steps. For example, one bank is known to have produced a sanctions clause for ship finance transactions. Kuwait's central bank is also reportedly declining offers from Iranian banks to open branches in Kuwait after they failed to meet the compulsory conditions. Swiss banks are reported to have frozen the accounts of 40 Iranian companies thus far. Banks that have yet to put into practice

pertinent procedures are likely to do so as part of due diligence measures (Farrar, 2010).

These banking sanctions are grave and crippling and the outcome is particularly apparent when considering Iran's transit. Banking sanctions caused a percentage of Iran's transit to disappear whereby creating an advantageous situation for Turkey, Pakistan, and Georgia, which are the major rivals. Jordan, Syria, Kuwait and Saudi Arabia, whom are also Iran's other rivals to trade with destinations like Iraq (Toumi, 2010)

3.4.4. Port Business

Based on the USA, any company, person or states engaged to export and import to/from Iran, and any vessel calls Iran ports or any transaction conducting by US$ are subjected breach of sanctions. All companies barred to conduct business with Iran's ports or shipping industry.

The Tidewater Middle East Company as main operator of the seven ports of Iran was added to Specially Designated Nationals (SDNs) listed by USA Department of the Treasury on 23 June 2011 (Woolich and Martin, 2011). Also the Office of Foreign Assets Control updated the list on 11 May 2019.

That any contact and deal with Iran port operator is subjected breach of USA sanctions. The USA declared that the only Iranian port namely Chabahar port is exemption from its sanctions. This port under developing by Indian government and it recognized as an importance for Afghanistan development[18].

The major international shipping lines such as CMA CGM, Hyundai, Maersk Line, and Mediterranean Shipping Co. and COSCO shipping lines, withdrew services to Iranian port, after USA imposed sanctions on the country. Also they

[18] Chabahar Port Development Exempted from US Sanctions,https://worldmaritimenews.com/archives/264394/chabahar-port-development-exempted-from-us-sanctions/

suspended working with Iranian national container shipping line namely, Islamic Republic of Iran Shipping Lines (IRISL).

Chapter 4. The Iranian port and Sanctions

4.1. Iranian Ports Overview

Iran having a long strip of maritime borderline in North and South, has constructed many ports. These ports are called Astara, Anzali, Nowshahr, Fereidoon Kenar and Amir Abad ports which are located in Northern part of Iran along the Caspian Sea. Abadan, Khoramshahr, Bandar Imam Khomeini, Jask, Lengeh, Genaveh, Shahid Bahonar, Shahid Rajaee, Bushehr and Qeshm ports, which are located along the Persian Gulf. And Chabahar port which is located near Oman Sea is the only ocean port of Iran. Most of these ports are historical heritages that has been reconstructed and redeveloped. However, some of them, which have been constructed for the economical purposes in the past, are not productive and efficient ports these days; though for domestic service reasons they are still operational. These ports sometimes play an important role in the area for local economics and construction purposes. Figure 4.1 shows Iran's commercial ports that are operational in the Northern and Southern parts of the country, which will be introduced in the following section.

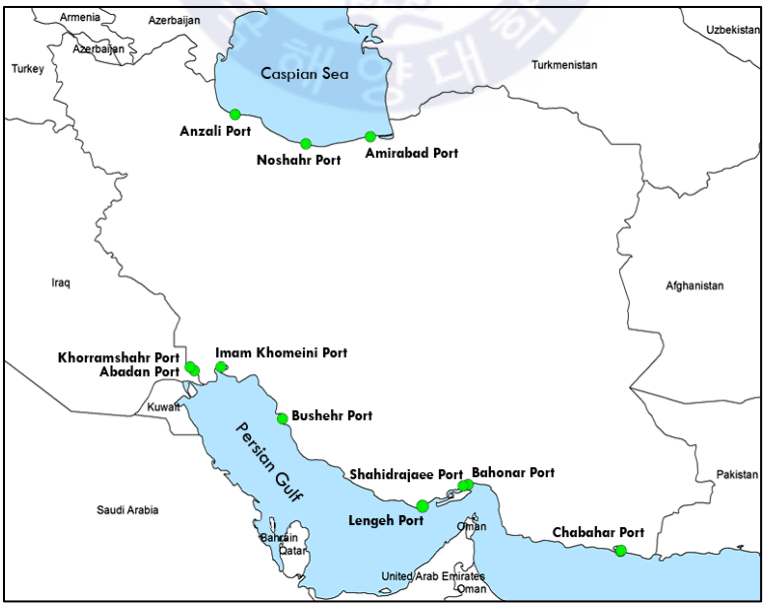

Figure 4.1. Iranian main ports location
Source: www. PMO.ir

4.1.1. Shahid Rajaee Port

The Shahid Rajaee port is located at the nearest point to the Hormoz strait as the strategical geographic position where the entrance of Persian Gulf is located. It is close to one of the important shipping routes of marine transportation, which is considered as an important trade and energy gateway for the world. This port is the Transit corridor for the North and South and it is the main bridge for Iranian import and export. This port is the biggest port of Iran, which belongs to Hormozgan province with a long line of the coastal strip in the south of Iran. This port is near to the heavy industries of the province as well as oil and gas refiners, shipbuilding, petrochemicals plants and many other manufacturing industries. Connection to the international railway network, as well as airport, and historic Silk Road, and benefit from the appropriate infrastructures, by these, this port is plying an important role in international trade and connecting the country to the international market. This port currently is trading with many of famous ports around the world through the world's leading container lines. Figure 4.2 shows the overview of the Shahid Rajaei port.

Figure 4.2. Shahid Rajaee port overview
Source: www. PMO.ir

The total area of the port covers about 2400 hectares and handles100 million tons of cargo per year; it has a capacity of 40 berths, with the largest and most advanced container terminal in the Iran, and after the opening of the second phase of the development plan of capacity, there are 6 million TEU containers a year as well as a large volume of general cargo handling operations; especially steel products, dry bulk, liquid bulk and crude oil products and many essential goods and commodities are carried out in this port.

Nowadays, this huge port complex, as the main gateway to import and export and regulating the pulse of the country's economy, has taken more shares in the field of sea transport and moving to globalization. In order to compete with the region's ports according to 20 years perspective horizon plan, many projects have gone into force with the aim of expanding and increasing the port productivity and efficiency. However, the main issue is that this port belongs to the government of Iran and the government formalities and regulation caused and created many problems for port management. The port performance has been extremely damaged after imposing USA and international sanction. In 2014 after three years working under sanction, the container throughput shrank by 38% for Shahid Rajaei port. Moreover, the port ranking fell down 43 steps in the world’s top container ports (Turloch, 2016). This reduction has an economical and operational impact on the port activities.

The development and completion projects of the third basins of the port for the construction of new jetties with a draft of about 17 meters designated for the berthing vessels with a capacity of 150 thousand tons considered as the starting point of new evolution in the port. Figures 4.3 and 4.4 show the container and general cargo throughputs respectively, for Shahid Rajaei port for the period of study.

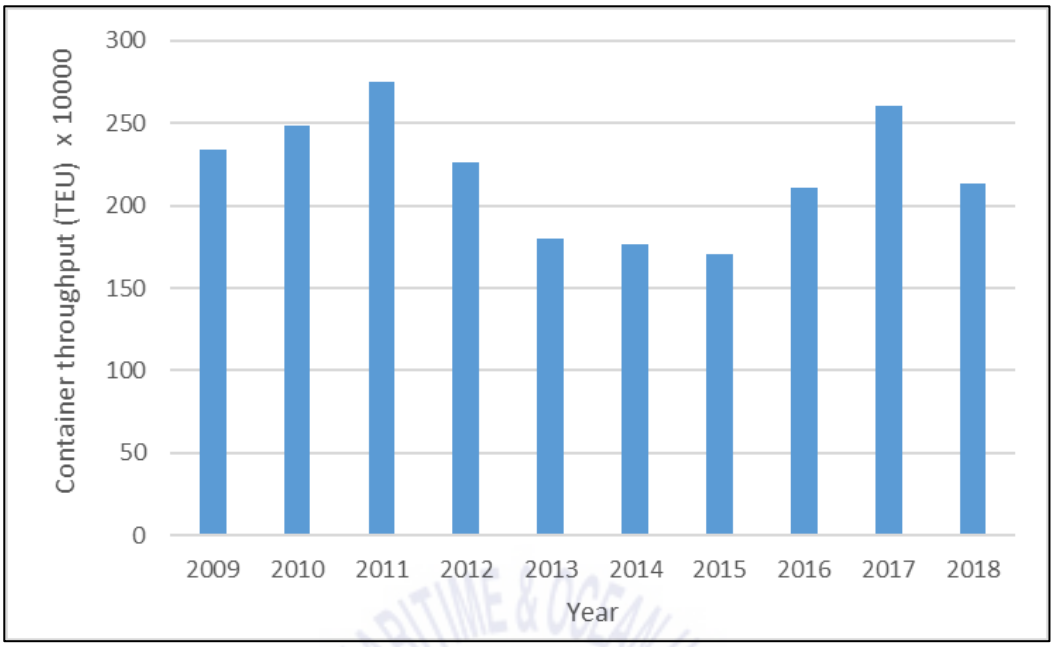

Figure 4.3. Container throughput for Shahid Rajaei port
Source: author's elaboration using Iran PMO data

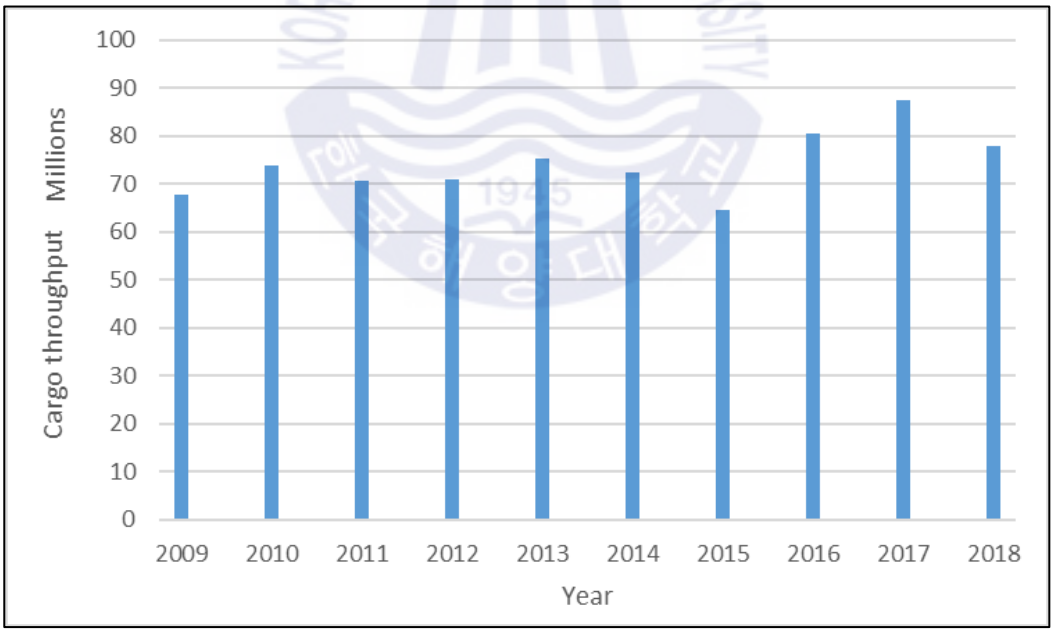

Figure 4.4. General cargo throughput for Shahid Rajaei port
Source: author's elaboration using Iran PMO data

Attaching the 2,400 hectares of the land located at the north part of Shahid Rajaee port and upgrading the port area to 4,800 hectares, providing the

establishing a port logistics town for the expansion of export, import and the provision of value added services are among the most important ongoing efforts to join to the third port generation of the world with its implementation in the near future. While the sanctions created lots of obstacles for development of this port, so it mays that the port will still have challenges due to the sanctions and market behaviors. In absence of the imposed sanction the special economic zone of Shahid Rajaee port will play the most valuable and effective role in the economic flourishing and distribution of goods in the region.

The port activities are reduced, especially in container cargo that the deduction is more than others are. The interesting is, the transit cargo from this port are increasing even the sanction could not be able to delete the transit advantage of this ports for CIS countries. The lower cost and shorten time for transportation of cargo from South to the North always is considered as an advantage of these ports. Furthermore, the port general cargo throughput during the sanction period are increasing. On the other hand, the sanctions create some technological difficulties for the port. For instance, some of its equipment's need spare part and to be upgraded. However, there was no possibility to easily provide the inquiries. Thus, this port is facing with some shortages that influence its performance.

4.1.2. Chabahar Port

The port of Chabahar is located at South Eastern part of Iran, at the North of Oman Sea. One of the features that distinguishes it from other Iranian ports and ports in Southern coast of Persian Gulf is its access to international open seas. Therefore, it is the only ocean port of Iran.

Regarding the position of Chabahar port, it has benefited from Geo-political, Geo-economical and Geo-strategic potentials. It is located, in both South, North and East. West transit corridors can play as a transport gateway, as well as a central commercial node between CIS countries and countries such as India, Pakistan,

Afghanistan, Russia, and Europe. Chabahar port development plan and it is Free Trade Zones (FTZ) advantages, will accelerate the development of the South-North transit corridor, consequently international trade in the region.

Currently, Chabahar port includes two complexes named Shahid Kalantari port and Shahid Beheshti port. Shahid Kalantari port is a traffic port and the vision of shahid Beheshti port development is to transform it into a multimodal and fourth-generation port. Hence, it can play as the regional Hub port.

This port is still under construction. Shahid Beheshti port development plan consists of five main phases, it will be completed by 2024 and nominal capacity of the port will reach to about 86 million tones. In this regard, the first phase has been completed in early 2018, which increased the nominal capacity of the port to over 8.5 million tons annually. This port is the only oceanic port of Iran, as well as being the entrance gate to the International North-South Corridor and Eastern development route of the country. It has more than 300 km marine borderline and minimum transit distances to Afghanistan, Pakistan & middle Asia and most economical port in commercial trade for these countries. Furthermore, it plays an important role in the international North-South Transit Corridor (INSTC). Chabahar port is the only port of Iran that has been taken an exception from USA sanctions from 2018, also the USA will agree the construction of a railroad line from Chabahar port to Afghanistan and shipments of non-sanction goods, like food and medicine. Recently Indian and Iranian governments have agreed for investment in this port. Figure 4.5 shows the overview of the Chabahar port.

Figure 4.5. Chabahar port overview
Source: www.PMO.ir

According to Iranian ports polices and the completion of the first phase of the new port, transiting cargo from this port has increased. Although this port has recently had an exemption from USA sanctions, the sanction has influenced the completion of the ports facilities especially that the port development plans were considered based on the use of foreign investments. Figures 4.6 and 4.7 show the container and general cargo throughputs, respectively for Chabahar port for the period of study.

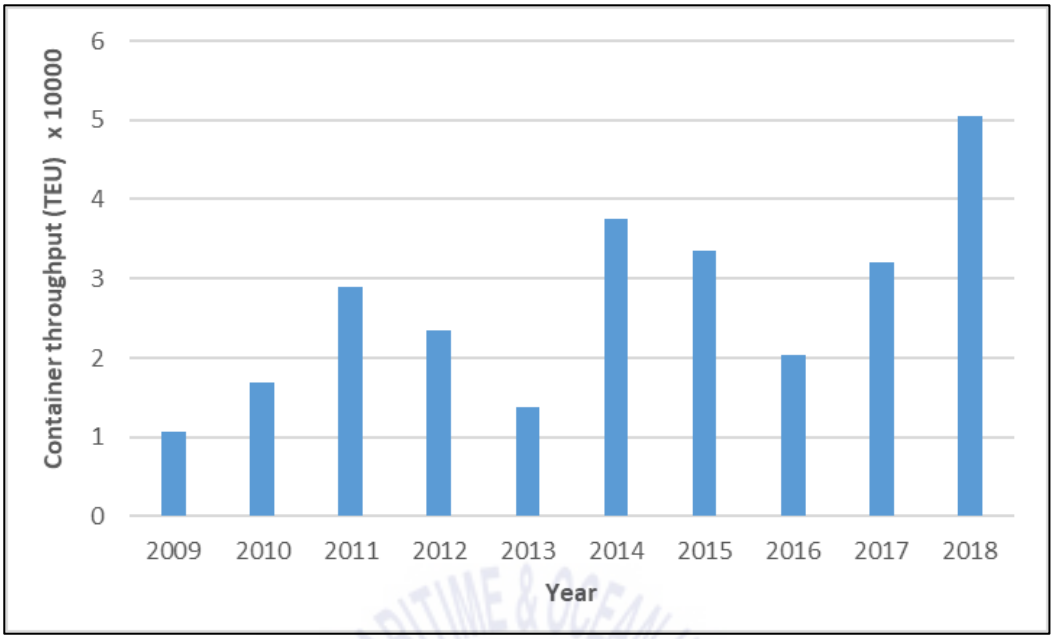

Figure 4.6. Container throughput for Chabahar port
Source: author's elaboration using Iran PMO data

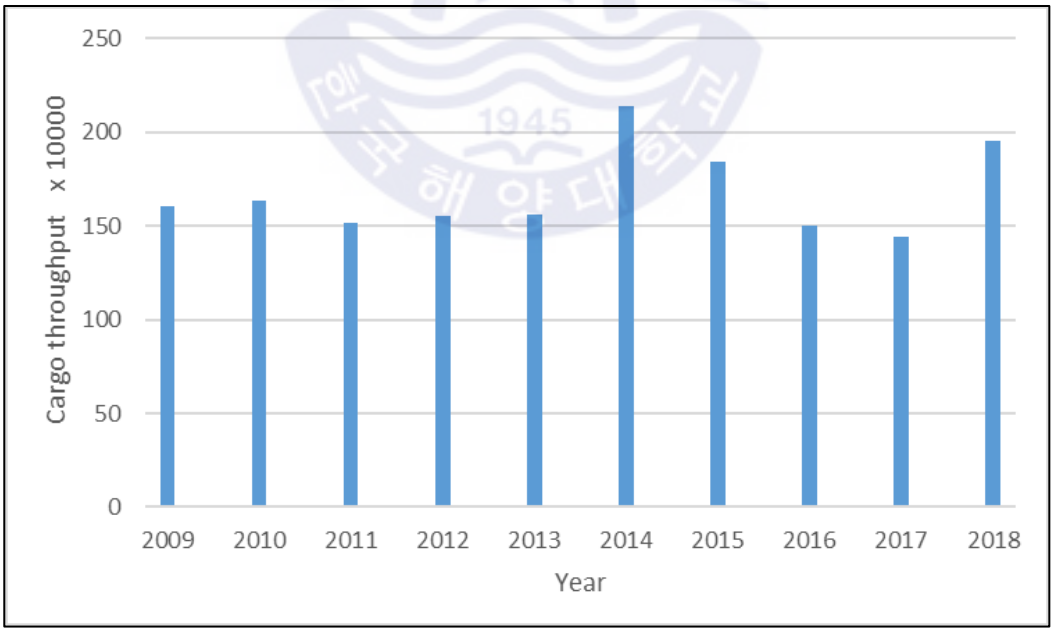

Figure 4.7. General cargo for Chabahar port
Source author's elaboration using Iran PMO data

4.1.3. Imam Khomeini port

Contemporary with establishing railway in 1928 in Iran, two wooden jetties were constructed at the Northwest of Persian Gulf. After the war, it would be known as Shahpour port. Three years later, it turned into the most important center of entering and exiting goods. In the year 1973, the residential place of native people transferred to Sarbandar (the city of Imam Khomeini) so the new situation provides the more possibility for development of the port.

After the magnificent Islamic revolution of Iran, the port's name changed into Imam Khomeini port and in 1982 with the ratification of the board of ministers, it officially named to Imam Khomeini port and established a new beginning toward the progress. This port gives the tiding of stable development through the transportation industry. Imam Khomeini port's Special Economic Zones (SEZ), in the middle of the ninth decade of the outset of its activity, now has supported the port to perform an important role as one of the most regional transportation hubs. In 2011, this port after alteration regulations system changed the role from an ordinary port to a special economic zone and joining the adjacent lands with over 11,000 hectares area has formed the largest special economic zone in the country. The port located in Northwest of the Persian Gulf, with an annual capacity of 54.5 million tons and a total warehouse area of 522,000 square meters. The container terminal capacity is 700,000 TEU and the average depth of berths is 13.5 meters, totally has 40 berth posts with a length of 7 kilometers, having an internal railway with a length of 120 kilometers that connects the country railroad. The port is supported by three airports, the distance to Mahshahr Airport is 18 kilometers, to Ahvaz airport is 110 kilometers and to Abadan airport is 100 kilometers. All the imported goods with 10% commercial exemption transported through this port with no limitation. The nearest southern port to over 70% of major industrial, production, agriculture, and population centers located in the central and western zone of the country. Figures 4.8 and 4.9 show the container and general cargo throughputs, respectively for Imam Khomeini port for the period of study.

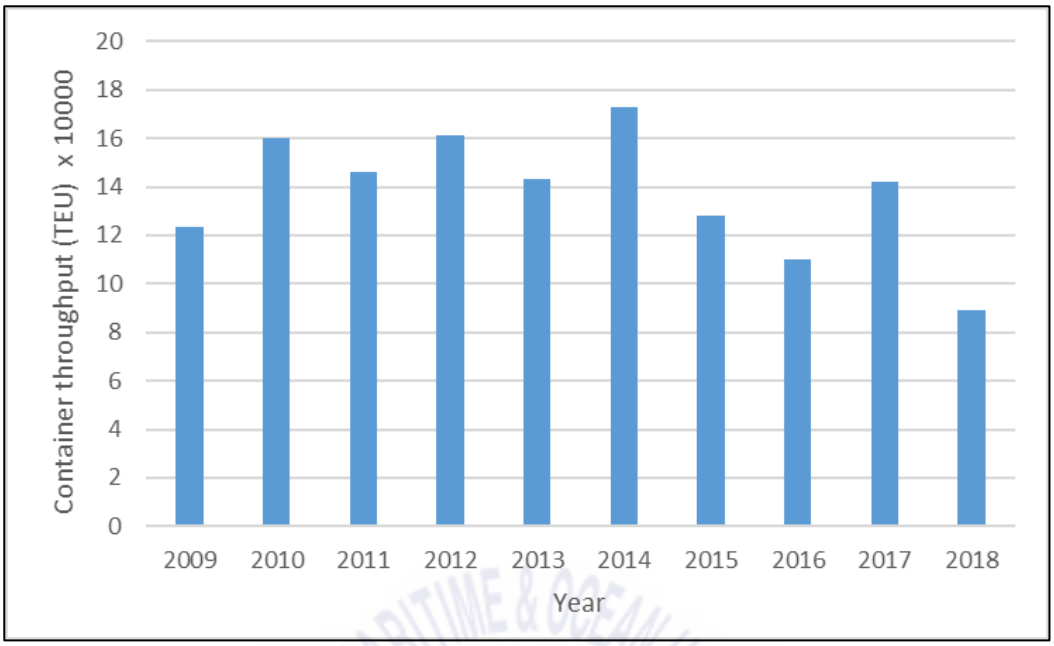

Figure 4.8. Container throughput for Bandar Imam Khomeini port
Source: author's elaboration using Iran PMO data

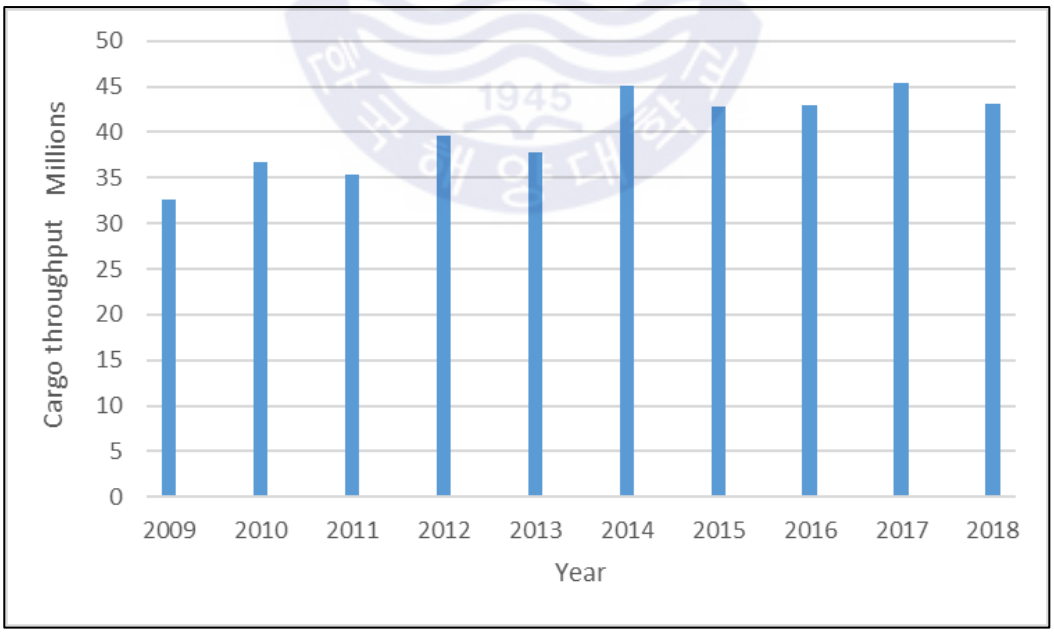

Figure 4.9. General cargo throughput for Bandar Imam Khomeini port
Source: author's elaboration using Iran PMO data

Figure 4.10 shows the Imam Khomeini port cargo handling performance during the study period. This port is the safest and shortest route to the important transit borders of neighboring countries such as Iraq, Turkey and Caucuses Zone.

Figure 4.10. Imam khomeini port overview
Source: www.PMO.ir

This port is responsible for over 40% of the country's commercial trade and has an important role in the national economy and the foreign trade as the second most important port of the country. It covers warehouse area of 507,000 square meter for storage purposes.

It has the container terminal area of 388,801 square meter and the annual capacity of 700,000 TEU. The 4 berths with the average draft of 13.5 meters and a total length of 7 km. The great potentials for the development of cargo re-export. It is the nearest Southern port to the country’s populated and industrial centers and the shortest and safest linked bridge to Iraq.

4.1.4. Bushehr Port

Historical background of Bushehr port dates back to Ilam epoch that was recognized as Lyan at that period. It should be noted that the recent discoveries indicated that Bushehr had been a developed and residential place.

The port of Bushehr is located in the North end of a peninsula on the coast of the Persian Gulf. This peninsula is 14 Km long. The depth of water is near to 7m in the external anchorage leading to internal anchorage by the external channel 9200 m in length and from the internal anchorage to Khor Soltani, Bushehr berth and then to Khor Booder by the internal channel 3900m in length. The channel is 140 m in average width. Bushehr port has a semi-tropical climate with very hot and humid summer and temperate winter. The factories, located near the port, are capable for repairing any kind of vessels up to 150,000 tons onshore and building offshore constructs. The Bushehr airport with 10 km distance from the port is accessible for the customers.

The port is handling different type of cargo, the container cargo and general cargo are the most activities of this port. Figure 4.11 and 4.12 show the container and general cargo throughputs, respectively for Bushehr port for the period of study.

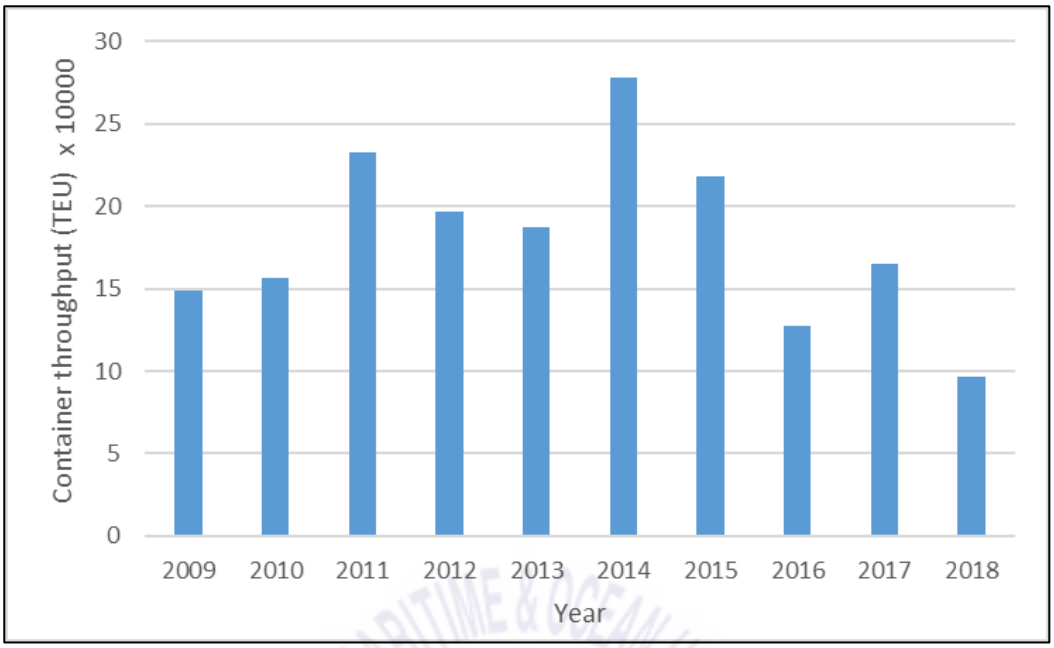

Figure 4.11. Container throughput for Bushehr port
Source: author's elaboration using Iran PMO data

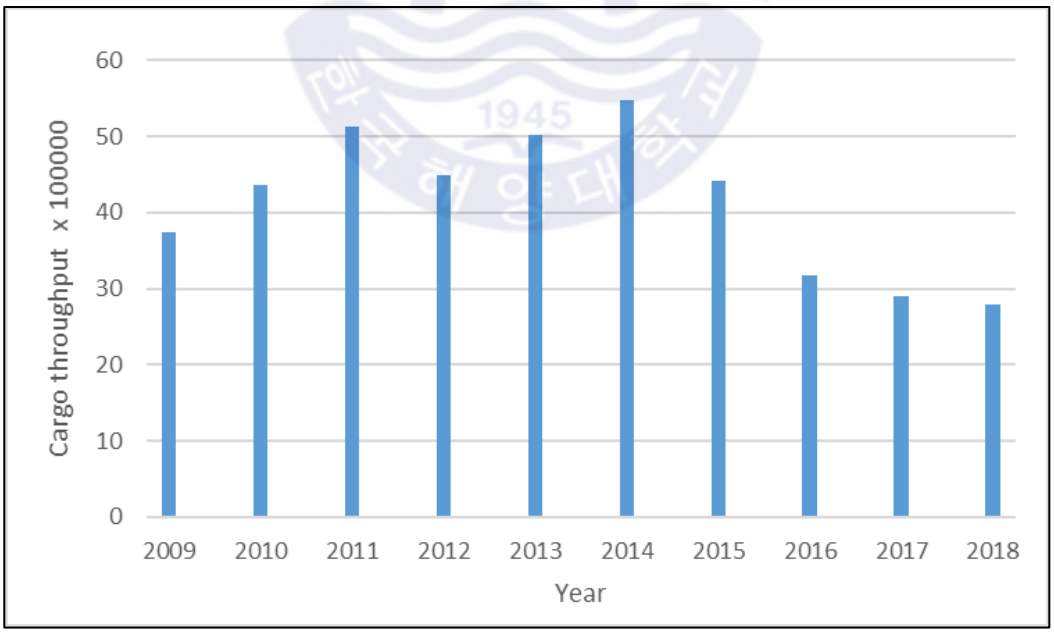

Figure 4.12. General cargo throughput for Bushehr port
Source: author's elaboration using Iran PMO data

4.1.5. Khorramshahr Port

Khorramshahr port is located at the North-West of Persian Gulf, in the South-West of the Iran and in the Southeast of Iraq (Shalamcheh Ground Border). It is also the intersection of Arvand & Karoun rivers in Khouzestan province. This port has a long history in seaborne trade and construction as well as the exploitation of special quays for ocean-going vessels launched in the early of 1922. During the outbreak of the Second World War, it became more and more so that the years before the Islamic Revolution, Khorramshahr port had 20 quays and was one of the largest port of the country with 4 million tons general cargo importation in1978. Recently, the complete pre-war infrastructures of the port including Quays, Warehouses, and yards are reconstructed. The port customers were enjoying by 25% import tax discount. The commercial free zones and special economic zones with the least formalities are possible. For the transit cargo, the customs duties is zero and there is no import tax, which can be good advantages for customers. Figures 4.13 and 4.14 illustrate the container and general cargo throughputs, respectively for Khorramshahr port for the period of study.

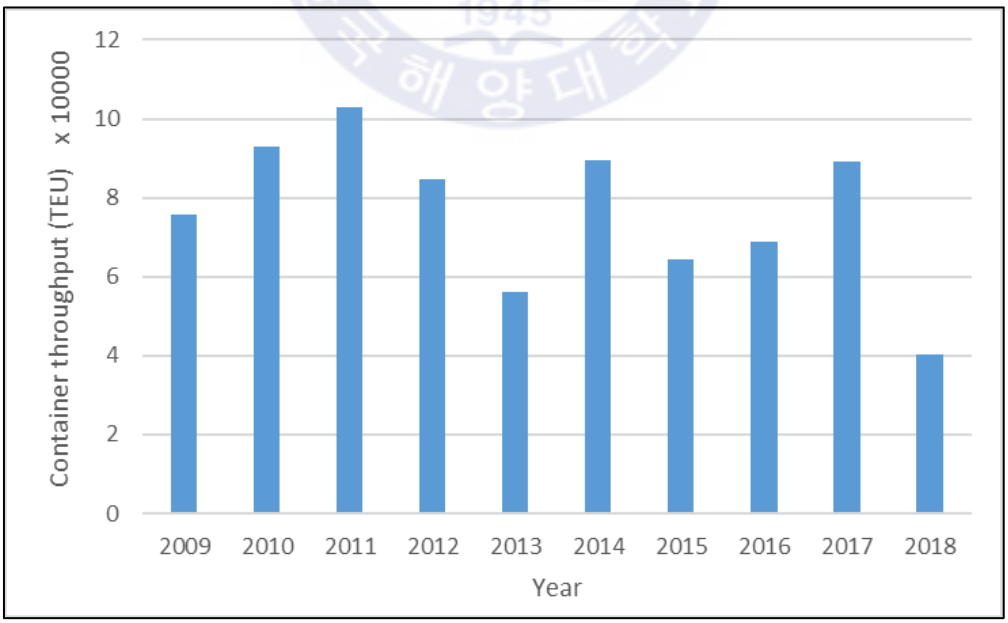

Figure 4.13. Container throughput for Khorramshahr port
Source: author's elaboration using Iran PMO data

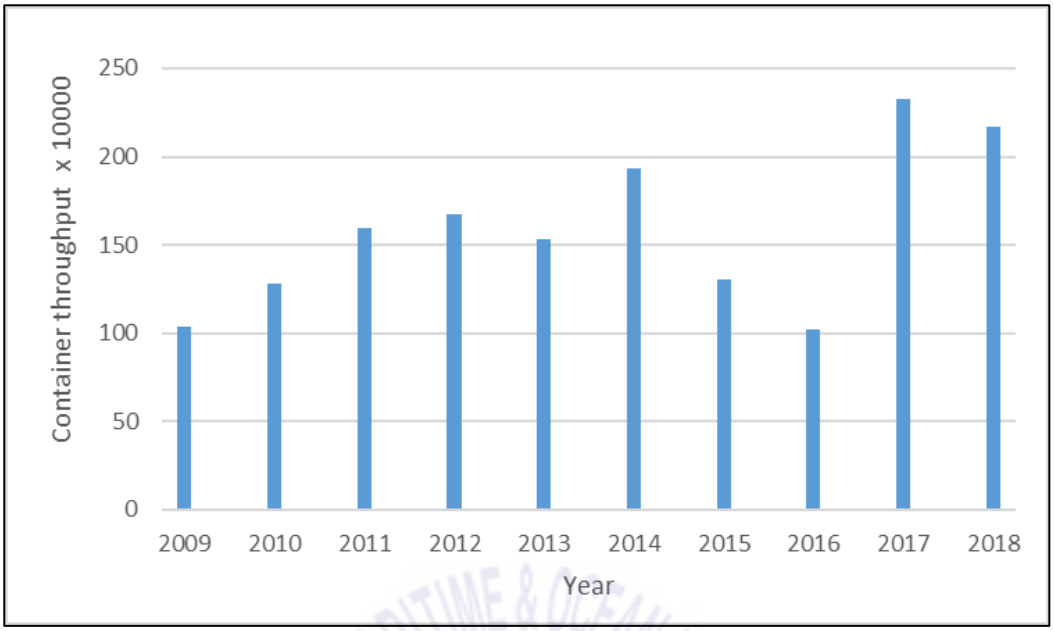

Figure 4.14. General cargo throughput for Khorramshahr port
Source: author's elaboration using Iran PMO data

4.1.6. Shahid Bahonar Port

Shahid Bahonar Port is one of the oldest active ports of Iran. In 1953, exploring a suitable location for the new Bandar Abbas jetty (presently called Shahid Bahonar Port), the Soro has been considered a suitable location for the first modern jetty in Bandar Abbas due to natural and historical factors. In 1955 the construction of Soro port was begun. This port was for a time called the Soro quay or the new quay. After the Islamic Revolution, the port was renamed the Port of Shahid Bahonar. 60 years ago, the port was one of the most active and largest commercial ports in the country after Khorramshahr and had an annual operating capacity of 8 million tons. Shahid Bahonar port is located in the south of Iran and the north of the Persian Gulf. The privileged geographical location of access to the world's open sea through the Persian Gulf, access to the International Trade Network and due to being close to the Qeshm and Kish Free Zones and the Persian Gulf commercial ports, this port is considered as a strategic and unique port complex. From a maritime point of view, the port harbors protected naturally by Qeshm Island from the effects of long waves on the Oman Sea and the Persian

Gulf. Shahid Bahonar Port is the third export port of the country, which has a special place in the export of goods, passenger terminal. The special feature of this port is that it has a water meter of 10.2 meters, which is the deepest port after the ports of Imam Khomeini and Shahid Rajaee. This port was not only the main port of Bandar Abbas in the past since it is located close to the city of Bandar Abbas, but it also accommodates a large number of tourists and visitors every day. The considerable volume of Bandar Abbas business depends on the activity of this port. Figures 4.15 illustrates the general cargo throughput for Shahid Bahonar port for the period of study.

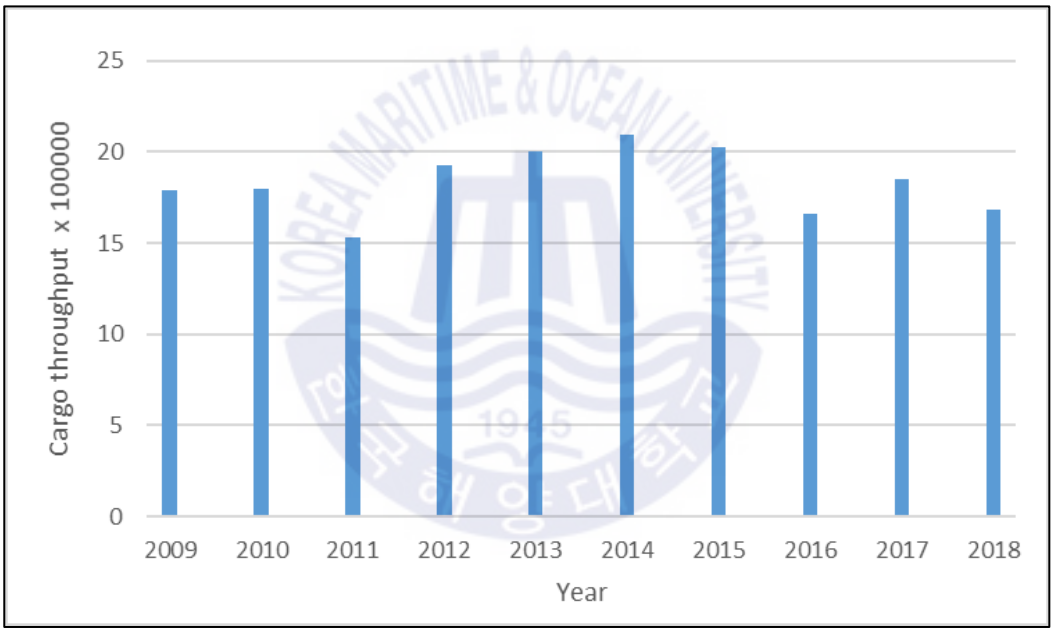

Figure 4.15. General cargo throughput for Shahid Bahonar port
Source: author's elaboration using Iran PMO data

Table 4.1 shows the Iranian port's activities in 2018 including loading, discharging, transit, transshipment, and cabotage. While, Table 4.2, illustrates the ports cargo throughput which divided into different types of goods.

Table 4.1. Iranian Ports Activity Type.

Loading And Discharge By Type Of Transport

2018 Ports	Export	Import	Transit		Cabotage		Transshipment		Other		TOTAL		
			Loading	Discharge	Loading	Discharge	Loading	Discharge	Loading	Discharge	Loading	Discharge	Loading and Discharge
Imam Khomeini	21,319,528	15,665,187	2,485,145	188,159	1,827,917	1,514,081	10,560	7,745	10,385	36,259	25,653,535	17,411,431	43,064,966
Khorramshahr	1,843,073	277,151	296	5,254	5	309	0	0	38,291	1,542	1,881,665	284,255	2,165,920
Abadan	65,864	25,131	0	449	0	0	0	0	185	1,100	66,069	26,660	92,729
Shahid Rajaee	44,689,791	7,967,366	1,449,002	3,188,092	757,154	15,264,455	1,633,362	1,267,578	1,020,876	665,180	49,550,184	28,352,672	77,902,856
Shahid Bahonar	1,015,276	58,351	6,553	37,416	498,434	22,789	0	0	2,942	39,405	1,523,205	157,961	1,681,166
Lengeh	958,952	92,658	0	273,324	3,899	483	0	0	73	1,661	962,924	368,126	1,331,050
Bushehr	1,515,242	765,347	15,893	240	78,042	344,890	0	0	72,501	0	1,682,153	1,110,002	2,792,155
Chabahar	111	729,611	0	61,983	0	1,118,637	0	1,987	45,655	0	45,766	1,912,218	1,957,984
Anzali	153,318	1,286,178	11,465	38,461	0	0	0	0	2,589	2,504	167,372	1,327,143	1,494,515
Now Shahr	13,836	564,967	692	582	0	0	0	0	7	0	14,535	565,550	580,085
AmirAbad	431,688	3,129,355	13,099	46,040	2,914	0	0	185	950	1,270	448,651	3,176,850	3,625,501
Qeshm	172,583	85,941	17	4,940	3,157,500	3,348,070	1,616	36,367	3,184	299	3,334,900	3,475,617	6,810,517
Jask	46,116	13,650	0	0	0	300	0	0	388	1,197	46,674	14,977	61,651
choebdeh	28,273	0	0	0	0	0	0	0	116	594	28,389	594	28,983
arvand kenar	1,228	0	0	0	0	0	0	0	83	6,348	1,312	6,348	7,660
Genaveh	5,547	9,570	0	0	30,766	35,248	0	15,311	2,886	9,306	39,199	69,435	108,634
Fereydun Kenar	0	82,102	0	4,790	0	0	0	0	0	0	0	86,892	86,892
Charak	0	0	0	0	345,754	303	0	0	0	0	345,754	303	346,057
Tiyab	130	13,750	0	0	0	0	0	0	0	0	130	13,750	13,880
Astara	121,928	70,618	0	0	0	0	0	0	0	0	121,928	70,618	192,546
Dayyer	174,858	451	0	0	58	2	0	0	634	69,262	175,550	69,715	245,265
Total	**72,557,343**	**30,837,384**	**3,982,162**	**3,849,731**	**6,702,443**	**21,649,567**	**1,645,538**	**1,329,173**	**1,201,745**	**835,927**	**86,089,895**	**58,501,117**	**144,591,012**

Source: www.PMO.ir

Table 4.2. Iranian Ports Cargo Type.

CARGO THROUGHPUT

2018 Ports	Essential Goods	Metal Goods	Construction And Mineral Goods	Automobils And Some Parts	Fertilizers And Chemicals	Clothes Paper And Wood	Miscellaneous	Containerized Cargo	Oil Products	Other	Total
Abadan	65,340	4,593	603	16,320	520	4,232	720	92	308	0	92,729
AmirAbad	3,045,701	81,059	417,425	4,884	45,074	2,068	0	2,456	26,834	0	3,625,501
Anzali	643,038	425,906	93,504	9,978	14,224	221,611	785	50,356	35,113	0	1,494,515
arvand kenar	1,465	0	87	18	0	6	6,085	0	0	0	7,660
Astara	27,185	38,963	83,075	202	39,008	4,113	0	0	0	0	192,546
Bushehr	261,103	10,080	1,104,478	10,497	34,664	1,602	496	613,336	755,899	0	2,792,155
Chabahar	194,216	10,455	736	6,605	1	1,212	8,991	637,031	1,098,737	0	1,957,984
Charak	0	0	126,364	0	0	0	219,693	0	0	0	346,057
choebdeh	28,263	0	0	9	0	1	710	0	0	0	28,983
Dayyer	21,612	321	20,323	661	0	13	63,320	139,014	0	0	245,265
Fereydun Kenar	57,749	0	0	0	0	0	0	0	29,143	0	86,892
Genaveh	900	0	2,142	0	0	0	82,467	23,125	0	0	108,634
Imam Khomeini	12,836,298	3,071,923	5,106,554	39,302	3,605,962	675,439	0	1,004,146	16,725,342	0	43,064,966
Jask	57,481	0	2,371	44	0	0	1,755	0	0	0	61,651
Khorramshahr	91,355	440,098	1,299,188	29,636	1,722	15,835	19	287,795	271	0	2,165,920
Lengeh	338,769	5,391	687,301	284,257	1,584	6,855	5,980	102	811	0	1,331,050
Now Shahr	455,357	5,379	3,948	21	648	114,725	0	7	0	0	580,085
Qeshm	62,402	4,909	178,807	1,701	0	18,781	6,373,132	49,208	121,577	0	6,810,517
Shahid Bahonar	443,208	2,835	491,657	76,139	160,739	3,438	1	42,060	461,089	0	1,681,166
Shahid Rajaee	393,124	6,478,691	21,655,759	120,745	2,043,493	124,941	84,453	21,950,104	25,051,546	0	77,902,856
Tiyab	13,880	0	0	0	0	0	0	0	0	0	13,880
Total	19,038,446	10,580,604	31,274,322	601,020	5,947,640	1,194,872	6,848,608	24,798,831	44,306,671	0	144,591,012

Source: www.PMO.ir

4.2. Effect of Sanctions on Iranian Ports

After the USA, the UN and EU piling on economic sanctions against Iran in 2011, international shipping lines were forced not to cooperate with Iranian shipping lines and ports. The economic impact in various sectors was visible, especially in both the sea trades and ports industry. To emphasize, its influence was more than significant. The Islamic Republic of Iran shipping lines (IRISL) and port operators were directly listed under those sanctions. Along this, some of the major shipping lines had stopped their services, which dealt with Iranian ports while some had changed their routes to the other ports of the Persian Gulf. Comparably, very limited shipping lines had made up their minds to substitute with other Iranian ports, which were operated by other operators. Worse still, international ports and Shipping lines were under intense surveillance by the USA, so no one could actually cooperate with IRISL (BAFT/TEC, 2017). Table 4.3 shows the impact of the sanction on the port business; before, during and after the sanction.

Table4.3. Impact of Sanction on Iranian Ports throughput.

Port	2011	2014	2017	Deviation%	Deviation%
	Before Sanction	During Sanction	After Sanction	2011 and 2014	2014 and 2017
Imam Khomeini	35358190	45046090.8	45349949	21.51	0.67
Khorramshahr	1597833	1936772.4	2329254.2	17.50	16.85
Abadan	91923	133620.46	87893.35	31.21	-52.03
Shahid Rajaee	70756979	72485339.1	87427280	2.38	17.09
Shahid Bahonar	1531482	2097396	1847081	26.98	-13.55
Lengeh	927412	860057	1300397.5	-7.83	33.86
Bushehr	5129902	5482882.4	2897623	6.44	-89.22
Chabahar	1519353	2138340	1440585	28.95	-48.44
Anzali	5464610	2684176	2177685	-103.59	-23.26
Now Shahr	743608	744030.594	608481.94	0.06	-22.28
AmirAbad	2869795	3487232	3192132	17.71	-9.24
Neka	376405	139039	404653	-170.72	65.64
Qeshm	8804927	8768498	6984666	-0.42	-25.54
Jask	24521	25824	45361	5.05	43.07
Genaveh	448906	153105	100595	-193.20	-52.20

Source: www.PMO.ir

4.2.1. Effect of Sanction on the Container Business

Since the container became a part of transportation tools brings enormous benefits for transportation system. The feature such as portability, agility, speed, security, capability for computing and traceability from host system to other, beside the suitable for multimodal transportation system are some of those benefits. Therefore, container business developed very fast and many ships, ports and terminals with huge amount of capital were constructed. Meanwhile the frim business extremely are sensitive and volatile. Therefore, there are a limited strong role player in the market and it is not easy to enter market for new business makers. Any violence in cargo balance may cause huge damage to shipping lines, terminals, cargo forwarder as well as for ports. In this competitive market, many shipping lines integrated and merged to continue the business, they are extremely under control by a set of procedures by their agreed alliances and conferences, in fact doing business out the conferences is very difficult for the members. When the

international sanction imposed against Iranian shipping lines, the majors ports and port operators of container shipping lines announced that they will stop their services to Iranian ports. The major of container shipping lines such as MAERSK, CMA CGM, COSCO Shipping, and Hyundai Merchant Marine (HMM) suspended all previous agreements with Iranian shipping line (Turloch, 2016).

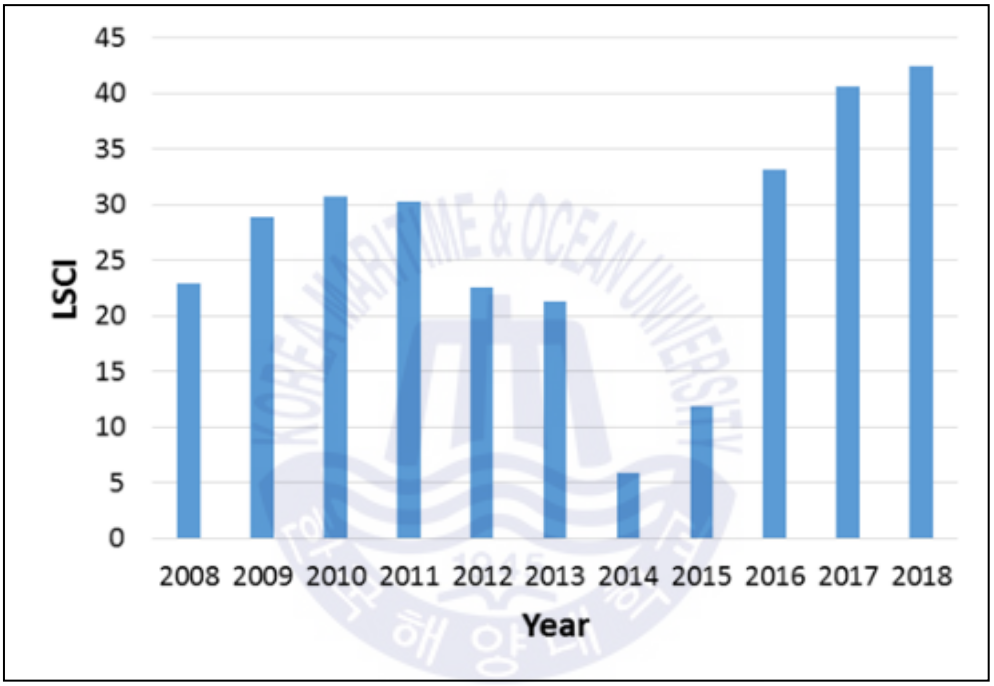

Figure 4.16. The Liner Shipping Connectivity Index (LSCI) for Iranian ports
Source: author's elaboration using UNCTAD data

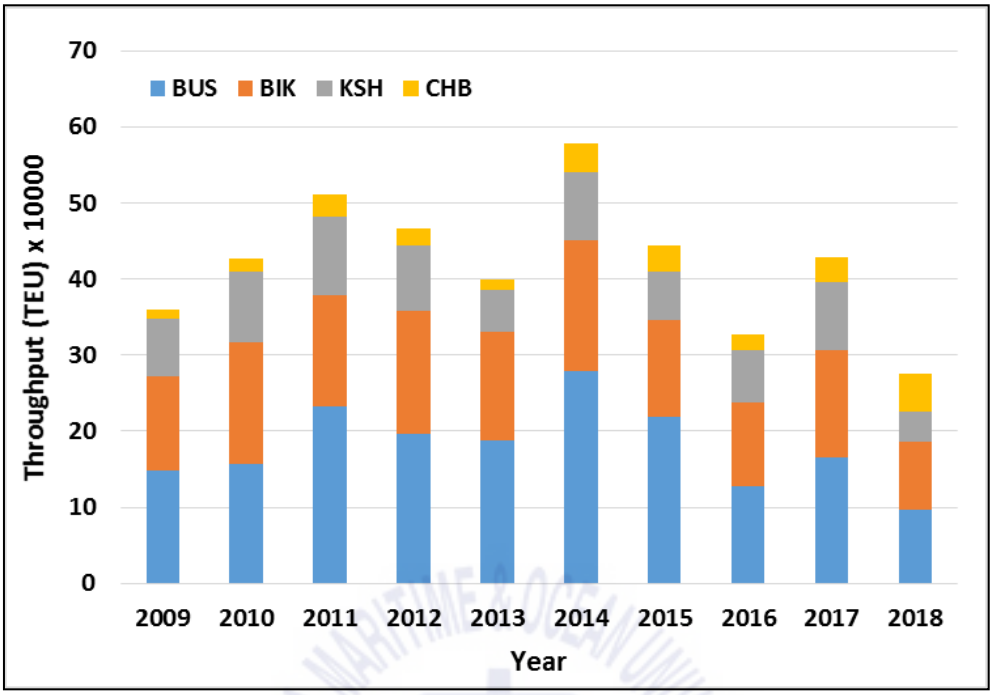

Figure 4.17. BUS, BIK, KHS, CHB container ports throughput
Source: author's elaboration using Iran PMO data

Even the Iranian ports authorities changed the operators of the ports that were the pretext of sanction and provide incentive offers for shipping lines, but still major shipping lines did not call at Iranian ports. According to UNCTAD, the liner shipping connectivity index (LSCI) for the Iranian container ports (Figure 4.16) had decreased from 30.3 in 2011 to 5.9 in 2014 (UNCTAD, 2018). This situation left Iranian port authorities a hard nut to crack and the port authorities have no choice than making new decisions. This event has a significant impact on the ports performance and therefore, the port authorities considered some incentive policies for attracting as well as encouraging the ships and cargo owners to calls their ports such as decreased duties, port charges and terminal handling charges. These policies are effective but cannot eliminate the effects of the sanctions fully. Therefore, the port authorities strategically tried to use the feeder ships instead of the liner ships which were able to approach and call at the smaller ports (Saul,

2016). These policies were supported and developed by the Iranian port authorities and so many middle-sized ships were moved to feeder ship companies for operation in the regional waters. Around 90% of goods in Iran which were supposed to import or export through the sea and ports were left at the ports due to lack of ships. Therefore, feeder ships enjoyed accelerated businesses for the time of sanctions due to high market demand and lower duties as well as costs. As international shipping lines were forbidden to cooperate with the Iranian ports, IRISL was not able to operate or ship the cargos due to insurance and transaction problems (Saul, & Hafezi, 2014). However, absence of the international and liner ships was not fully compensated. By establishment of feeder ships companies, the cargos moved from large and more efficient ports to the small ports, which somehow caused some extra cost for the cargo owners. Before 2012 when sanctions had not been imposed yet, Iranian container port had been enjoying annual growth rate of 18% for five years continuously. However, when economic sanctions were imposed, the port throughput decreased by 18% in 2012 (Drewry, 2018). Figure 4.3 shows the significant reduction of the Iranian major port container and cargo throughput during the sanctions period from year 2012 to 2018. As it is obvious from this figure, the container throughput shrank by 38% for Shahid Rajaei port after 2011. The port ranking fell more than 40 places in the world's top container ports (Turloch, 2016). This reduction has an economical and operational impact on the port activities. Meanwhile, Figure 4.17 shows that some containers had been moved to the other ports and accordingly, the port throughputs were slightly increased. Hence, the sanction period was claimed to be an opportunity for small and middle-sized ports to improve their respective capability as well as facility to attract more cargo owners and shipping lines to call at their ports. However, while they were satisfied with improved profits, it could be challenging on the other hand for the small ports to actually practice dealing with the international cargo owners and shipping lines.

4.2.2. Impact of Sanctions on the Container Throughputs

The impacts of Iranian port sanction were extensive, ranging from economic; social to operational whereby the lost imposed on port container throughput was also immense and abiding. In order to identify and evaluate the amount of these damages, it is necessary to calculate the container throughputs reduction volume from 2012 to 2018. According to the calculations of Drewry Shipping Consultants, theoretically Iran's port handling in 2017 would be triple that had been achieved. Evaluation of port throughput from 2000 to 2011 is fundamental to predict the ideal throughput of Iranian port for 2012 to 2018 in case there is no imposed of sanction. This is because of both periods should assume similar progressing trend if there is no disruption. Statistical data assessment result denotes a strong relationship between the two available data of container volume and years. Hence, one of the proper methods to estimate the ideal container throughput here is to apply simple linear regression method. By applying regression method, the equation $y=0.2108x-421.33$ with $R^2=0.98$ is found and the result of this prediction reasonably fit with the other similar studies and their estimated results. By simple calculation from Figure 4.18, the total amount of reduction in throughputs during the period of sanctions are 10,951,651 TEU which is shown in Table 4.4.

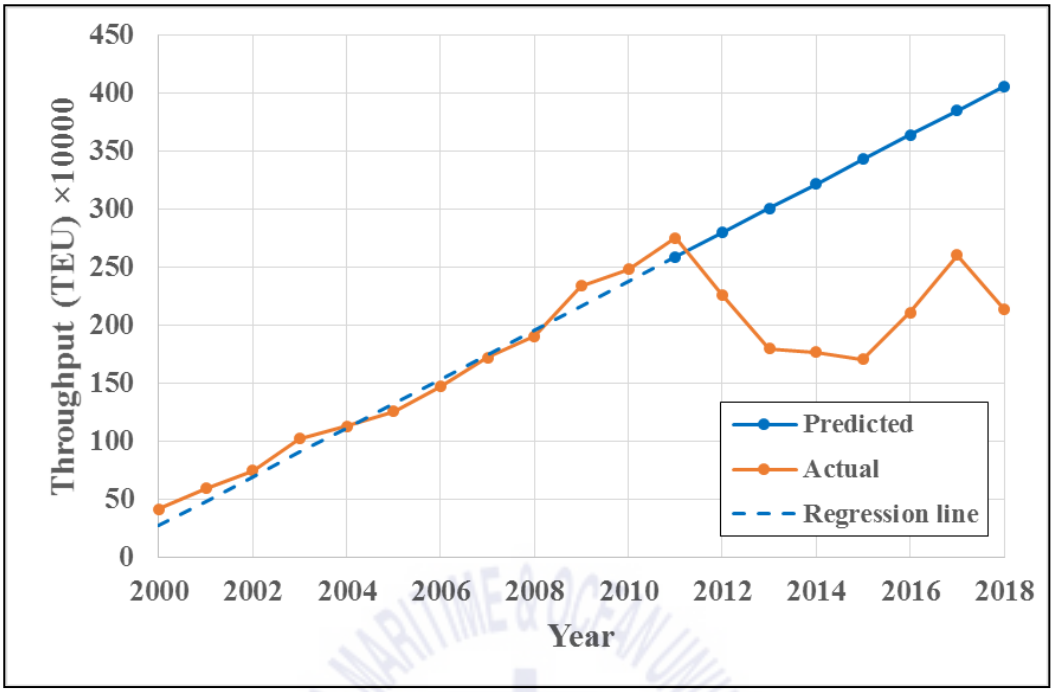

Figure 4.18. Comparison between actual and predicted container throughput
Source: author's elaboration using Iran PMO data

Table 4.4. Actual and predicted throughputs for five ports

Port	Year	2012	2013	2014	2015	2016	2017	2018
SHP	Actual TEU	2,261,333	1,796,862	1,766,645	1,705,603	2,108,925	2,606,557	2,137,175
	Perdicted TEU	2,799,600	3,010,400	3,221,200	3,432,000	3,642,800	3,853,600	4,064,400
BIK	Actual TEU	161,419	143,254	172,843	127,894	109,851	141,815	88,870
	Perdicted TEU	141,040	153,710	166,380	179,050	191,720	204,390	217,060
BUS	Actual TEU	196,891	186,907	278,140	218,095	127,366	165,007	96,678
	Perdicted TEU	191,216	210,234	229,252	248,270	267,288	286,306	305,324
CHB	Actual TEU	23,528	13,809	37,478	33,585	20,278	32,060	50,410
	Perdicted TEU	21,772	23,903	26,034	28,165	30,296	32,427	34,558
KSH	Actual TEU	84,827	56,004	89,375	64,343	68,851	89,302	40,119
	Perdicted TEU	121,612	130,663	139,714	148,765	157,816	166,867	175,918

Source: author's calculation

4.2.3. Influence of Sanctions on Container Ports Service.

The influence of sanction on the performance of Iranian port was varied. The sanction not only caused to cut the port container throughputs, but also influenced the other ports' services. The ports' services such as ports service time, ports

operation time and loading and unloading service, can affect the port's operation and performance. Therefore, it is important to review the factors and understand the effect of the sanctions on those factors. This study will be helpful to understand why the port's throughput was reduced and how these factors can affect ports' productivity and efficiencies.

4.2.4. Ship Size

As it was mentioned in the above paragraph, the sanction has forced major shipping lines to withdraw their service to Iranian ports. Therefore, in the absence of the major shipping lines owning mega and larger ships, the middle size shipping companies owning smaller ships and feeder shipping companies increased their services to Iran’s ports, as is shown in Figure 4.19. During the sanction time, the ships size calling these ports were decreased. It means that smaller ships visited the ports. The length of the ships decreased by 31%. Providing services to the smaller ships by this ports, which are organized for bigger vessels, is equal to lose the productivity and efficiency. However, when there is no bigger ship to call to the port, the ports welcome even smaller ships. Accepting the smaller ships in these ports has been implemented as policy by Iranian port authorities to support and keep running the port business.

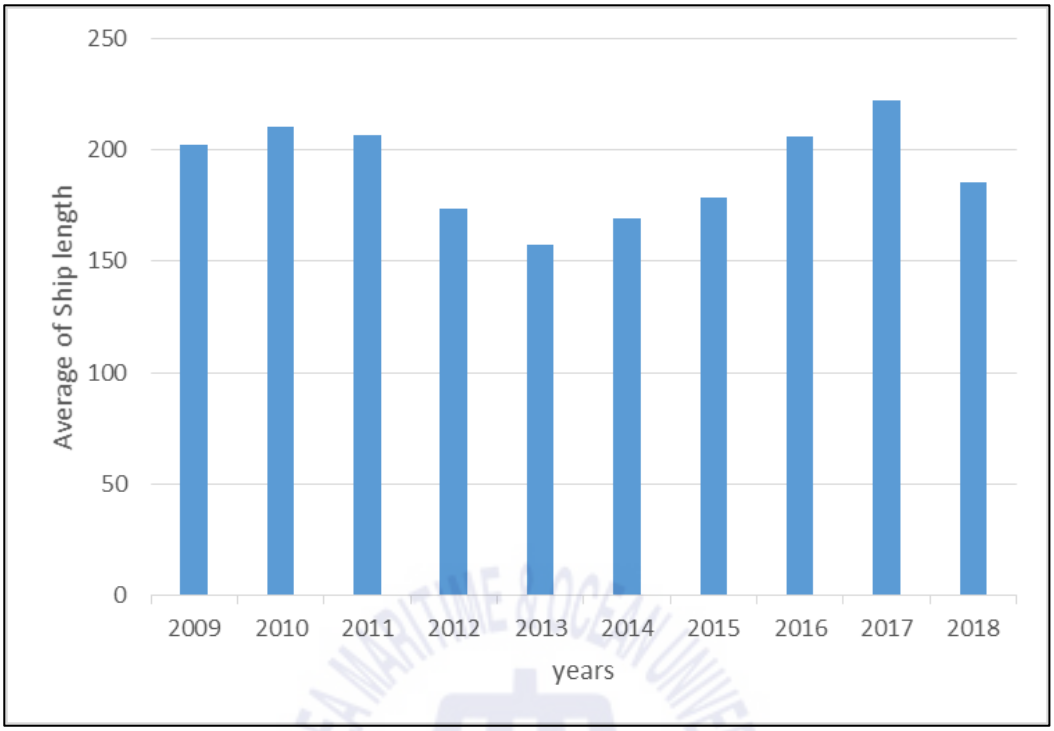

Figure 4.19. SHR Port called ship Average length
Source: author's elaboration using Iran PMO data

4.2.5. Port Service Time

The ports of Iran for the period during and after the sanction are struggling with enormous issues that still their effect on the port performance is unfinished. The sanction banned Iran to access the new technology for ports, so the ports was suffering from the lack of technology and software, which caused to pull down the port performance. As it is visible from Figures 4.20, 4.21 and 4.22, the port service time to the ships are increased. As it can be observed from Figure 4.20, the ships waiting time in anchorage in 2014 are increased by 41% because of the technological problems. Then after removing the sanctions, the ships anchorage time came down to the same level as it was before. The same trend happens for the port berth time and operation time according to Figures 4.21, and 4.22, it is shown that those are increased and consequently the total port time for ships has been increased by 28%, as it is visible from Figure 4.22. Due to no competitiveness services, the port will face with weak performance and of course low competency.

Hence, it is visible that the port ranking was extremely reduced in 2014 according to the LSCI. Moreover, the port lost many of its customers because of increases in services cost.

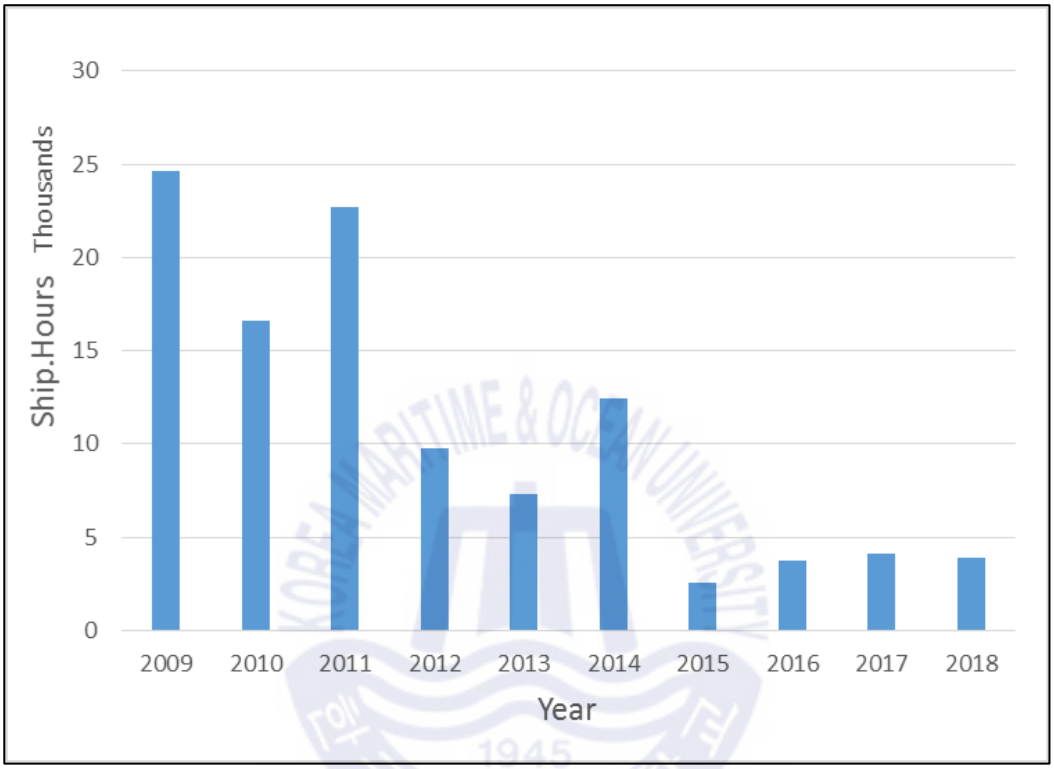

Figure 4.20. SHR Port called ship Anchorage time
Source: author's elaboration using Iran PMO data

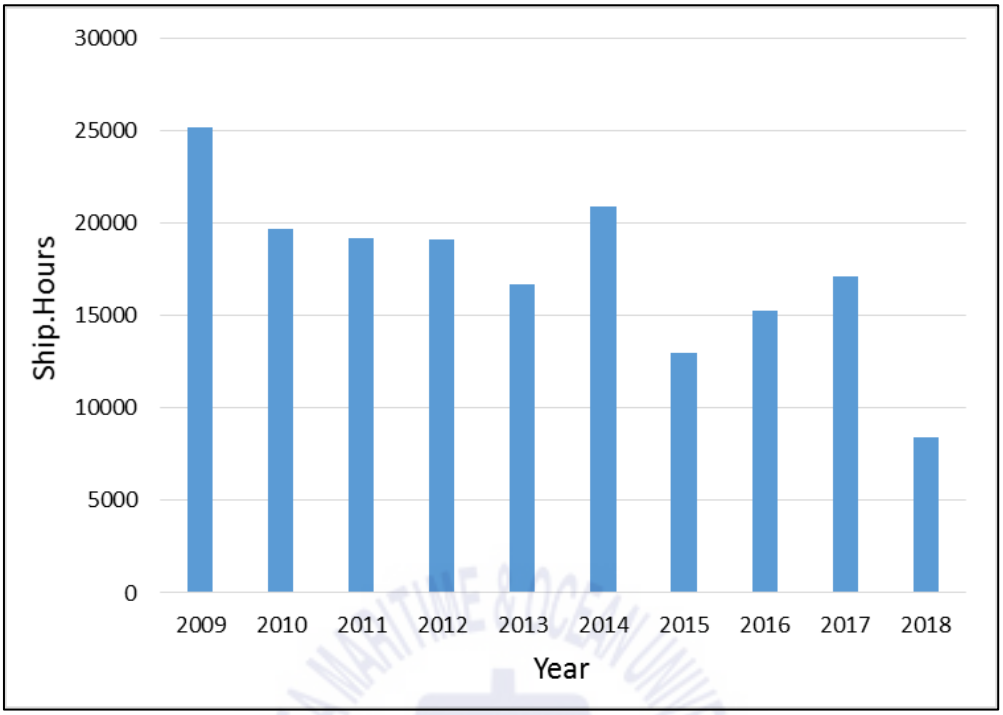

Figure 4.21. SHR Port called ship Berth time
Source: author's elaboration using Iran PMO data

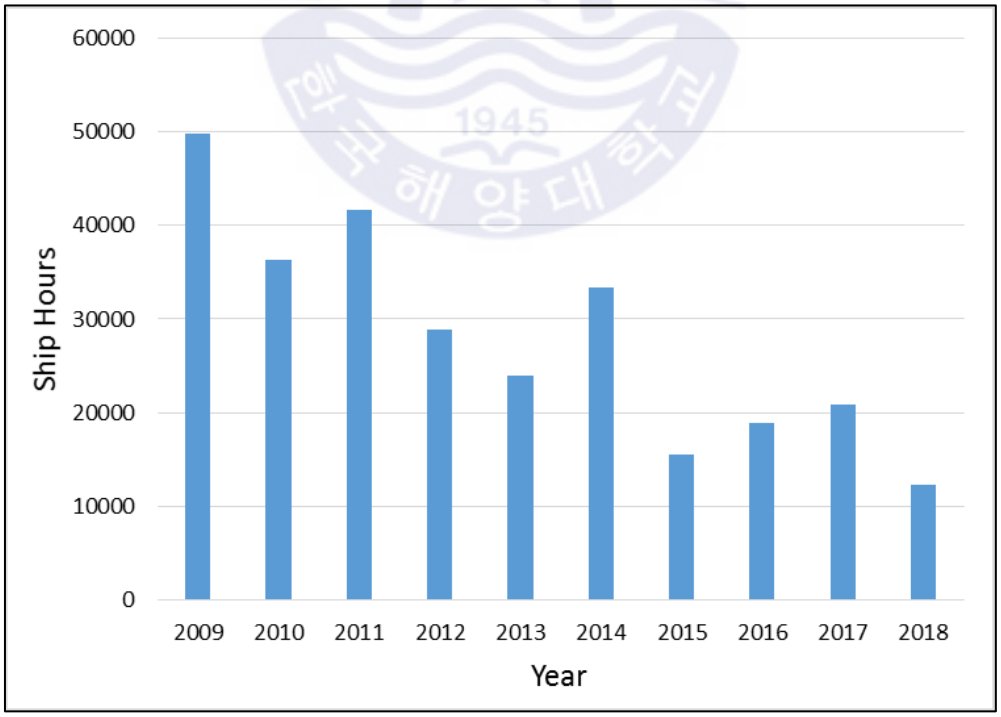

Figure 4.22. SHR Port Operation time
Source: author's elaboration using Iran PMO data

4.2.6. Influence of Sanction on the General Cargo Ports Business

The Iran economy and trade has been targeted by international sanction, which mainly focused on closing the trade ways between Iran and other nations, since the business itself will bring political, cultural and technological relation between countries and states. Over 90% of Iran's import and export are handling by seaport as well as vessels. Therefore, the ports, and their business stabilities are crucial for the country. Thus, the sanctions designer mostly concentrates on banning the transaction, maritime insurance, and shipping and ports to push Iran to their desired direction. Hence, the port managers, authorities, and policymakers are facing with a complicated situation, which needs implementation of a set of procedures to ensure that all external and internal factors that can affect the port performance are under control. Although they sufficiently prepared to challenge with controlling the sanction effects on the Iranian port business, succession is difficult because of inequalities. Nevertheless, they could mitigate their influences.

4.2.7. The Iranian Ports General Cargo Throughput

The port operation and cargo throughput depend on the number of ships call, the size of ships and the number of customers. For the imposed sanctions against Iran in 2012, all above-mentioned factors were influenced by them. The major shipping lines, which are owning bigger ships, withdrew services to Iran ports; consequently, both ships number and size are decreased. In addition, when the vessel moved to other ports, the number of customers are moved with them. It was expected that after imposing the sanctions due to its bans and limitation for key role players, the port's throughput will be reduced, but different consequence was observed. From Figure 4.23, it is visible that after imposing the sanctions for period of 2011 to 2014, the ports throughputs continuously were increased for four years. Nevertheless, the port throughputs suddenly shrank in the year 2015 by 10%.

This indicates that the port performance has significantly impacted and the operation of the port is facing with issue. However comparing 10% with 38%

deduction of container ports cargo throughputs, it is not so numerous. Whereas through the years 2012, 2013, and 2014 the port's throughput is increased by 2.3%, 0.4%, and 5.3%, respectively. There are two reasons that the general cargo throughput and its reduction are three times less than the container port throughputs. First, the number of container shipping lines and ships is less than general cargo ships. Moreover, container ships are doing business under the control of alliances, so they have to follow the alliance's instructions. In addition, container shipping business is so sensitive, cannot tolerate risks, so it is easier for consignees and cargo owners to find a ship for Iran ports destination that could keep cargo throughputs ongoing. Second, when the container ships gave up working with the Iranian port, many container cargos are handled by generalships. It may not be efficient, but it compensates the cargo throughput. Therefore, general cargo ports compared with container cargo ports could keep the level of performance as well as ports productivity, and relative efficiency remained at the same level before sanctions.

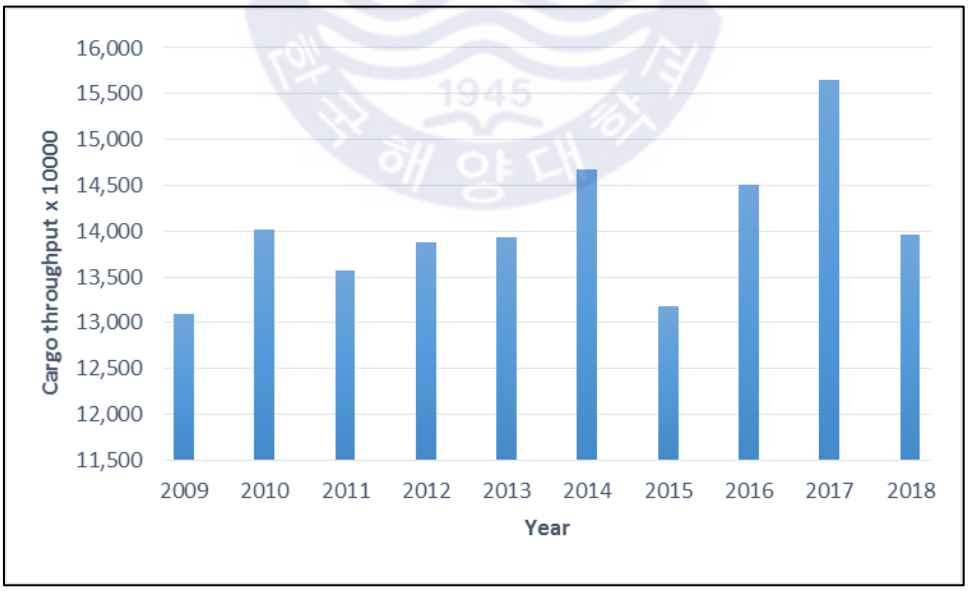

Figure 4.23. Iran General Cargo Ports Throughputs
Source: author's elaboration using Iran PMO data

Chapter 5. Analyzing the Influence of Sanction on port Performance and Relative Efficiency

5.1. Previous Studies of Ports efficiency by Using DEA

The role of the transportation is increasingly important for the world economy. In addition, especially, the cargo containerization has played very important role in all transportation modes (Cullinane et al. 2004). The ports are one of the key infrastructures, which are essential for connecting the bridge between sea and land transportation (Cullinane et al. 2007). Hence, the port performance measurement is necessary to understand that whether the system is moving in the desired direction or not (Cullinane et al. 2010). Port performance and its efficiency is under the influence of many physical and monetary factors and any changes can be a new issue for the ports authorities in this competitive market. So the port performance measurement is a powerful tool for regional and national port evaluating and operations (Cullinane et al. 2004). DEA has been presented as one of the important approaches for measuring efficiency. It is applicable for different sectors of transportation, especially for port performance measurement that has been studied by evaluating cargo handling productivity by assuming the labor, capital and the time as inputs and the throughput as the output (Bendall and Stent, 1987; Ashar, 1997). Meanwhile, container throughput over a period was studied by (Wanye and Talley 1998). Recently the DEA has also been applied across a wide range of port services. Roll and Hayuth (1993) applied DEA to compare the port performance by assuming manpower, capital and cargo uniformity as the 3 inputs; and cargo throughput, level of service, user's satisfaction and ship calls as the 4 outputs. Martinez-Budria et al. (1999) applied DEA to study the relative efficiency of 26 Spanish port authorities. Then, Tongzon (2001) used DEA to study the efficiency of chosen Australian and other international ports. Moreover, Valentine and Gray (2001) as well, measured the port efficiency of worldwide ports using the DEA. On the other hand, the ports quality performance indicators

were studied by Marlow and Paixao Casaca (2003). Although most of these applications are limited to the use the standard form of DEA-CCR (e.g. Charnes, Cooper and Rhodes, 1978) , DEA-BCC (e.g. Banker, Charnes and Cooper, 1984) as well as cross-sectional data which gives a snapshot of producers and their efficiency, the panel data are more reliable and valuable. Using panel data could ensure that performance over the period is more accurate (Cullinane et al. 2004). Only relatively few studies have specifically addressed the issue of dynamic changes in the port efficiency over the time using the panel data. Itoh (2002) had studied about applying DEA window analysis to evaluate eight international major ports, while Cullinane et al. (2004) had applied DEA windows analysis to analyze the efficiency of worldwide ports during the period of year 1992-1999. (Al-Eraqi et al. 2008) studied the relative efficiency of East Africa and Middle East's seaports; Kevin and Wang (2010) studied the top 30 ranking of worldwide leading container ports by applying DEA windows. Kevin and Wang (2010) assumed three inputs and three outputs to calculate the efficiency. Besides, Van Dyck (2015) assessed port efficiency in West Africa by applying DEA, assuming the total quay length (m), terminal area (ha), number of quayside gantry, number of RTG and number of reach stackers as inputs while deciding the container throughput (TEUs) as relevant output. Last but not least, Rapee and Ke (2016) also studied the efficiency measurement of container ports in Thailand using DEA windows Analysis approach. They assumed the length of port, number of crane and warehouse area as inputs and quantity of product as an output.

5.2. Data Envelopment Analysis (DEA) Concept

DEA has been formulated as a mathematical and non-parametric method for evaluating the performance or efficiency measurement of Decision Making Units (DMU) in the different firms. Efficiency is a fundamental concept for any economic activity. So measuring the efficiency is one of the main factors to understand the organization approaches and check whether the organization goals

are in the right direction or not (Cullinane et al. 2007). The measurement of the efficiency in some organization could be challenging because of the variety of the factors engaged in the calculation. Since the DEA has been introduced in 1978, (Charnes, Cooper, Rhodes, 1978) many researchers in different fields quickly recognized that it is the best methodology as it could be easily used in modeling the operational processes for performance evaluations (William, 2012). The DEA is a linear programming model applied to the real data and shows new approaches to establish the experimental assessment of the relationship between the inputs and outputs (Cullinane et al. 2004). The homogeneity of inputs and outputs are essential assumption to achieve the accurate result for measuring relative efficiency by DEA for any set of DMUs. In the absence of this assumption, the result may not be valid (Cullinane et al. 2007). Since the DEA has been formulated, it has been steadily used in the transportation field; its application is used particularity to calculate the port's performance and port efficiency. The DEA intends to investigate the technical performance of DMUs without using cost data (Bichou, 2012). The cost data for performance studies is more suitable than operational (technical) data, however, due to the difficulty in collecting cost data, DEA seeks to examine the performance and its relative efficiencies through the technical data inputs and outputs of DMUs and search the best margins for the minimum inputs or the maximum outputs (Thanassoulis, 2000). The DEA has been considered as a technical model to evaluate and benchmark performance against best practices (Cook et al., 2014). The DEA must undoubtedly determine what can be obtained from the analysis: decreasing inputs or increasing outputs. If the goal is to identify elements that are over-utilizing resources, then input reduction should be the main concern of the analysis and appropriate input-model analysis tool. If the goal were to increase output, the appropriate analytical tool would be a model-oriented output (Cook et al., 2014). In this research, the aim is to produce the highest output by using given input, therefore chose an output-oriented model is more suitable than an input-oriented model. The next section

describes the formulation of the DEA window model as implemented in this research for the measurement of the technical efficiency (TE), pure technical efficiency (PTE) and scale efficiency of the container and general cargo ports of Iran. However, when there is an insufficient number of DMUs comparing to the number of relevant inputs and outputs in the model, another approach is to collect a time series panel data and then use the DEA Window Analysis approach.

5.3. DEA Window Approach

Panel data can examine dynamic changes based on annual data to obtain accurate measurement with respect to the transfer of output results. This technique works on the principle of moving averages (Cooper et al. 2007) and it is useful to detect performance trends of a unit over time. Each unit in a different year is treated as if it was a "different" unit. In doing so, the performance of a unit in a particular year is not only compared to its performance in other periods but also to the performance of other units. In short, the units of the same DMUs in different years are treated as if they were independent of each other.

To formulate the window analysis, Asmild et al. (2004) and Gu and Yue (2011) proposed N Decision Making Units DMUs (n = 1, 2... N) and T times observation T (t = 1, 2… T) in periods using the r inputs to produces s outputs. Then the DMU_n^t expresses that an $DMUn$ in time period t using r dimensional input vector $X_n^t = (X_n^{1t}, X_n^{2t}, \dots, X_n^{rt})'$ and produces s dimensional output vector $Y_n^t = (Y_n^{1t}, Y_n^{2t}, \dots, y_n^{st})'$.

If a window starts at time K ($1 \le K \le T$) and window width be w ($1 \le w \le t-K$), then the inputs and outputs through the Eqs. (1) and (2) are given as follows:

$$\boldsymbol{X_{kw}}=(\boldsymbol{X_1^K}, \boldsymbol{X_2^K}, \dots, \boldsymbol{X_N^K}, \boldsymbol{X_1^{K+1}}, \boldsymbol{X_2^{K+1}}, \dots, \boldsymbol{X_N^{K+1}}, \boldsymbol{X_1^{K+w}}, \boldsymbol{X_2^{K+w}}, \dots, \boldsymbol{X_N^{K+w}})', \quad (1)$$

$$\boldsymbol{Y_{kw}}=(\boldsymbol{Y_1^K}, \boldsymbol{Y_2^K}, \dots, \boldsymbol{Y_N^K}, \boldsymbol{Y_1^{K+1}}, \boldsymbol{Y_2^{K+1}}, \dots, \boldsymbol{Y_N^{K+1}}, \boldsymbol{Y_1^{K+w}}, \boldsymbol{Y_2^{K+w}}, \dots, \boldsymbol{Y_N^{K+w}})', \quad (2)$$

The CCR (Constant return to scales, CRS) Standard introduced by Charnes et al. (1978) which is the model of the data envelopment analysis window problem forDMU_t^K, can be obtained from the Eqs. (3) to (6).

Min θ, (3)

Subject to:

$\theta\,'X_t - \lambda\,'X_{KW} \geq 0$, (4)

$\lambda\,'Y_{KW} - Y_t \geq 0$, (5)

$\lambda_n \geq 0 \quad (n = 1, 2,\ldots, N \times \mathrm{w})$ (6)

To achieve the BCC (Banker, Charnes and Cooper. 1984) Standard model formulation, it is assumed that the restriction is: $\sum_{n=1}^{n} \lambda_n = 1$.

Measured value of CCR method is defined as the technical efficiency (TE) and the measured value of BCC method is defined as the pure technical efficiency (PTE) (Gu, & Yue, 2011). The scale efficiency (SE) is obtained through dividing technical efficiency to pure technical efficiency. Figure 5.1 illustrates the SE derived from the CCR and the BCC. The BCC model is illustrated through the Eqs. (7) to (11).

Min θ, (7)

subject to:

$\theta\,'X_t - \lambda\,'X_{KW} \geq 0$ (8)

$\lambda\,'Y_{KW} - Y_t \geq 0$, (9)

$\sum_{n=1}^{n} \lambda_n = 1$ (10)

$\lambda_n \geq 0 \quad (n = 1, 2... N \times \mathrm{w})$. (11)

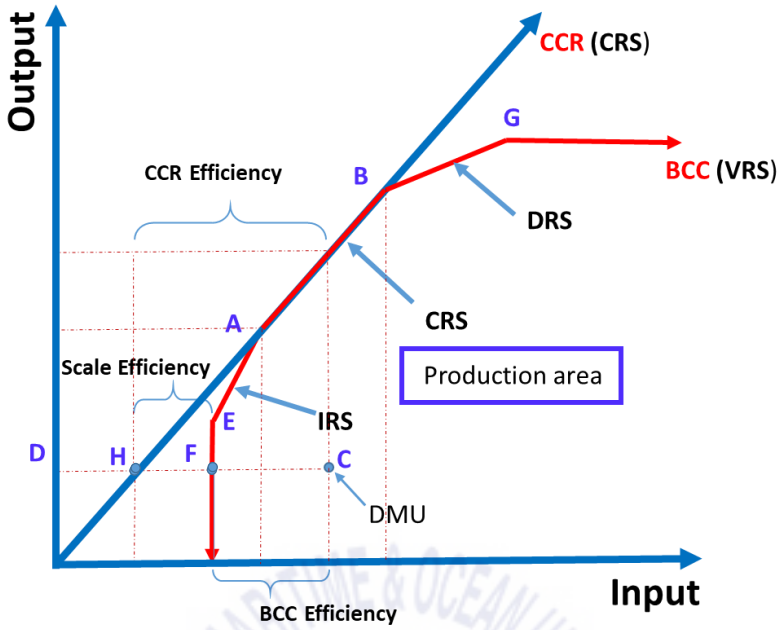

Figure 5.1. CCR Model and the BCC model frontier.
Source: Reproduced by authors from Banker et al.

Asmild et al. (2004) figured out that there are no technical changes for the specified panel windows and all DMUs in the specified panel window contrast against each other (Repkova, 2014). They offered to use a narrow panel window width. Charnes et al. (1995) indicated that the panel width equal to 3 or 4 appears to be the best balance of formation and stability of the efficiency scores to ensure that the results will be reliable.

Furthermore, a notable feature of this technique is that there are nk units (DMUs) in each window where n is the number of units in a given time period (and it is the same in all periods), and k can be define as the length of each window (equal for all windows) (Cooper et al. 2007). This feature is extremely important in the case of a small number of DMUs with a large number of inputs and outputs since it increases the discriminatory power of the DEA models. This is accomplished by dividing the total number of periods, T, into a series of overlapping periods or windows, each of length k (k < T) and thus having nk units. Hence, the first window has nk DMUs for the time periods {1, . .., k}, the second one has nk DMUs

and the time periods {2, . . ., k + 1}, and so on and the last window consists of nk DMUs and the time periods {T - k + 1, . . ., T}. In all, there are T - k + 1 separate analyses where each analysis examines nk DMUs.

5.4. The Analysis of container ports efficiency

In this study, the first 10 ports of Iran are selected for evaluating the container ports' productivity and relative efficiency. But 5 ports were excluded due to the low container throughput and only 5 ports with over 10,000 TEUs throughput had been selected for this study including Shahid Rajaei port (hereinafter referred to as SHR), Bandar Iman Khomeini port (hereinafter referred to as BIK), Bushehr port (hereinafter referred to as BUS), Chabahar port (hereinafter referred to as CHB) and Khorramshahr port (hereinafter referred to as KSH). The summary of the descriptive statistical performance of the mentioned ports is presented in Table 5.1. This 10-year data (from year 2009 to 2018) is a secondary data, which had been published in the annual reports of Iran's Ports and Maritime Organization (PMO). This period (from year 2009 to 2018) as researched by current study had included those years when sanctions were imposed. It is clear that these restrictions had caused the importing and exporting of cargos from/to Iranian ports to decrease. In order to evaluate the ports' productivity, DEA window analysis method is used to measure Iranian ports' efficiency over the sanctions period. The advantage of using window analysis is the enhancement of the accuracy of productivity and efficiency results. As window analysis was done over a period, the time valid of data is longer (Cullinane et al. 2007). To achieve this goal, the sampling and proper definition of inputs and outputs appears to be the most challenging part in applying DEA window analysis. Typically, the selection and number of inputs, outputs and DMUs determine between the efficient and inefficient units. However, when evaluating the sample size, there is a conflict. Larger sample size includes more DMUs, which in return, leads to a greater probability of capturing high-performance units that could serve as the efficient frontier and improve

discriminatory power (Itoh, 2002). However, large dataset range might reduce homogeneity of the dataset, which means that some external effects beyond the manager's control will affect the results (Golany and Roll 1989). In addition, the computational needs of the large data set will also increase. However, there are a number of rules indicating how to choose the number of inputs and outputs and their relationship to the number of DMUs. Boussofiane et al. (1991) stipulated that in order to obtain a discriminatory power of the CCR and BCC model, the number of DMUs should not be less than the product of the number of inputs and outputs (Cullinane et al. 2010). Dyson et al (2001) generally recommended the unit numbers to be twice of input and output variables. However, there are some cases that the number of firms are less than the number of inputs and outputs.

5.4.1. Data Selection, Define Input and Output

Data defining is an important parts of DEA analysis therefore Careful selection of inputs and outputs is critical to the quality and outcome of the analysis. For defining proper inputs and outputs, the factors influencing the role of ports in the transportation should be considered thoroughly such as providing a proper window for ships, providing proper services for port customers, as well as the availability of proper equipment to transfer cargos and containers from the ship to shore and vice versa. Meanwhile, the yard size and the inland facilities are the most important parameters to decrease the time and cost of services and improve competitiveness and productivity (Cullinane et al. 2004). Therefore, besides the worker's number, which can influence the performance of a port in comparison to the others, UNCTAD had proposed a list of the important factors for ports including the Quay wall, the number of Gantry crane and the size of the yard (UNCTAD, 1976). Therefore, in this research, the “Length of Quay wall”, the “Number of Quay wall", "Number of Gantry Crane”, and the “Size of Yard Area” were defined as inputs and the “Container Throughput” was defined as the output. The correlation results for the last window between input and output variables are tabulated in Table 5.2.

Table 5.1 Descriptive statistics of container ports inputs and output[19]

	Quay wall Length (M)	Number of Berth	Number of Gantry Crane	Yard Space (Ha)	Throughput (TEU)[20]
Max	3,215	10	30	140.00	2,137,175
Min	800	3	2	3.00	40,119
Average	1,429	5	8.8	36.80	482,650.40
SD	910.71	2.61	10.62	52.23	827,545.2

Table 5.2 Inputs and output correlation of container ports

	Quay wall Length (M)	Number of Berth	Number of Gantry Crane	Yard Space (Ha)	Throughput (TEU)
Quay wall Length (M)	1				
Number of Berth	0.9344	1			
Number of Gantry Crane	0.9856	0.9669	1		
Yard Space (Ha)	0.9604	0.9898	0.9918	1	
Throughput (TEU)	0.9798	0.9603	0.9984	0.9894	1

5.4.2. Empirical Results for Container Ports

In order to apply the DEA window model for calculation and analysis of the efficiency of the ports, it is required to define a proper window length and window numbers. However, there are no specified rules for the definition of window length and size (Cullinane et al. 2010). Nevertheless, Cooper et al. (2007) used a simple formula to calculate the size of the window and number of different firms. They proposed that the number of windows "W" could be obtained from W=k-L+1,

[19] Time period 2018.
[20] TEU is the Twenty Foot Equivalent Unit a measure used for capacity.

where “k” is the number of periods and “L” is the length of windows. Assuming L=4, we can then induce that W=7 as ‘k’ is 10 in our study. Meanwhile, the number of different units, “DMUs” could be obtained from DMUs= n × L × W, where “n” is the number of firms. Since there are total 5 firms being studied in our research, we can then infer that we will have a sum of 140 DMUs in our study (5x4x7=140). This technique is suitable for evaluation of the firm’s efficiency when the number of firms are limited but inputs and output variables are large. As a sum, in order to calculate and analyze the container ports’ efficiency, 140 different units “DMUs” were considered in In the Table 5.5, (CCR- model) and the table 5.8, (BCC-model) for different container ports. As indicated in both Tables, the length of the window is 4 and windows size is 7. Calculated efficiency for each port was displayed in different windows.

5.4.2.1. Shahid Rajaee (SHR) Port efficiency

Through Table 5.5, it can be observed that the SHR container port average technical efficiency decreased from 0.89 to 0.84 and 0.80 from the first window (W1) to the second window (W2) and third window (W3) respectively. Then from the fourth window (W4) to the fifth window (W5), sixth window (W6) and seventh window (W7) the port efficiency is improved with the level of efficiency source 0.83, to 0.87 and 0.91. As we can see at beginning of sanction for the first window port technical efficiency fell down, however after adopting new polices by port managers the port productivity and relative efficiency grew up from the third window during the sanction.

5.4.2.2. Bandar Imam Khomeini (BIK) Port efficiency

According to the Table 5.5, we can see that the BIK port efficiency continuously is increased from the first window (W1) to the fourth window (W4) with efficiency source of 0.27 to 0.33, then form fifth window (W5) to the seventh (W7) decreased by 0.32 to 0.28. It seems that when the sanctions were so serious

during 2012 to 2015 the port acted well and started to observe some containers. Therefore, port efficiency improved. However, when the sanctions senders show some relaxation in 2016, it seems that cargo has been gone from this port.

5.4.2.3. Bushehr (BUS) Port efficiency

From Table 5.5 it is seen that from the column of the average BUS port technical efficiency is increased from first window (W1) to second window (W1) from 0.79 to 0.83 and then it came down and reached to the 0.80 for third window (W3). As Table 5.5 shows, this port's efficiency is decreased after second window (W2) to the seventh window (W7) and reached to 0.7 for window seven with the lowest level of efficiency source.

5.4.2.4. Chabahar (CHB) Port efficiency

Chabahar port is not an efficient container port; recently this port has been developed for the purpose of container activity. However, its performance in the past years was very low.

5.4.2.5. Khorramshahr (KSH) Port efficiency

Khorramshar port technical efficiency was decreased from the first window (W1) to the second and third window (W2, W3) from 0.87 to 0.82 and 0.81 and from the third window it was increased to 0.82 for the fourth window (W4) and the efficiency growth was continued and reached to the highest level of efficiency source 0.87 for sixth window (W6), and then came down to the lowest level of port efficiency for the seventh window (W7) with level 0.73. Figures 5.2 and 5.3 show the technical efficiency variation through the windows and years, respectively for CCR model.

The analysis of container port efficiency by BCC model show that from Table 5.8, almost all the ports efficiency during sanction are reduced. It is clearly visible

from figures 5.2 and 5.4 that except Chabahar port, all four ports show higher level of efficiency. It is due to the scale efficiency as shown in figure 5.1.

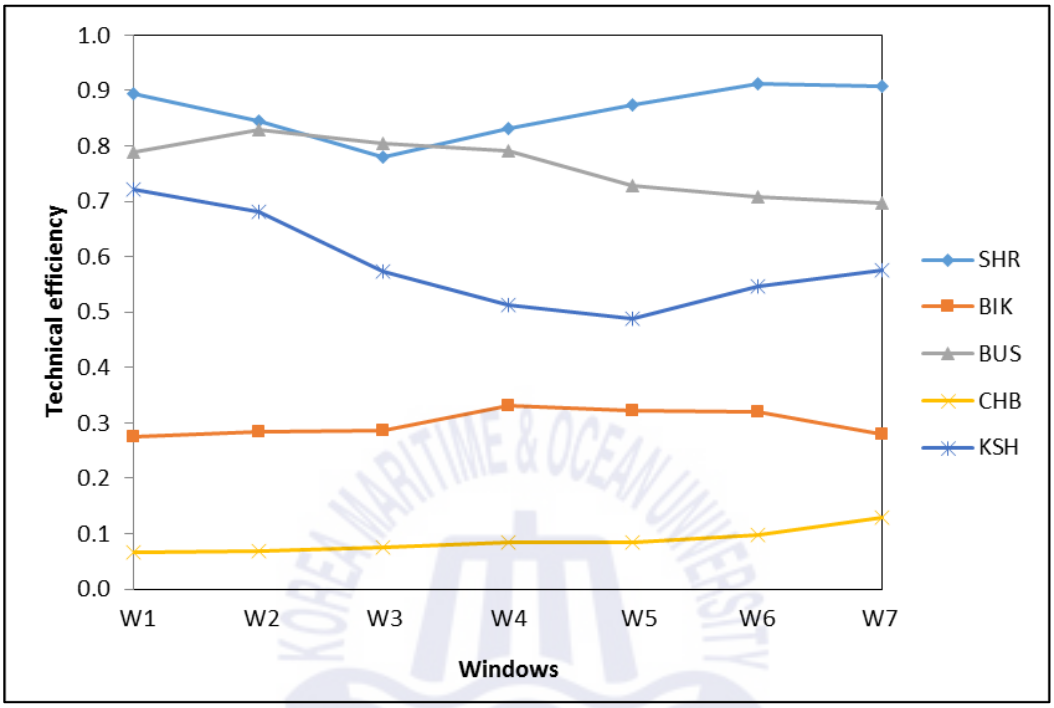

Figure 5.2. Container Ports Technical Efficiency (CCR-Model) through the Windows
Source: author's elaboration

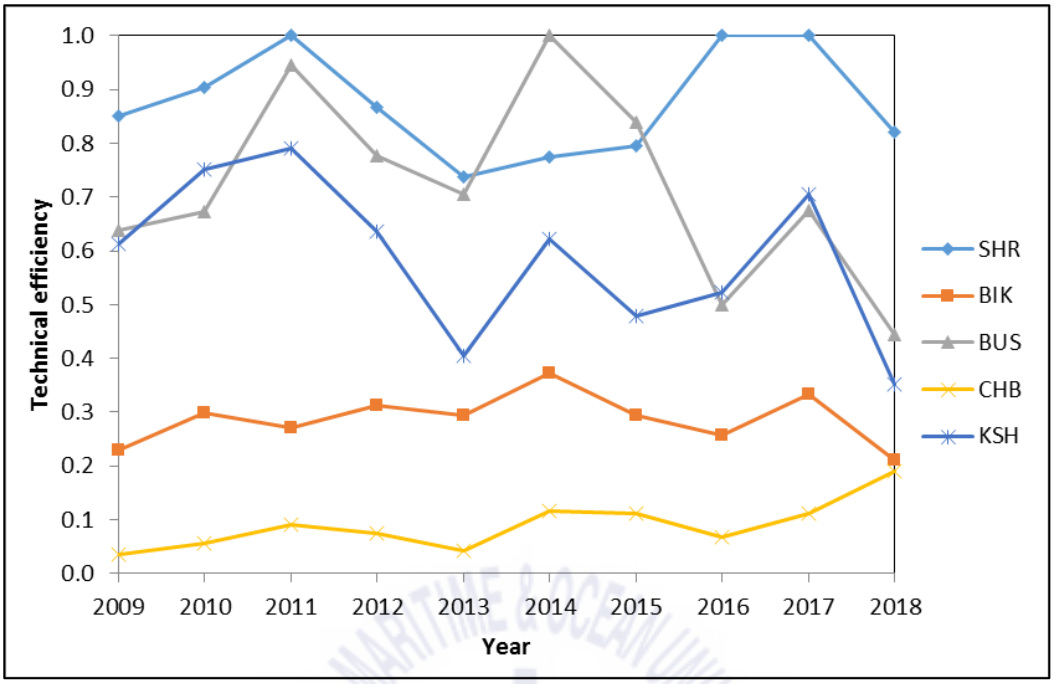

Figure 5.3. Container Ports Technical Efficiency (CCR-Model) through the Year
Source: author's elaboration

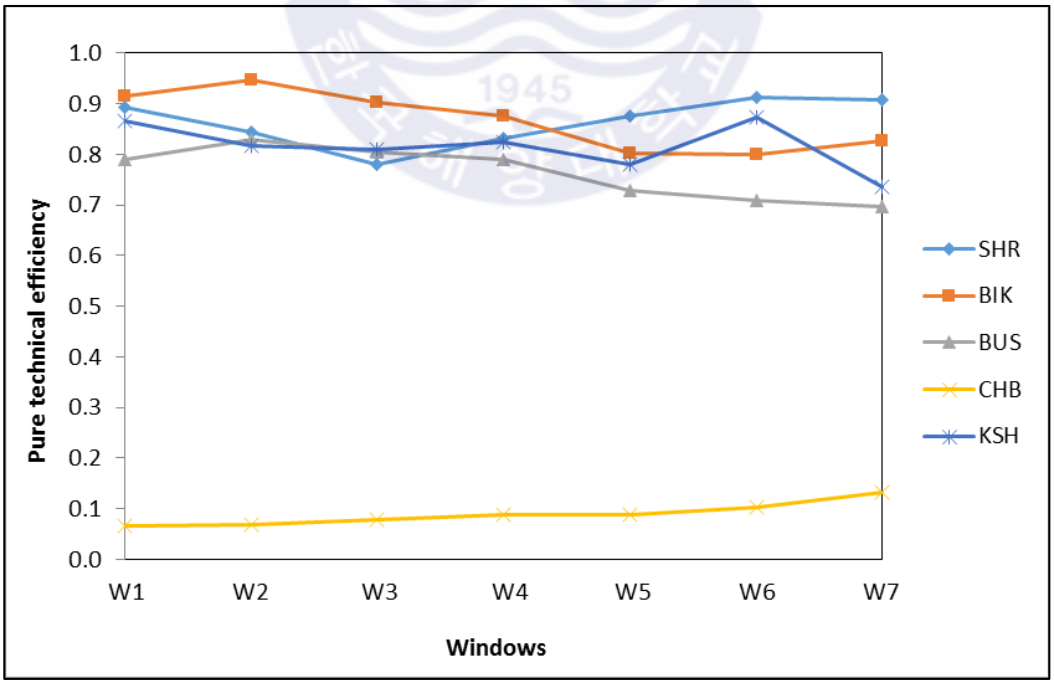

Figure 5.4. Container Ports Pure Technical Efficiency BCC-Model) by Windows
Source: author's elaboration

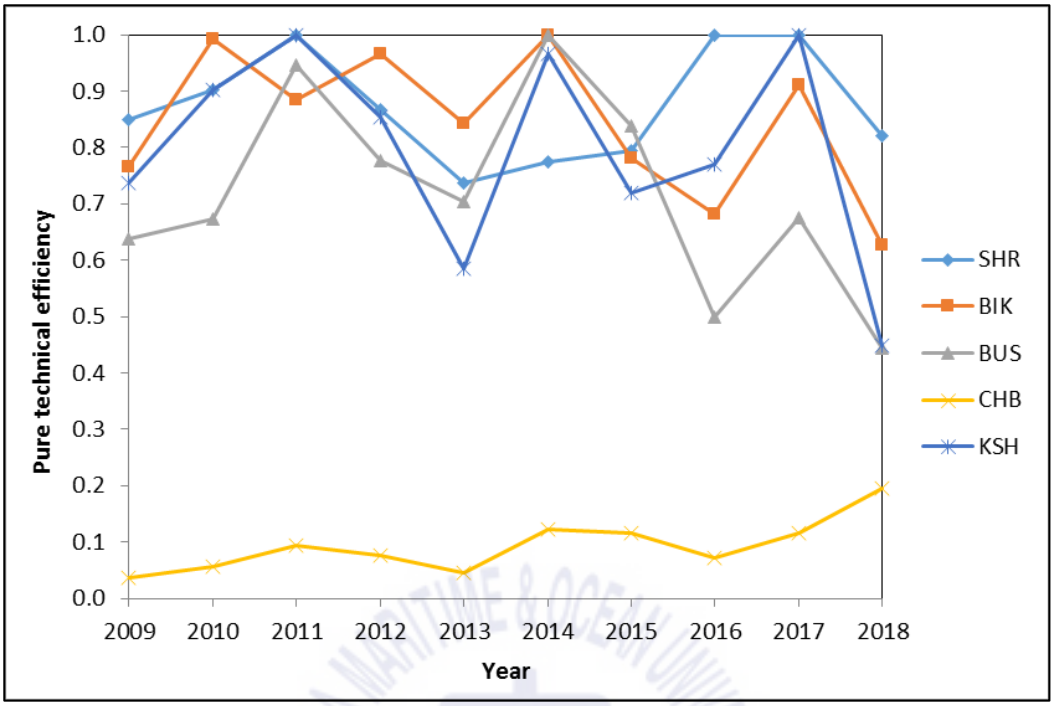

Figure 5.5. Container Ports Pure Technical Efficiency (BCC-Model) through the years
Source author's elaboration

The results of DEA efficiency scores under the constant variable are presented in Table 5.3. The average technical efficiency is shown in a four-year window. During the period of 2009 to 2018, the average efficiency calculated using CRS range from 50% to 55%. This analysis shows that Iran container ports are considered to be low efficient. Therefore, the average inefficiency of the port sector in the CCR model was in the range of 50% to 45%. The reason for the inefficiency of container ports is mainly the lack of cargo capacity in ports. It is clear that the average of the container port efficiency reduced by 9% during the sanctions. However, as Table 5.4 shows, the sanctions were affected the average of ports efficiency source from 0.62 in 2011 and the changing of average technical efficiency over the time from 2009 to 2018. While the sanction decreased the efficiency to 0.4 in 2018.

Table 5.3. Container Ports Technical Efficiency (CCR-Model) through the windows

Window / DMUs	2009-2010-2011-2012	2010-2011-2012-2013	2011-2012-2013-2014	2012-2013-2014-2015	2013-2014-2015-2016	2014-2015-2016-2017	2015-2016-2017-2018	Average
SHR	0.894	0.844	0.779	0.833	0.875	0.912	0.907	0.863
BIK	0.275	0.284	0.285	0.330	0.321	0.320	0.279	0.299
BUS	0.789	0.830	0.804	0.791	0.729	0.709	0.696	0.764
CHB	0.066	0.068	0.076	0.084	0.084	0.098	0.128	0.086
KSH	0.721	0.681	0.573	0.514	0.488	0.546	0.577	0.586
Average	0.549	0.541	0.504	0.510	0.499	0.517	0.517	0.520

Table 5.4. Container Ports Technical Efficiency (CCR-Model) through years

Year / DMUs	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Average
SHR	0.850	0.903	1.000	0.866	0.738	0.775	0.795	1.000	1.000	0.820	0.875
BIK	0.230	0.298	0.270	0.312	0.293	0.374	0.294	0.257	0.333	0.212	0.287
BUS	0.639	0.673	0.946	0.776	0.705	1.000	0.838	0.500	0.675	0.443	0.719
CHB	0.035	0.056	0.092	0.074	0.043	0.116	0.111	0.068	0.111	0.189	0.090
KSH	0.613	0.751	0.791	0.636	0.405	0.623	0.479	0.523	0.705	0.352	0.588
Average	0.473	0.536	0.620	0.533	0.437	0.577	0.503	0.470	0.565	0.403	0.512

Table 5.5. Container Ports Technical Efficiency (CCR-Model) through the widows

Year / DMUs	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Average	C-Average
SHR (W1)	0.850	0.903	1.000	0.822							0.894	
(W2)		0.903	1.000	0.822	0.653						0.844	
(W3)			1.000	0.822	0.653	0.642					0.779	
(W4)				1.000	0.795	0.781	0.754				0.833	
(W5)					0.852	0.838	0.809	1.000			0.875	
(W6)						0.838	0.809	1.000	1.000		0.912	
(W7)							0.809	1.000	1.000	0.820	0.907	0.863
BIK (W1)	0.230	0.298	0.272	0.300							0.275	
(W2)		0.298	0.272	0.300	0.267						0.284	
(W3)			0.267	0.295	0.262	0.316					0.285	
(W4)				0.352	0.312	0.377	0.279				0.330	
(W5)					0.332	0.401	0.296	0.255			0.321	
(W6)						0.401	0.296	0.255	0.329		0.320	
(W7)							0.305	0.262	0.338	0.212	0.279	0.299
BUS (W1)	0.639	0.673	1.000	0.845							0.789	
(W2)		0.673	1.000	0.845	0.802						0.830	
(W3)			0.838	0.708	0.672	1.000					0.804	
(W4)				0.708	0.672	1.000	0.784				0.791	
(W5)					0.672	1.000	0.784	0.458			0.729	
(W6)						1.000	0.784	0.458	0.593		0.709	
(W7)							1.000	0.584	0.757	0.443	0.696	0.764
CHB (W1)	0.035	0.056	0.095	0.077							0.066	
(W2)		0.056	0.095	0.077	0.045						0.068	
(W3)			0.085	0.069	0.040	0.110					0.076	
(W4)				0.073	0.043	0.117	0.105				0.084	
(W5)					0.044	0.119	0.107	0.064			0.084	
(W6)						0.119	0.107	0.064	0.102		0.098	
(W7)							0.126	0.076	0.120	0.189	0.128	0.086
KSH (W1)	0.613	0.751	0.833	0.686							0.721	
(W2)		0.751	0.833	0.686	0.453						0.681	
(W3)			0.708	0.583	0.385	0.614					0.573	
(W4)				0.592	0.391	0.623	0.449				0.514	
(W5)					0.392	0.626	0.451	0.482			0.488	
(W6)						0.626	0.451	0.482	0.626		0.546	
(W7)							0.565	0.605	0.784	0.352	0.577	0.586
Average	0.473	0.536	0.620	0.533	0.437	0.577	0.503	0.470	0.565	0.403		

The results of the efficiency of each port show that the most efficient container ports were SHR and BUS. On the other hand, the lowest efficient container ports were CHB and BIK. It can be seen that the group of largest ports are more efficient than smaller ports. The reason why the group of large ports is more efficient, is that the ports allocated recourses are balanced in these ports better than smaller ports. Table 5.5, presents the technical efficiency for each container port under analysis through CCR model for each window.

Table 5.6. Container ports Pure Technical Efficiency (BCC-Model) through the windows

Window / DMUs	2009-2010-2011-2012	2010-2011-2012-2013	2011-2012-2013-2014	2012-2013-2014-2015	2013-2014-2015-2016	2014-2015-2016-2017	2015-2016-2017-2018	Average
SHR	0.894	0.844	0.779	0.833	0.875	0.912	0.907	0.863
BIK	0.916	0.946	0.902	0.876	0.801	0.799	0.826	0.866
BUS	0.789	0.830	0.804	0.791	0.729	0.709	0.696	0.764
CHB	0.067	0.070	0.079	0.089	0.088	0.103	0.132	0.089
KSH	0.866	0.817	0.809	0.824	0.779	0.872	0.735	0.815
Average	0.706	0.701	0.675	0.682	0.654	0.679	0.659	0.680

Table 5.7. Container ports Pure Technical Efficiency (BCC-Model) through years

Year / DMUs	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Average
SHR	0.850	0.903	1.000	0.866	0.738	0.775	0.795	1.000	1.000	0.820	0.875
BIK	0.765	0.992	0.885	0.967	0.843	1.000	0.780	0.682	0.910	0.627	0.845
BUS	0.639	0.673	0.946	0.776	0.705	1.000	0.838	0.500	0.675	0.443	0.719
CHB	0.036	0.057	0.094	0.076	0.045	0.122	0.116	0.071	0.115	0.195	0.093
KSH	0.737	0.903	1.000	0.855	0.585	0.967	0.720	0.771	1.000	0.449	0.799
Average	0.605	0.705	0.785	0.708	0.583	0.773	0.650	0.605	0.740	0.507	0.666

Table 5.8 Container Ports Pure Technical Efficiency (BCC-Model) through the windows

Year / DMUs	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Average	C-Average
SHR (W1)	0.850	0.903	1.000	0.822							0.894	
(W2)		0.903	1.000	0.822	0.653						0.844	
(W3)			1.000	0.822	0.653	0.642					0.779	
(W4)				1.000	0.795	0.781	0.754				0.833	
(W5)					0.852	0.838	0.809	1.000			0.875	
(W6)						0.838	0.809	1.000	1.000		0.912	
(W7)							0.809	1.000	1.000	0.820	0.907	0.863
BIK (W1)	0.765	0.992	0.905	1.000							0.916	
(W2)		0.992	0.905	1.000	0.887						0.946	
(W3)			0.845	0.934	0.829	1.000					0.902	
(W4)				0.934	0.829	1.000	0.740				0.876	
(W5)					0.829	1.000	0.740	0.636			0.801	
(W6)						1.000	0.740	0.636	0.820		0.799	
(W7)							0.902	0.775	1.000	0.627	0.826	0.866
BUS (W1)	0.639	0.673	1.000	0.845							0.789	
(W2)		0.673	1.000	0.845	0.802						0.830	
(W3)			0.838	0.708	0.672	1.000					0.804	
(W4)				0.708	0.672	1.000	0.784				0.791	
(W5)					0.672	1.000	0.784	0.458			0.729	
(W6)						1.000	0.784	0.458	0.593		0.709	
(W7)							1.000	0.584	0.757	0.443	0.696	0.764
CHB (W1)	0.036	0.057	0.097	0.079							0.067	
(W2)		0.057	0.097	0.079	0.046						0.070	
(W3)			0.088	0.071	0.042	0.114					0.079	
(W4)				0.077	0.045	0.123	0.110				0.089	
(W5)					0.046	0.125	0.112	0.068			0.088	
(W6)						0.125	0.112	0.068	0.107		0.103	
(W7)							0.130	0.078	0.124	0.195	0.132	0.089
KSH (W1)	0.737	0.903	1.000	0.823							0.866	
(W2)		0.903	1.000	0.823	0.544						0.817	
(W3)			1.000	0.823	0.544	0.867					0.809	
(W4)				0.949	0.627	1.000	0.720				0.824	
(W5)					0.627	1.000	0.720	0.770			0.779	
(W6)						1.000	0.720	0.770	0.999		0.872	
(W7)							0.721	0.771	1.000	0.449	0.735	0.815
Average	0.605	0.705	0.785	0.708	0.583	0.773	0.65	0.605	0.74	0.507		

Tables 5.7 and 5.8 illustrate the pure technical efficiency of individual ports calculated under the variable return to scale. The average efficiency calculated in BCC model reduced from 0.089 to 0.86.6. The most efficient ports were SHR and BIK. Also in BCC model, the lowest efficient ports was CHB. Table 5.9 present the pure technical efficiency for each container port under analysis through BCC model for each windows.

5.5. The Analysis of general cargo ports efficiency

For studying of general cargo ports, the first 10 ports of Iran are selected for evaluating the general cargo ports' productivity and relative efficiency. But 4 ports were excluded due to the low cargo throughput and only 6 ports with over 1-million-ton cargo throughput had been selected for this section of study including Shahid Rajaei port (hereinafter referred to as SHR), Bandar Iman Khomeini port (hereinafter referred to as BIK), Bushehr port (hereinafter referred to as BUS), Chabahar port (hereinafter referred to as CHB), Khorramshahr port (hereinafter referred to as KSH) and Shahid Bahonar port (hereinafter referred to as SHB). The summary of the descriptive statistical performance of the mentioned ports is presented in the Table 5.9. This 10-year data (from year 2009 to 2018) is a secondary data which had been published in the annual reports of Iran's Ports and Maritime Organization (PMO). This period (from year 2009 to 2018) as researched by current study had included those years when sanctions were imposed. It is clear that these restrictions had caused the importing and exporting of cargos from/to Iranian ports to decrease. In order to evaluate the ports' productivity, DEA window analysis method is used to measure Iranian ports' efficiency over the sanctions period. Aforementioned, that there are a number of rules indicating how to choose the number of inputs and outputs and their relationship to the number of DMUs. Boussofiane et al. (1991) stipulated that in order to obtain a discriminatory power of the CCR and BCC model, the number of DMUs should not be less than the product of the number of inputs and outputs

(Cullinane et al. 2010). Dyson et al (2001) generally recommended the unit numbers to be twice of input and output variables. However, there are some cases that the number of firms are less than the number of inputs and outputs. In this study the methodology of DEA window has been selected and applied as proper methodology, which the explanation of that and its requirements can be seen in section 5.3.

5.5.1. Define Input and Output for General Cargo Ports

As discussed in previous sections careful selection of inputs and outputs is critical to the quality and outcome of the analysis. For defining proper inputs and outputs, the factors influencing the role of ports in the transportation should be considered thoroughly such as providing a proper window for ships, providing proper services for port customers, as well as availability of proper equipment to transfer cargos from the ship to shore and vice versa. Meanwhile, the yard size and the inland facilities are the most important parameters to decrease the time, cost of services, and improve competitiveness and productivity (Cullinane et al. 2004). Therefore, besides the worker's number, which can influence the performance of a port in comparison to the others, UNCTAD had proposed a list of the important factors for ports including the Quay wall, the number of Gantry crane and the size of the yard (UNCTAD, 1976). Therefore, in this part of this study, the “Length of Quay wall”, the “Number of Quay wall", "Number of Crane”, and the “Size of Yard Area” were defined as inputs; and the “Cargo Throughput”, the “Number of ships” and the “tone/ship” as a factor related to the ship size was defined as the output. The correlation results for the last window between input and output variables are tabulated in Table 5.10.

Table 5.9. Descriptive statistics of General cargo ports inputs and output

	Qauy wall Length (m)	Number of Crane	Numberof Berth	Storge Area (Ha)	tons/Ship	Number. Ship.Call	Throughput (ton)
Max	8245.00	50.00	37.00	1999979.00	25942.75	3363.00	77902856.00
Min	1280.00	10.00	10.00	250000.00	2854.27	113.00	1681166.00
Average	3913.33	22.50	20.67	713329.83	12939.19	1157.50	21594174.50
SD	2926.61	14.07	10.78	668415.95	9576.18	1090.85	29282370.68

Table 5.10. Inputs and output correlation of General cargo ports

	Qauy wall Length (m)	Number of Crane	Numberof Berth	Storge Area (Ha)	tons/ship	Number. Ship.Call	Throughput (ton)
Qauy wall Length (m)	1						
Number of Crane	0.8969	1.0000					
Numberof Berth	0.9888	0.8297	1.0000				
Storge Area (Ha)	0.9467	0.9642	0.8899	1.0000			
tons/ship	0.8001	0.6690	0.7737	0.7677	1.0000		
Number. Ship.Call	0.9054	0.9695	0.8432	0.9821	0.6334	1.0000	
Throughput (ton)	0.9458	0.9686	0.8876	0.9995	0.7759	0.9793	1.0000

5.5.2. Empirical Results of General Cargo Ports

As explained in the previous section, in order to apply the DEA window model for calculation and analysis of the efficiency of the ports, it is required to define a proper window length and window numbers. As discussed in the above, there is no specified rules for the definition of window length and size. There are some recommendation from the field researchers to find proper result that it is better to consider them. Therefore, the size of window can be calculate by a simple formula. They proposed that the number of windows “W” could be obtained from

W=k-L+1, where “k” is the number of periods and “L” is the length of windows. Depending on the frim and the period of study, chosen proper length for window may influence the result of the study.

For the current study due to the time period and the sanctions period, 4 years, by assuming L=4, we can then induce that W=7 as ‘k’ is 10 in our study. Meanwhile, the number of different units, “DMUs” could be obtained from DMUs= n × L × W, where “n” is the number of firms. Since there are total 6 firms being studied in our research, we can then infer that we will have a sum of 168 DMUs in our study (6x4x7=168). This technique is suitable for evaluation of the firm’s efficiency when the number of firms are limited but input and output variables are large. As a sum, in order to calculate and analyze the general cargo ports’ efficiency, 168 different units “DMUs” were considered in Table 7 for different general cargo ports. As indicated in Table 5.11, (CCR-model) and Table 5.14, (BCC-model) the length of the window is 4 and windows size is 7. Calculated efficiency for each port was displayed in different windows. Comparing this table to the general cargo ports efficiency table, the general cargo ports efficiency does not show big fluctuation during the period of study. It is showing that the ports performance and productivities not changed. Because as discussed the availability general cargo ships, transferring some of container cargo by general ships, flexibility of this frim, Iran’s general ports could to keep the same level of productivity and performance during the sanctions period. In order to discuss and analyze the obtained efficiency result from the DEA window, the following result reviewing are presented for different ports.

5.5.2.1. Bandar Imam Khomeini (BIK) Port Efficiency

Through the efficiency table 5.11, the BIK port efficiency will compare and discuss for the period of before, during, and after sanction. Considering the windows form first to seventh, while all seven windows contain the period of 2009 to 2018, each window is containing the period of 4 years, such as the first window,

which includes the period of 2009 to 2012 and the window seventh, which contains 2015 to 2018. Now from first window that indicates the time period before sanction, as it is shown in column of the average efficiency of each window (W1) for the BIK port, port efficiency was increasing from first window (W1) to fourth (W4) and to seventh window (W7) the efficiency source is 0.96 to 0.96, and 0.98 respectively (before, during and after sanctions). Therefore, the port operation efficiency was efficient at 0.96 during the embargo. Hence, there are no significant reduction for the third window (W3), because the first year of sanction the efficiency source slightly (2%) decreased, but immediately it also recovered in the next window. The port of BIK will remain efficient by the average level of efficiency about 0.97.

Table 5.11. General cargo ports Technical Efficiency (CCR-Model) by year and widow

Year / DMUs	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Average	C-Average
BIK (W1)	0.932	0.973	0.944	1.000							0.962	
(W2)		0.973	0.944	1.000	0.982						0.975	
(W3)			0.898	0.952	0.938	1.000					0.947	
(W4)				0.952	0.938	1.000	0.978				0.967	
(W5)					0.937	1.000	0.976	1.000			0.978	
(W6)						1.000	0.973	0.975	1.000		0.987	
(W7)							0.994	0.974	1.000	0.983	0.988	0.972
BUS (W1)	0.845	0.957	1.000	0.941							0.936	
(W2)		0.957	1.000	0.939	1.000						0.974	
(W3)			1.000	0.910	0.958	1.000					0.967	
(W4)				0.947	0.976	1.000	1.000				0.981	
(W5)					0.972	1.000	0.994	0.944			0.977	
(W6)						1.000	0.992	0.942	0.876		0.953	
(W7)							1.000	0.947	0.887	0.881	0.929	0.959
CHB (W1)	1.000	0.925	0.918	0.900							0.936	
(W2)		1.000	1.000	0.974	0.994						0.992	
(W3)			1.000	0.979	0.997	0.974					0.987	
(W4)				0.982	1.000	0.973	0.940				0.974	
(W5)					1.000	0.962	0.933	0.823			0.929	
(W6)						1.000	1.000	0.869	0.988		0.964	
(W7)							0.838	0.742	0.783	1.000	0.841	0.946
KSH (W1)	0.540	0.678	0.929	1.000							0.787	
(W2)		0.685	0.931	1.000	0.887						0.876	
(W3)			0.841	0.901	0.803	1.000					0.887	
(W4)				0.901	0.803	1.000	0.790				0.874	
(W5)					0.803	1.000	0.790	0.655			0.812	
(W6)						1.000	0.785	0.647	1.000		0.858	
(W7)							0.794	0.645	1.000	1.000	0.860	0.850
SHB (W1)	0.776	0.817	0.783	0.873							0.812	
(W2)		0.824	0.786	0.877	0.915						0.850	
(W3)			0.760	0.849	0.885	1.000					0.873	
(W4)				0.818	0.852	0.955	1.000				0.906	
(W5)					0.799	0.887	0.924	1.000			0.903	
(W6)						0.891	0.926	1.000	0.900		0.929	
(W7)							0.917	1.000	0.892	0.875	0.921	0.885
SHR (W1)	0.956	1.000	0.988	1.000							0.986	
(W2)		1.000	0.968	0.995	1.000						0.991	
(W3)			0.968	0.995	1.000	0.982					0.986	
(W4)				0.996	1.000	0.982	0.964				0.986	
(W5)					0.972	0.955	0.937	1.000			0.966	
(W6)						0.927	0.910	0.971	1.000		0.952	
(W7)							0.910	0.971	1.000	1.000	0.970	0.977
Average	0.842	0.899	0.925	0.945	0.934	0.979	0.928	0.895	0.944	0.957		

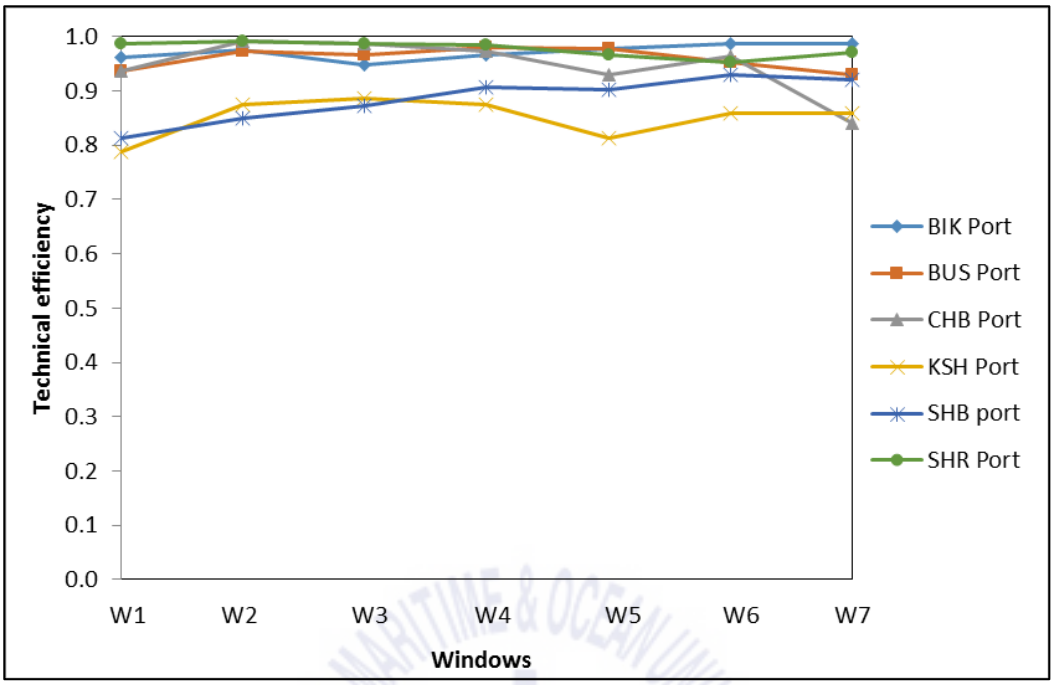

Figure 5.6. General ports technical efficiency (CCR-model) by windows
Source: author's elaboration

5.5.2.2. Bushehr (BUS) Port Efficiency

According to Table 5.8, Bushehr port efficiency has no significant variation. From the first window (W1) just the period of before sanction (2009 to 2012) to fourth window (W4) the period of 2012 to 2015, this port efficiency increased from 0.93 to 0.98. It means that the port efficiency level, even during the sanction period (W4), increased by 5%. For the next windows for window W5 to W6 and W7, the port efficiency level decreased from 0.97 to 0.95 and 0.92. It is easy to understand that from the beginning of sanction to the half period of the time study the Bushehr port efficiency increased by 5% and in the second half of the study period, the efficiency level decreased by 5%. It can be concluded that the sanction has no significant influence on the Bushehr port performance and relative efficiency. The average level of the Bushehr port efficiency was 0.96.

5.5.2.3. Chabahar (CHB) Port Efficiency

From table 5.8 it can be observed that the port of Chabahar efficiency level has increased for the period of the sanction. The table has shown that for the first window (W1) period 2009 to 2012 the port efficiency was 0.93, but from the second window (W2), the port efficiency increased to the highest level of 0.99. For the third and fourth windows (W3 and W4), the port efficiency slightly goes back but still, with the level of 0.98 and 0.97, looks more efficient rather than before embargo. For the next window (W5), the efficiency decreased to 0.92, then increased for the sixth window to 0.97, and then fallen again for the seventh window to 0.84. It may be due to two reasons, first is in 2016 the Indian government agreed to develop the Chabahar port by upgrading the port facilities and equipment's so a sort of port policies and the procedures have been changed. Adaptation of new systems and requirements was a challenge for port managers. Therefore, it caused the lower performance for the port. And the second reason is, after 2016, there was some indication that sanction will be removed soon. Therefore, many cargo owners and ships change their cargos destination to the other ports, and so the Cabahar port has faced with lower cargo throughput. Then the port efficiency decreased by 13%. It is clear that the Chabahar port growth will continue because the new dominant role player, like Indian, Afghanistan, and regional governor, intended to support its developments. This port is only an Iranian port that has an exception from the USA government in order to help and logistic support for Afghanistan development.

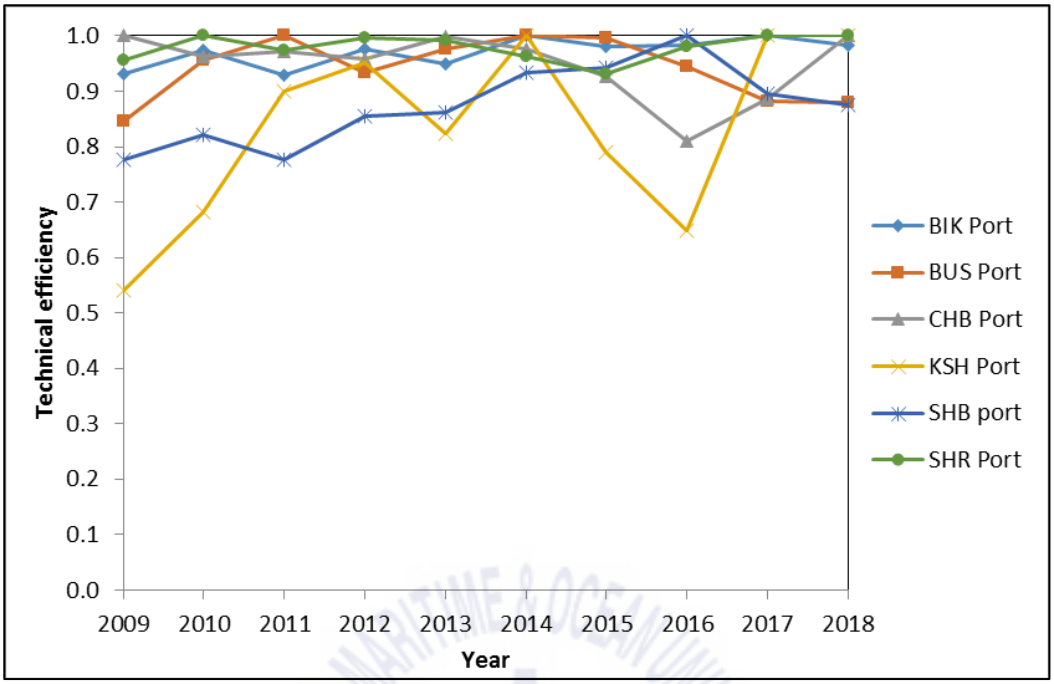

Fig. 5.7. General ports Technical efficiency (CCR-model) by year
Source: author's elaboration

5.5.2.4. Khorramshahr (KSH) Port Efficiency

Before the sanction, the efficiency of Khorramshahr port from 2009 to 2012, first window (W1), was 0.78 and from Table 5.8, it can be observed that for the second and third window, it increased to the level of efficiency 0.87 and, 0.88. For the next window (W4), it is slightly decreased, but still, it is higher than the first window (W1). It means that the port performance and consequently, productivity still is well. However, for the window (W5) due to the sanction influence (period of 2013 to 2016), the port cargo throughput was reduced. Because of the Iraqi port (Umm Qasr) were developed, and some cargo directly moved to the Iraqi port, and the Khorramshahr port efficiency decreased to the level of 0.81. Then for the next window (W6), the port compensates the reduction of efficiency, but still, due to low cargo throughput, the port efficiency maintained on the level of 0.85. After the year 2016, when the sanction was withdrawn for the two years. Some of the ports cargo was moved to the most efficient ports due to lower transportation costs.

5.5.2.5. Shahid Bahonar (SHB) Port Efficiency

The port efficiency for the period of study starting by 0.81 for the first window (W1) before imposing the sanction. As it can be seen from Table 5.8, in the second window (W2) the Shahid Bahonar port efficiency increased to 0.85, and the port growth continued for the next window (W3) and reached 0.87. From the table of efficiency, it can be seen that for following three windows (W4, W5, W5) the port efficiency was growing due to increasing port performance and productivity, and it went up to 0.90 and 0.93 and for the last window (W7), the efficiency level of the port stands on the 0.92. The reason of efficiency growth for this port can be explained that: when the imposed sanction on some of the large ships or big shipping line withdrew their services to the Iranian ports, it will create the opportunity for small and middle size vessels to involve business with Iranian ports, and it also creates the chance for the small ports to practice with accepting more ships and increasing cargo throughput as well as facility and equipment's and consequently, this ports' efficiency was increased. Nevertheless, the port average efficiency level for the period of the study maintained at 0.85.

5.5.2.6. Shahid Rajaee (SHR) Port Efficiency

Shahid Rajaee Port is one of the most efficient ports in Iran. Still, sanctions caused serval sort of problems for this port. Reduction of cargo throughputs, no access to new technology, lack of spare parts, and of course, the employment issues, are main issues that the port was challenging with during the sanctions were some of them. The port was straggling with the matters as mentioned above, this port was able to improve the efficiency level during the sanction period. For the first window (W1) it can be seen from Table 5.8 that the port efficiency level was 0.98. It was improved for the next window (W2) to the 0.99 before the beginning of the sanction, for following windows (W3, W4) in the period of (2011 to 2014) when the sanction was imposed, the level of efficiency dropped to the level of 0.98. It means that the port performance and productivity was facing with some issues,

for the windows (W5, W6), the port growth under the influence of the sanction is still negative and reduced to 0.96 and 0.95. As it is seen from the Table 5.8, in the last window (W7) the port efficiency increased, and it reached the level of 0.97.

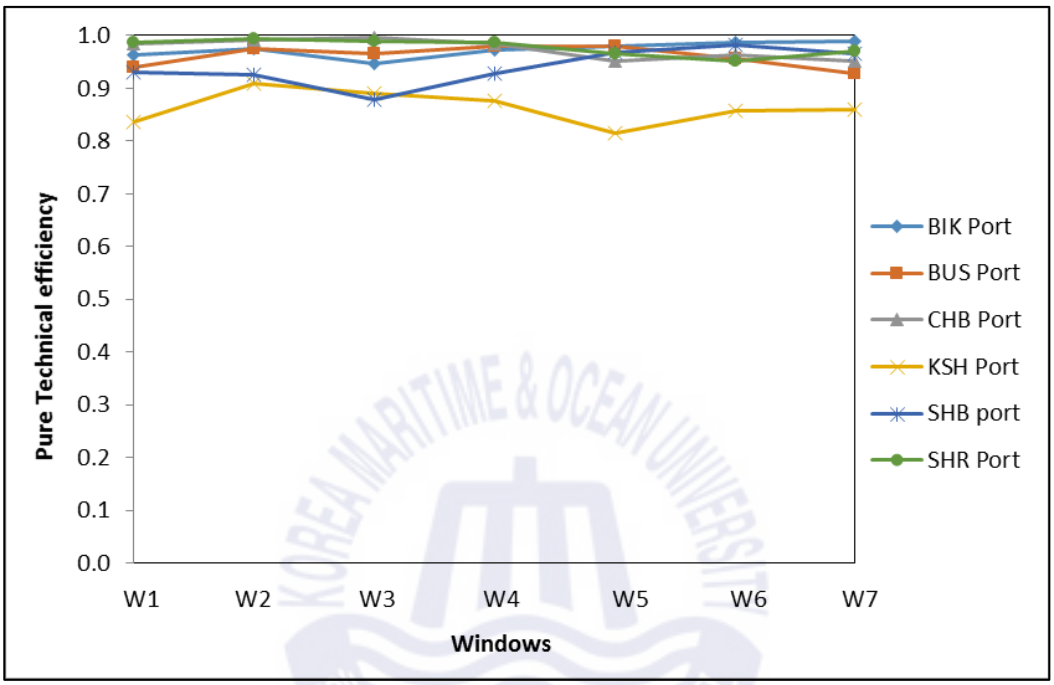

Figure 5.8. General ports pure technical efficiency (BCC-model) by windows
Source: author's elaboration

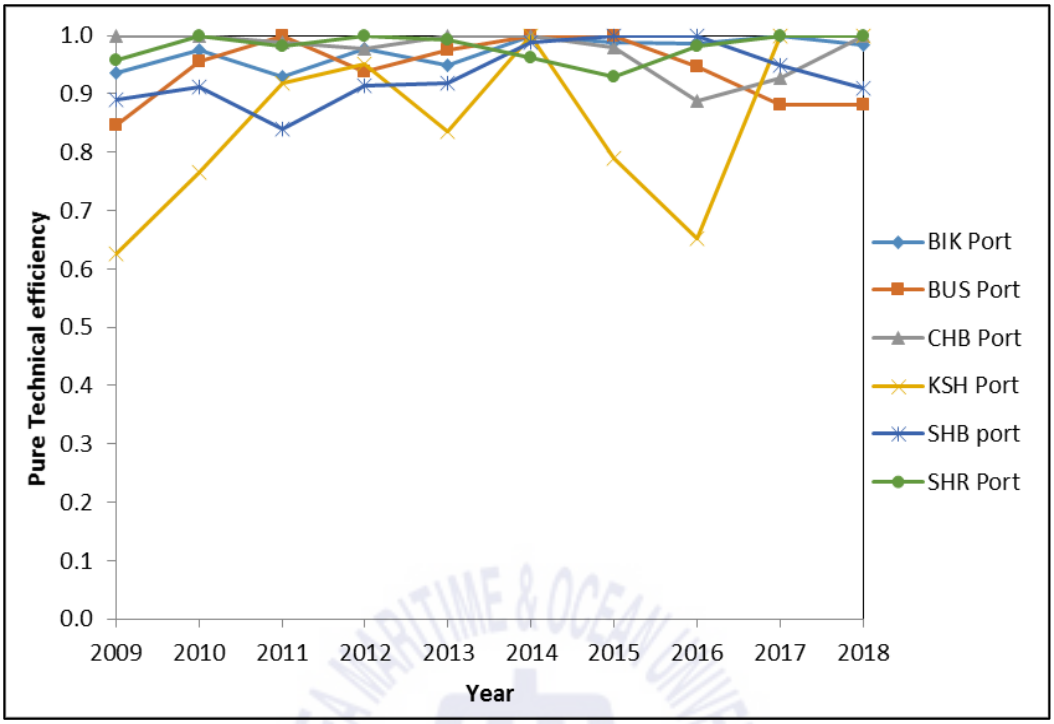

Fig. 5.9 General ports pure Technical efficiency (BCC-model) by year
Source: author's elaboration

The analysis results of DEA efficiency scores under the constant variable are presented in Table 5.12. The average technical efficiency is shown in a four-year window. During the study period, the average efficiency was calculated using CRS range from 92% to 95%. This analysis shows that Iran general cargo ports are considered to be mostly efficient. Therefore, the average inefficiency of the port sector in the CCR model was in the range of 8% to 5%. It can be seen that the average of the general cargo ports efficiency during the sanctions is not reduced. However, from Table 5.13 it can be seen that the changing of average technical efficiency over the time from 2009 to 2018 indicates that the sanctions were not affected the average of ports efficiency source. Therefore, it can be seen that the efficiency was increased from 92% in 2011 before sanction to 95.7% in 2018 during the sanctions.

Table 5.12. General cargo ports Technical Efficiency (CCR-Model) through the window

Window / DMUs	2009-2010-2011-2012	2010-2011-2012-2013	2011-2012-2013-2014	2012-2013-2014-2015	2013-2014-2015-2016	2014-2015-2016-2017	2015-2016-2017-2018	Average
BIK Port	0.962	0.975	0.947	0.967	0.978	0.987	0.988	0.966
BUS Port	0.936	0.974	0.967	0.981	0.977	0.953	0.929	0.953
CHB Port	0.936	0.992	0.987	0.974	0.929	0.964	0.841	0.898
KSH Port	0.787	0.876	0.887	0.874	0.812	0.858	0.860	0.868
SHB port	0.812	0.850	0.873	0.906	0.903	0.929	0.921	0.931
SHR Port	0.986	0.991	0.986	0.986	0.966	0.952	0.970	0.954
Average	0.903	0.943	0.941	0.948	0.928	0.941	0.918	0.932

Table 5.13. General cargo ports Technical Efficiency (CCR-Model) through the year

Year / DMUs	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Average
BIK Port	0.932	0.973	0.929	0.976	0.949	1.000	0.980	0.983	1.000	0.983	0.970
BUS Port	0.845	0.957	1.000	0.934	0.976	1.000	0.996	0.944	0.882	0.881	0.942
CHB Port	1.000	0.962	0.973	0.959	0.998	0.977	0.928	0.811	0.885	1.000	0.949
KSH Port	0.540	0.682	0.901	0.951	0.824	1.000	0.789	0.649	1.000	1.000	0.834
SHB port	0.776	0.821	0.776	0.854	0.863	0.933	0.942	1.000	0.896	0.875	0.874
SHR Port	0.956	1.000	0.974	0.996	0.993	0.962	0.930	0.981	1.000	1.000	0.979
Average	0.842	0.899	0.925	0.945	0.934	0.979	0.928	0.895	0.944	0.957	0.925

From table 5.11, it may be concluded that the most efficient general cargo ports were SHR and BIK. The least efficient general cargo ports were KHS and SHB. It can be seen that similar to the container ports, the group of largest ports are more efficient than smaller ports. The reason why the group of large ports is more efficient is, beside better allocation of the resources, cargo throughput in these ports are much more than smaller ports. Tables 5.14 and 5.15 and 5.16 illustrate the pure technical efficiency of individual ports calculated under the variable return to scale (BCC-model), respectively. The average efficiency calculated in the BCC- model reached the value from 0.92 to 0.96. The most

efficient ports were ports SHR, and BIK. Also in BCC-model, the lowest efficient ports was KSH with the source of efficiency 0.86.

Table 5.14. General cargo ports pure Technical Efficiency (BCC-Model) by windows

Window / DMUs	2009-2010-2011-2012	2010-2011-2012-2013	2011-2012-2013-2014	2012-2013-2014-2015	2013-2014-2015-2016	2014-2015-2016-2017	2015-2016-2017-2018	Average
BIK Port	0.964	0.976	0.948	0.973	0.979	0.988	0.990	0.974
BUS Port	0.939	0.974	0.967	0.981	0.980	0.956	0.929	0.961
CHB Port	0.984	0.992	0.995	0.985	0.952	0.964	0.952	0.975
KSH Port	0.836	0.909	0.889	0.876	0.815	0.858	0.860	0.863
SHB port	0.930	0.926	0.878	0.929	0.967	0.983	0.965	0.940
SHR Port	0.987	0.995	0.991	0.987	0.966	0.952	0.970	0.978
Average	0.940	0.962	0.945	0.955	0.943	0.950	0.944	0.949

Table 5.15. General cargo ports pure Technical Efficiency (BCC-Model) by year

Year / DMUs	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Average
BIK Port	0.936	0.975	0.930	0.976	0.950	1.000	0.987	0.986	1.000	0.984	0.972
BUS Port	0.846	0.957	1.000	0.937	0.976	1.000	1.000	0.947	0.882	0.881	0.943
CHB Port	1.000	1.000	0.988	0.978	0.998	1.000	0.979	0.888	0.927	1.000	0.976
KSH Port	0.625	0.766	0.918	0.952	0.836	1.000	0.790	0.651	1.000	1.000	0.854
SHB port	0.889	0.912	0.840	0.914	0.918	0.988	1.000	1.000	0.950	0.909	0.932
SHR Port	0.958	1.000	0.983	1.000	0.993	0.962	0.930	0.981	1.000	1.000	0.981
Average	0.876	0.935	0.943	0.960	0.945	0.992	0.948	0.909	0.960	0.962	0.943

Table 5.16. General cargo ports pure Technical Efficiency (BCC-Model) by year and windows

Year / DMUs	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Average	C-Average
BIK (W1)	0.936	0.975	0.945	1.000							0.964	
(W2)		0.975	0.945	1.000	0.983						0.976	
(W3)			0.899	0.953	0.940	1.000					0.948	
(W4)				0.953	0.940	1.000	1.000				0.973	
(W5)					0.937	1.000	0.981	1.000			0.979	
(W6)						1.000	0.973	0.978	1.000		0.988	
(W7)							0.996	0.978	1.000	0.984	0.990	0.974
BUS (W1)	0.846	0.957	1.000	0.952							0.939	
(W2)		0.957	1.000	0.940	1.000						0.974	
(W3)			1.000	0.910	0.958	1.000					0.967	
(W4)				0.947	0.976	1.000	1.000				0.981	
(W5)					0.972	1.000	1.000	0.947			0.980	
(W6)						1.000	1.000	0.947	0.876		0.956	
(W7)							1.000	0.947	0.887	0.881	0.929	0.961
CHB (W1)	1.000	1.000	0.964	0.973							0.984	
(W2)		1.000	1.000	0.974	0.994						0.992	
(W3)			1.000	0.982	1.000	1.000					0.995	
(W4)				0.983	1.000	1.000	0.958				0.985	
(W5)					1.000	1.000	0.958	0.851			0.952	
(W6)						1.000	1.000	0.869	0.988		0.964	
(W7)							1.000	0.944	0.865	1.000	0.952	0.975
KSH (W1)	0.625	0.766	0.955	1.000							0.836	
(W2)		0.766	0.955	1.000	0.918						0.909	
(W3)			0.845	0.903	0.809	1.000					0.889	
(W4)				0.903	0.809	1.000	0.791				0.876	
(W5)					0.809	1.000	0.791	0.660			0.815	
(W6)						1.000	0.785	0.649	1.000		0.858	
(W7)							0.794	0.646	1.000	1.000	0.860	0.863
SHB (W1)	0.889	0.931	0.902	1.000							0.930	
(W2)		0.893	0.857	0.955	1.000						0.926	
(W3)			0.760	0.855	0.899	1.000					0.878	
(W4)				0.844	0.887	0.985	1.000				0.929	
(W5)					0.885	0.984	1.000	1.000			0.967	
(W6)						0.983	1.000	1.000	0.949		0.983	
(W7)							1.000	1.000	0.950	0.909	0.965	0.940
SHR (W1)	0.958	1.000	0.989	1.000							0.987	
(W2)		1.000	0.980	1.000	1.000						0.995	
(W3)			0.980	1.000	1.000	0.982					0.991	
(W4)				1.000	1.000	0.982	0.964				0.987	
(W5)					0.972	0.955	0.937	1.000			0.966	
(W6)						0.927	0.910	0.971	1.000		0.952	
(W7)							0.910	0.971	1.000	1.000	0.970	0.978
Average	0.876	0.935	0.943	0.96	0.945	0.992	0.948	0.909	0.96	0.962		

5.6. Scale efficiency for container and general cargo port

A unit is said to be scale efficient when its size of operation is optimal so that any modifications on its size will render the unit less efficient. The value for scale efficiency is obtained by dividing the technical efficiency (CCR) by the pure technical efficiency (BCC). The scale efficiency score indicates whether a firm operates at the most productive scale size (score=1) or not, a score smaller than one indicates that the firms is over/under-dimensioned. The success of a branch operating on an optimum scale means that an efficient branch works at the most productive scale size.

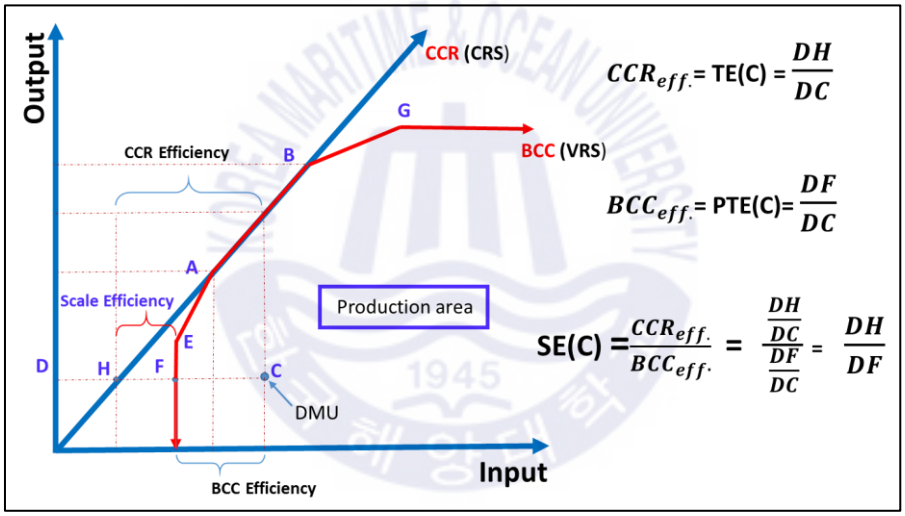

Figure 5.10. The Scale efficiency (SE)
Source: Reproduced by authors from Banker et al.

As it can be observed from Figure 5.10, the DMUs A and B are shown optimal source of efficiency in both model of CCR and BCC model. The scale efficiency for the both DMUs A and B are equal to one because the technical efficiency (CCR model) and pure technical efficiency (BCC) are optimal and both are equal to one.

By calculation of technical efficiency (CCR model) and pure technical efficiency (BCC model), now we are able to calculate the scale efficiency for each port in each window. The result of these calculations are shown in Table 5.17.

Table 5.17. Scale efficiency for general cargo and container ports.

	Scale Efficiency for General Cargo Ports			Scale Efficiency for Contianer Ports		
DMUs	CCR Efficiency	BCC Efficiency	Scale Efficiency	CCR Efficiency	BCC Efficiency	Scale Efficiency
BIK (W1)	0.962	0.964	0.9983	0.275	0.916	0.3004
(W2)	0.975	0.976	0.9991	0.284	0.946	0.3004
(W3)	0.947	0.948	0.9989	0.285	0.902	0.3164
(W4)	0.967	0.973	0.9934	0.330	0.876	0.3769
(W5)	0.978	0.979	0.9988	0.321	0.801	0.4007
(W6)	0.987	0.988	0.9992	0.320	0.799	0.4007
(W7)	0.988	0.990	0.9981	0.279	0.826	0.3380
BUS (W1)	0.936	0.939	0.9965	0.789	0.789	1.0000
(W2)	0.974	0.974	0.9997	0.830	0.830	1.0000
(W3)	0.967	0.967	1.0000	0.804	0.804	1.0000
(W4)	0.981	0.981	1.0000	0.791	0.791	1.0000
(W5)	0.977	0.980	0.9974	0.729	0.729	1.0000
(W6)	0.953	0.956	0.9966	0.709	0.709	1.0000
(W7)	0.929	0.929	0.9999	0.696	0.696	1.0000
CHB (W1)	0.936	0.984	0.9507	0.066	0.067	0.9804
(W2)	0.992	0.992	1.0000	0.068	0.070	0.9804
(W3)	0.987	0.995	0.9918	0.076	0.079	0.9641
(W4)	0.974	0.985	0.9883	0.084	0.089	0.9514
(W5)	0.929	0.952	0.9761	0.084	0.088	0.9510
(W6)	0.964	0.964	1.0000	0.098	0.103	0.9510
(W7)	0.841	0.952	0.8828	0.128	0.132	0.9733
KSH (W1)	0.787	0.836	0.9409	0.721	0.866	0.8326
(W2)	0.876	0.909	0.9629	0.681	0.817	0.8326
(W3)	0.887	0.889	0.9969	0.573	0.809	0.7083
(W4)	0.874	0.876	0.9974	0.514	0.824	0.6234
(W5)	0.812	0.815	0.9963	0.488	0.779	0.6262
(W6)	0.858	0.858	0.9995	0.546	0.872	0.6262
(W7)	0.860	0.860	0.9998	0.577	0.735	0.7844
SHB (W1)	0.812	0.930	0.8731			
(W2)	0.850	0.926	0.9180			
(W3)	0.873	0.878	0.9943			
(W4)	0.906	0.929	0.9756			
(W5)	0.903	0.967	0.9331			
(W6)	0.929	0.983	0.9454			
(W7)	0.921	0.965	0.9543			
SHR (W1)	0.986	0.987	0.9993	0.894	0.894	1.0000
(W2)	0.991	0.995	0.9958	0.844	0.844	1.0000
(W3)	0.986	0.991	0.9958	0.779	0.779	1.0000
(W4)	0.986	0.987	0.9989	0.833	0.833	1.0000
(W5)	0.966	0.966	1.0000	0.875	0.875	1.0000
(W6)	0.952	0.952	1.0000	0.912	0.912	1.0000
(W7)	0.970	0.970	1.0000	0.907	0.907	1.0000

Source: author's elaboration

Figure 5.11 shows the average scale efficiency for ports of general and container cargos through the period of the study. As we can see from this figure, the BIK port having scale efficiency source equal to one was well-organized for general cargo. However, this port is not performing well in container cargo, as the scale efficiency for container cargo is 0.3. It indicates that the container cargo activities in this port is so small. For BUS port as it seen from the figure, the scale efficiency for both types of cargo are about one. So it illustrates that this port is well-organized for both types of cargos. Therefore, both cargo throughput and size of activity are big enough in size of operation. The port of CHB having 0.96 level of scale efficiency source shows performing well but not full efficient. It mays that it needs some modifications in inputs or outputs. For the port of KSH, in general cargo activity with scale efficiency source of 0.98, it is almost efficient but for container cargo with scale efficiency level of 0.72, it is inefficient and therefore, it needs to be evaluated and modified accordingly. The port of SHB has no activity in container cargo and also it is not efficient for general cargo with level of scale efficiency source about 0.93. Finally we have the SHR port which is well-organized for both types of general and container cargo. As we can see from Figure 5.11, for both types of cargo, the scale efficiency of the port is equal to one. The ports of BUS and SHR operation sizes are big enough and both are performing well.

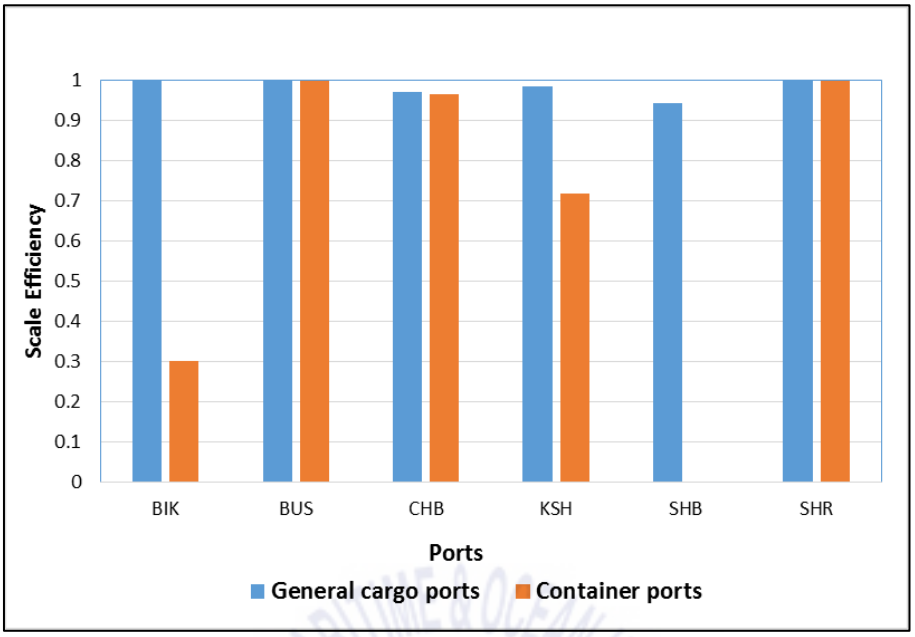

Figure 5.11 The average Scale Efficiency for general and container cargo ports
Source: author's elaboration

Chapter 6. Conclusion

6.1. Summary

Nowadays the ports tasks are more than their traditional roles as a simple port of service for ships and cargos. Ports are the good location for logistics, trade and industrial activities, as well as for other businesses. Therefore, port system does not only give services as main part of transportation system, but also acts as the major sub-system for the logistics, production and trade; which needs to be managed effectively as any crises or strikes at the ports may have create damage and risk for whole logistics chain system. As a result of this study, it is clearly visible that ignoring the proper policy by the Iranian port policy makers did not only cause problem for Iranian ports, but also indented the nationwide logistics because 90% of country's essential needs are transported by sea. As we all know, intentional sanction is meant to swipe the governmental sectors to change the political behavior. Iranian ports which serve for international business are exposed to high risk facing with the intentional sanction as whole Iranian ports belong to government and therefore, are definitely good targets.

The Iranian port policy makers are compelled to make use of the private, public and international sectors properties to improve ports' productivity and relative efficiency as it could help to diminish the impact of imposed sanctions.

While the last round of UN sanctions includes provisions to prevent Iran's use of the international financial system, and in particular the use of its banks to fund possible nuclear proliferation, the EU sanctions banned the export to Iran of key equipment and technology for refining petroleum products and for the exploration and production of natural gas in a bid to prevent Iran from increasing its own domestic ability to produce refined products such as diesel, gas oil and petrol. The USA sanctions went further and banned the export to Iran of refined petroleum products, or any goods, services, technology, information or support that could

develop the country's ability to import refined petroleum products. Furthermore, several nations imposed sanctions against Iran along with UN, EU and USA.

In this study, five container ports of Iran with over 10,000 TEUs throughput were selected including Shahid Rajaei, Bandar Imam Khomeini, Bushehr, Chabahar and Khorramshahr ports and five aforementioned ports plus Shahid Bahonar port totally six ports of general cargo ports with 1 million tons cargo throughput in order to evaluate the influence of the imposed sanctions during 10 years (from year 2009 to 2018). Then we applied the DEA window to analysis the ports efficiency. The following conclusions can be made.

Both container and general cargo ports analysis result in CCR-model showed that the ports of SHR and BUS have a higher source of efficiencies with the level of 0.86 and 0.97 for SHR port and 0.76 and 0.96 for BUS port, respectively. However, the lowest efficiency from container port belongs to CHB with efficiency source 0.086 and for general cargo ports belongs to the KSH port with efficiency source 0.85. While the result of analysis from BCC-model showed that two highest efficiency of container ports belong to the BIK with efficiency source 0.87 and SHR with efficiency source 0.86 and for general cargo ports belongs to SHR with efficiency of 0.98 and CHB with efficiency of 0.98 and BIK with efficiency of 0.97, and the container ports lowest efficiency belongs to CHB with efficiency 0.089 and for general cargo lowest efficiency ports belongs to the port of KSH with of efficiency 0.86

Moreover, it is found that productivity of Iran’s ports was reduced under the influence of imposed sanctions. Nevertheless, after implementation of various policies like the establishment and use of feeder shipping companies, the ports productivity was improved and ports relative efficiencies were increased. This practice allowed the Iranian shipping lines and seaport to remain on the market during sanction period. When the sanctions were over, some of the customers were eventually back to the same route.

To react to the sanction influence and technical problems, the port managers need to implement a set of procedures to improve and increase the ports productivity; such as proper maintenance management systems that can be helpful to ensure the operation of facilities. Moreover, they should devise a personnel management system, which can strengthen the competence of staff in dealing with unexpected problems.

The sanctions imposed to some Iranian ports provided hands-on opportunity for some other small ports to practice with the international sea transportation. It may be a challenge for those ports but it is definitely a golden chance to truly understand the needs of international transportation. Those ports are trying to improve their infrastructures and facilities to play an effective role in establishing the gateway to national and international efforts. In fact, smaller ports comparing to bigger ports are more efficient and flexible to react to cargo throughputs variations. It is easier for this size of ports to achieve high level of productivity and efficiency despite the current insufficient infrastructure.

According to the result of this study, it is clear that the sanction influence on the container business and container port was intensive and maybe its effect will maintain endlessly. It has not only depredated the ports container throughputs, but also prevent the growth of the port; the container ports should handle at least three times more than it is now.

General cargo ports under sanction influence performed better rather than the container ports, indeed the performance of these ports was not gladden, however it was not frustrating. As we discussed there are two main reason. That’s why container ports managers was not able to control the container business detriment. First, the number of container ships and shipping lines are less than general ships and the container business is more exclusive. Second, the container ships are operating under a more sensitive and competitiveness area, which is under protection of shipping alliances, so they are sharing customers and ports

information between members, maybe a severe market was not allowed them to tolerate any risks, hence container shipping business reaction to any risk is inevitable.

As we discussed, for both ports of BIK and KSH, the operation size in container cargo is small and since the distance between these two ports is close, it seems that it is better that one of the ports of BIK and KSH be chosen as the container port and equipped accordingly as container cargo handling port.

Sanctions against the shipping industry of Iran caused many of the global insurance companies to revise providing the insurance services to Iranian ships. In response to these restrictions, Iran's shipping lines have found alternative means of trading to neuter the sanctions against the country, such as setting up of new companies outside Iran, flag change, establishing P&I clubs and changing the names of the owners and ships which are part of these sanctions.

6.2. Implication

The finding of this study provides meaningful implications to improve and support the shipping lines, ports managers and authorities and logistic companies businesses. Nowadays, many ports are extended and developed and competitions are intensive. Therefore, port business is becoming tougher. On the other hand, shipping lines and shipping company are consolidating and merging pushing ports to provide higher and better services as well as cheaper and economical price. In such a competitive market, port managers should organize their ports for the best services to their customers. The role of port management in facilitating ports for complicate situation and quick response is very important. Management Control System (MCS) to support Port Authority (PA) decision-making process is one the most necessary tools for port managers in order to take quick decision with the

least negative effects. These kind of tools may be beneficial for Iranian ports authorities.

Shipping lines, port operators and logistic companies are desensitized to many risks from time to time. To enable Iranian ports to recognize related potential risks and minimize them, a procedure should be considered to identify the applicable sanctions. Hence, shipping lines should consider a procedure that they compliance with, so as to be able to identify the applicable sanctions in prior and ensure appropriate warranties and immunity to mitigate those potential risks.

One of the manager's concerns is how to improve port performance. This study is possible to conclude that the port managers continuously need to control the port's key performance indicators and respond timely for any changes. As a result of this study, if Iranian ports managers consider the examining of those indicators such as balancing equipment in ports, upgrading and updating the small ports facilities as well as the application of MCS, perhaps they could be able to diminish the effect of sanctions.

Since some shipping lines had stopped their services to Iranian ports, cargo owners are now bearing higher cost due to the lack of ships on the routes and longer transportation time. Extra cost also was imposed for cargo owners who used Iran's routes for transit.

The sanction has not affected the general cargo ports efficiencies in fact, general cargo ports efficiencies was improved during the sanctions.

The imposed sanctions have shown to have a huge influence on Iranian seaports and shipping business. Particularly, the impact on the container business was instantaneous and port throughput shrank by 38%. The general cargo port performed better, even from beginning of the sanctions general cargo throughput

was increased by 5%.

For container ports, two years after the sanctions, whole of the port's efficiency was decreased. However after two years, some of the middle size ports and smaller ports have compensated the efficiency.

The sanction has not affected the general cargo ports efficiencies in fact, general cargo ports efficiencies was improved during the sanctions.

It seems that Iranian ports lost a lot of customers and cargos, many opportunities for investment and updates of new technologies. Therefore, those imposed sanctions are evidently detrimental to the performance and productivity as well as the competiveness of Iranian ports. Worse still, the recovery will take some times as the import/export goods and services from/to Iran might face some problems in the coming years due to the lack of new technologies.

The impacts of sanction could be less if Iranian port policy makers consider both public and private sectors in investment and operation of ports, since the purpose and target of sanction could be absolutely different. Not least to be mentioned, such consideration could also help bridging technology and port system gap of Iranian port via proper international port connections and technological employment for the sake of port facility and efficiency improvement.

In addition, lower formalities of private sectors compared to government sectors had promised their agility in investment, construction of new and smaller ports as well as equipment of current ports to level up relevant productivity and efficiency which could then enhance Iranian port competitiveness. Hence, despite interminable problems, Iranian port managers need to work hand in hand with private sectors.

As we discussed, both ports of BIK and KSH operation sizes in container cargo is small and both ports are suffering from the shortage of proper facilities

and new technology. Moreover, these ports are close together and the volume of cargo is limited. Therefore, it seems to be better that one of the ports of BIK or KSH be chosen as container port and accordingly be equipped as the container cargo handling port.

It is found that productivity of Iran's ports was reduced under the influence of imposed sanctions. However, after implementation of various policies like the establishment and use of feeder shipping companies, the smaller ports productivity was improved and ports relative efficiencies were increased.

Finally, it seems that the imposed sanctions to some Iranian ports provided an opportunity for some other small ports to practice with the international sea transportation. It may be a challenge for those ports but it may create chance to understand the needs of international transportation. Those ports are trying to improve their infrastructures and facilities to play an effective role in establishing the gateway to national and international efforts.

In fact, US sanctions have targeted Iranian citizens and ordinary people rather than the government sectors. Hence it has made a lot of difficulties in people's lives.

6.3. Limitation and Further studies

The main aims of this study is to evaluate the ports performance and efficiency in order to provide some information for port managers and support them to have the proper reaction facing with complicate situations.

The technical efficiency analysis provides benchmark information and insights for port managers to realize that whether the ports and organization performance are in correct directions or not. However, in order to figure out more proper results, the cost efficiency analysis also was considered in this study. However, due to some limitations and lack of proper data for all of the ports, it was not concluded. The cost efficiency analysis results are more tangible for managers, while reliable data was not available, and collection of such data was very difficult since many ports do not publish the costs, expenses, revenue and incomes for researchers. This study was conducted concentrating on the ports performance and efficiencies, which was suffering from lack of cargo throughput and technical problems due to the sanctions.

For further studies we first suggest to analyze the impact of Iran sanctions on the Iranian shipping lines performance and evaluate the impact of sanctions on the Iranian shipping industries focusing on shipping activities considering that international shipping have stopped cooperation with Iranian shipping lines.

Secondly, Iran is one of the major countries in oil production and exporter, and since one of the sanction aims is to cut the oil export from Iran and therefore, under pressure of sanctions, exporting oil from Iran is reduced. Therefore, the impact of Iran's sanctions on world shipping industries especially in oil tanker business is recommended for next study by researchers.

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