

Master's Research Report

Global Value Chain of Machinery Industry of Bangladesh:

A Case of Refrigerator and Its Parts

By

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Summary

Bangladesh is a fast-growing South Asian country. It has entirely depended on agriculture till the last century. However, in recent years it has focused on diversifying its economy. There are many potential industries in Bangladesh among which the refrigerator industry is remarkable. Previously this sector was import dependent but now the development of local production is impressive. Bangladesh has improved so much in the refrigerator industry that within one decade it captured most of the domestic market with 80% market share of the local companies.

Among all the local companies Walton is the market leader in the refrigerator industry. It has more than 70% market share where the global giants (Samsung, LG, Panasonic, Hitachi, etc.) altogether have 20% market share in Bangladesh. Adopting top-notch technology and providing sustainable products at affordable prices is the reason behind the success of Walton. Other local companies such as Jamuna, Vision, and Minister are also following the lead of Walton and prospering in the domestic market. Walton is also focusing on developing the value chain and exporting globally on a large scale.

The supportive industrial policy of the Government of Bangladesh has played a vital role behind the establishment of the refrigerator industry. High import duty, tax waiver in the early stage, low import duty for refrigerator parts, etc. have given extra boost to this industry to grow. Also, the entire development of Bangladesh, namely urbanization, electrification all over the country, the inclusion of women in the workforce, and overall development of lifestyle has created a great demand for refrigerators all over

the country. If the local manufacturing and assembling companies keep growing at the pace as they are, within a few years the Bangladesh refrigerator industry can be an export-oriented sector.

Keywords: refrigerator, Walton, international competitiveness, export, manufacturing, assembling, parts.

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Acronyms

ACAMA: Automobiles Components & Accessories Manufacturers Association

BDT: Bangladesh Taka

BEIOA: Bangladesh Engineering Industry Owner's Association

BEMMA: Bangladesh Electrical Merchandise Manufacturer Association

BIDA: Bangladesh Investment Development Authority

BITAC: Bangladesh Industrial Technical Assistance Center

BSCIC: Bangladesh Small and Cottage Industry Association

BUET: Bangladesh University of Engineering and Technology

CSR: Corporate Social Responsibility

EPB: Export Promotion Bureau

FDI: Foreign Direct Investment

FMCG: Fast Moving Consumer Goods

GVC: Global Value Chain

HS: Harmonized System

IoT: Internet of Things

LE: Light Engineering

MFA: Multifiber Arrangement

NBR: National Board of Revenue

PP & PDC: Pilot Plant and Process Development Center

QC: Quality Control

Certification Page

I, Ahad Khondokar Oli, Student ID # 51221003 hereby declare that the contents of this Research Report are original and true and have not been submitted to any other university or educational institution for the award of a degree or diploma. All the information derived from other published sources has been cited and acknowledged appropriately.

Ahad Khondokar Oli

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1. Introduction

Significance of the research

Bangladesh is one of the fastest-growing south Asian countries in the world. The significance of Bangladesh has always been strong internationally due to its geographic location and geopolitical strength. Due to the abundance of assets, Europeans came to Bangladesh in the 15th century. The Portuguese, Dutch, French and British rulers have ruled the country for centuries. Finally, the British dynasty left this region in 1947 leaving Bangladesh as a part of the Pakistan regime. The lack of harmony between East Pakistan (Bangladesh) and West Pakistan was obvious from the beginning due to differences in language and culture and discrimination between the two parts of Pakistan.

Several movements have taken place to strengthen the demand for a sovereign country in this region which eventually emerged as Bangladesh. Bangladesh as a sovereign and independent country including the Language movement 1952, which was the first-time politicians and commoners realized that this portion of Pakistan needs to be a separate country. In 1966 Bangabandhu Sheikh Mujibur Rahman, the Father of the Nation was compelled to propose his historic six principles, the "Magna Carta," which effectively laid the groundwork for East Pakistan's future independence, because of the political and economic deprivation of the Bengali nation. Finally, in 1971, Bangladesh achieved its independence after a bloodshed war of 10 months which left Bangladesh with millions of dead bodies and a destroyed country.

From that point Bangladesh has come a long way and developing the economy from scratch has helped the country to grow rapidly. Bangladesh is an agricultural country where most people work in the agricultural sector. This country is evolving at a great pace and started to keep its mark in other sectors like services and industrial manufacturing.

There are a lot of studies published regarding the machinery industry of Bangladesh and other south Asian countries. A few pieces of research have been conducted using the Global Value Chain (GVC) model and the flying geese model. But there is a gap in the existing research in which not any research has been conducted on the perspective of the refrigerator sector of Bangladesh. This study can fill the existing gap and illustrate the prospect and opportunities of the refrigerator sector of Bangladesh. This study can play a significant role to draw the attention of investors and establish FDI (Foreign Direct Investment) which can fasten the growth of this sector. Eventually, it will help the economy of Bangladesh and its commercial relation with neighboring countries.

This research is also unique due to the usage and analysis of import and export data of refrigerators and its parts which is new in the business research area. Both direct and indirect import and export data have been used to conduct this research. The export data of refrigerators were also collected from the data of partner countries including India, Nepal, the UK, etc. The export and import data of the last 20 years (2001-2021) was used for this study. The dataset was collected by the author from Global Trade Atlas which is one of the most dependable and comprehensive resources for global trade. The author collected data of the Refrigerator export of Bangladesh from data of partner countries. Since the Government of Bangladesh does not release import and export data of the country timely, the author

approached the latest trade data of Bangladesh's partner countries and formulate import and export data of Bangladesh up to the year 2021. This extensive and unique data collection and analysis make this research significant and impactful for the research arena and the business world.

Objective and Research Questions

The objective of this research is to analyze the significance of the refrigerator sector of Bangladesh and its prospects. The research questions that would be answered through this research report are as follows:

- How did the refrigerator industry develop in Bangladesh?
- How did the refrigerator industry gain international competitiveness?
- What is the future perspective of the "Made in Bangladesh" refrigerator in the domestic and international markets?

Structure of the Report

The rest of the research report is developed in the following order. In the literature review, the existing research are mentioned based on relevance. GVC (Global Value Chain) of the South Asian and East Asian countries were elaborated through previous research works. The flying geese model was also elaborated from intra-industry, inter-industry, and international aspects. For both frameworks, SME (Small and Medium Enterprises), RMG (Ready Made Garments), and other raising industries were studied. The following section is

about the evaluation of the electrical and the refrigerator industry in Bangladesh. This section describes the contribution of local companies like Walton, Rahimafrooz, Jamuna, Vision, Minister, etc. to the growth of the economy. It also describes how local companies are developing their capacities to face challenges and play competitively with the global giants. In the next section, data analysis was conducted. Data for this research was collected secondarily, Global Trade Atlas, one of the most dependable data sources for international trade is used for collecting data. Import and export data of HS codes 8418 (Refrigerator) and 841899 (Parts of Refrigerator) were used for that purpose. International trade data of Bangladesh for the last two decades (2001-2021) has been collected and analyzed in this research. To analyze the recent data, the Statistical Yearbook of Bangladesh,2021 was used. Finally, the conclusion part summarizes the research result and completes the paper.

2. Literature Review

2.1 Industrialization and Global Value Chain

Global Value Chain (GVC) refers to a group of activities a firm executes including the initial conception of the experience of the end-user of the product. GVC plays a vital role in the growing economy of developing countries. It helps to flourish diversified sectors of the economy including tourism, apparel, electronics, etc. in terms of employment, global trade, and production, and creates ways for countries to collaborate with the global economy. In general, it helps a country to reduce its unemployment, raise the standard of living, and eradicating poverty.

The input-output structure of GVC is typically represented as a series of value chain boxes connected by arrows that represent the flows of tangible and intangible goods and services, which are critical for mapping the value added at various stages of the chain. It includes Research and Development, design, production, distribution, marketing, and sales for most industries.

The dynamics and structures of the companies may vary from industry to industry. It is important to identify the type of companies involved in the industry and their key characteristics: global or domestic; state-owned or private; large, medium, or small; and so on. Identifying the firms that participate in the chain will help to understand its governance structure of that industry (Fernandez-Stark & Gereffi, 2019). For instance, the refrigerator

industry of Bangladesh is highly dependent on the import of raw materials and refrigerator parts as this country is not yet independent in manufacturing refrigerator parts.

When certain actors in a chain have more power than others, governance analysis allows one to understand how the chain is controlled and coordinated. There are various types of governance such as,

Market Governance: It means product information is easily transmitted and suppliers do not have to be depended on buyers. This does not require formal cooperation and partners can easily switch to new parties with minimal switching costs.

Modular governance: It works when complicated transactions are relatively simple to define. In modular chains, suppliers are typically highly skilled, produce goods according to customer specifications, and take full responsibility for process technology utilizing generic equipment that spreads investments across a large customer base. The operation of modular governance depends on both information technology and information exchange standards (Fernandez-Stark & Gereffi, 2019).

Relational Governance: When buyers and sellers rely on complicated information that is difficult to codify, communicate, or learn, relational governance develops. As a result, parties engage frequently and exchange expertise. Such connections necessitate trust and foster mutual reliance, which is controlled by reputation, social and physical proximity, ties to one's family and community, and other factors.

Captive Governance: In these networks, small suppliers are dependent on one or a limited number of powerful buyers. Such networks have extensive lead company oversight and management. As the buyers have dominant power in the market, ethical leadership is important to ensure the suppliers get fair prices for their contribution.

Hierarchy Governance: Vertical integration and management control are characteristics of hierarchical governance chains, which are found in top companies that design and produce their products.

Economic upgrading refers to the upliftment of an industry when it moves to high-value activities to increase the benefits of being part of a Global Value Chain (GVC). There are 4 types of upgrading which are:

Process upgrading occurs when the manufacturing process becomes more efficient due to technological advancement. **Product upgrading** refers to the manufacturing of a higher-value product or upgrading the existing product line. **Functional upgrading** refers to learning new skills (or giving up old ones) to improve the total skill and value-added content of the activity. And **Chain upgrading** refers to when firms move into new but related industries.

There are some other types of upgrading (Fernandez-Stark, Frederick & Gereffi, 2011) that are relevant to the refrigerator industry of Bangladesh. Firms that join national, regional, or global value chains for the first time are said to be making an **entry into the chain**. This one is the first and most difficult upgrade track. Walton can be a great example of this when it first started assembling refrigerators and after a decade it started to export refrigerators to

various countries. Backward linkage upgrading occurs when local businesses (domestic or international) start to deliver tradable inputs and/or services that previously utilized imported materials. Any local refrigerator company is upgrading this way as these companies are moving to setting up and operating their manufacturing plant and lowering import of refrigerators. End market upgrading refers to moving up in the chain to more sophisticated products requiring higher standards.

Global Value Chain (GVC) helps policymakers to answer questions regarding development issues and help assuring industry upgradation. The importance of appropriate policy is immense in terms of the sustainable growth of a country. GVC assists to reshape the trade and investment policy of a country including the import-export process, tariffs, and industry-specific policies. (Fernandez-Stark & Gereffi, 2019) GVC also provides quantifiable metrics and information on employment, export, wages, etc. which helps policymakers and govt. agencies to develop policy. It helps policymakers to observe country-specific growth tack and strategies and follow likewise. (Frederick, 2019) Policies play a vital role in attracting FDI which assures further innovation. GVC-oriented policies help to encourage innovation through targeted training programs, skill development, and innovation (Lema, Pietrobelli , & Rabellotti, 2019).

GVC has significance at the macro level of the industry. GVC organization depends on a variety of location-specific factors, such as levels of economic development, trade and tariff regimes, regulatory environments, government policy interventions, labor costs, technology sophistication, and cultural norms (Kano, Tsang, & Yeung, 2020). GVCs not only influence but also can change the macroenvironment; in particular, the sustainability effects of GVCs

and related policy implications have sparked a lot of scholarly and practitioner discussion to date.

Environmental improvement is a significant aspect of GVC which can be done in a wide range of ways, each focusing on a different aspect of economic actors' activities. Such as:

Process improvement: eco-efficiency is achieved through the reorganization of production systems or the application of superior technology (e.g., reduction of energy or materials used per unit of output) (Marchi, Maria, Krishnan, & Ponte, 2019).

Product improvement: The creation of sophisticated, environmentally friendly product lines (for example, the use of recyclable, recycled, or natural inputs, product dematerialization, and the avoidance of toxic or impacting materials) (Marchi, Maria, Krishnan, & Ponte, 2019).

Organizational improvements: It enhancements to a company's overall way of doing business and managing the organization, frequently associated with the accomplishment of standards and certifications (Marchi, Maria, Krishnan, & Ponte, 2019).

According to a wide range of opinions, international fragmentation via GVCs can increase multinational corporations' opportunistic behaviors to restructure their value chain internationally depending on the different levels of environmental standards defined at the country level. (Marchi, Maria, Krishnan, & Ponte, 2019). To fully assess these issues, better environmental and economic measures of how value is produced and distributed along GVCs are required. To summarize, environmental improvements in GVCs can no longer be viewed

as an additional layer in the analysis of how the global economy is being reorganized. Rather, it should be central to comprehending restructuring dynamics in GVCs.

Social upgrading is another type of upgrading enabled by the Global Value Chain (GVC). The process of strengthening workers' rights and entitlements as social agents by raising the standard of their employment is known as social upgrading. Measurable standards and enabling rights are the two components of social upgrading. Measurable standards are quantifiable aspects like wages and working hours. Etc. and enabling rights refer to providing laborers with rights that are more difficult to quantify and are directly related to worker rights like bargaining, non-discrimination, voice, and empowerment. Social upgrading may vary for different levels and different types of workers. Recently, international institutions such as national host governments, donor governments, international organizations, lead firms, trade union organizations, industry associations, and civil society and advocacy groups have taken an active role in coordinated governance initiatives (Rosi, 2019) These governance initiatives have directly focused on overcoming deep-rooted practices in GVCs that hinder social upgrading.

The ongoing penetration of capital into developing-world rural areas via global value chains may be unavoidable, and it frequently provides a much-needed injection of resources. Given this, the GVC framework (and its associated GPN approach) offers a fruitful approach to understanding how agricultural value chain interventions will impact patterns of agrarian change, livelihoods, and rural development. Still, there is mounting evidence that economic upgrading of firms does not always result in improved labor conditions; in fact, firm

upgrading can be associated with social 'downgrading' through increased casualization or deteriorating work conditions. (Nielson, 2019).

Global Value Chain (GVC) also has a significant impact on the Corporate social responsibility of various parties involved in the chain. The GVC approach has successfully conceptualized how local suppliers can engage in production, process, functional, and intersectoral upgrading strategies to improve their relative position within the wider GVC. There are two major approaches which are buyer-driven approaches and supplier-driven approaches. The buyer-driven approach is comprised of a compliance approach and cooperation variation. A compliance approach entails international buyers developing a corporate code of conduct, insisting that their network of suppliers use this code of conduct, auditing their suppliers for code compliance (via first, second, or third-party auditing), and offering suppliers the opportunity to improve in view of future code compliance if gaps are discovered during the audits (Lund-Thomsen, 2019). The emphasis in a cooperation approach to CSR in GVCs is on leading firms retaining long-term trade relations with their suppliers, revising their purchasing practices, providing capacity-building and awareness-raising to help suppliers and workers manage code of conduct and national labor law compliance, supporting NGOs and trade unions in conducting year-round monitoring of supplier performance, and finally working with other brands and NGOs in multistakeholder interdisciplinary initiatives (Lund-Thomsen, 2019). Supplier-driven approaches to CSR are frequently linked to industrial clusters or emerging global suppliers. Unfortunately, it is difficult to assess the effectiveness of these CSR programs as the variation of labor right from country to country, delegation issues of governments, the role of international organizations, and some other reasons.

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The economic growth of Bangladesh is a result of a combination between different industries in the economy. The fast and sustainable economic growth of Bangladesh became possible due to the diversification of resources and investment in different industries and not over-prioritizing one single industry.

The agriculture industry is one of the major industries in Bangladesh that it has been nourishing for hundreds of years. Economically agriculture plays a significant role in Bangladesh because 40% of total employment comes from agriculture. (Asaduzzaman, 2021) Rice is the main crop of this country which it has become sufficient in producing. The agriculture industry of Bangladesh is also supporting the agro-business industry full-fledged, Basic raw materials of agro-business industries like rice milling, sugar, tea, spices, tobacco, edible oil, cotton textiles, jute textiles, starch, etc. come from the local agricultural production of Bangladesh. This industry has always been a strength for the economy of Bangladesh, and it seems to remain so in the upcoming future though there are challenges like the financial crisis of farmers, storage difficulties, unutilized lands etc. (Khatun, 2022).

Bangladesh is trying hard and soul to develop its agricultural sector and assure independence with the help of technological advancement in machinery, cultivation, and storage management. This industry started its journey in the 1980s and has been growing since then. Though there have been many difficulties and external competition, this industry did not fail to grow rapidly. The availability of cheap labor and natural resources has given a competitive edge to this industry. The MFA (Multifiber Arrangement) quota imposed by the World Trade Organization (WTO) helped a lot to grow this industry in Bangladesh. Though the quota has been phased out, the impact is still there because Bangladesh's readymade garments industry has successfully managed to create and maintain sustainable relationships with the largest consumer markets of Europe and North America. 73% of the total RMG export earnings come from North America and European countries. (Mirdha, 2022). Now this industry is the largest export earner for Bangladesh which earned nearly 28 billion USD in 2019-20; (Bangladesh Garment Manufacturers and Exporters Association, 2020). Though there are some challenges like the global economic crisis, lack of skilled labor force, Infrastructural inefficiency, etc. still Bangladesh RMG industry keeps growing fast. Now its contribution is 83% of total export earnings and it is expected to earn 100 billion USD by the year 2030. A recent study on the growth of the RMG industry in developing countries stated that developing countries enter into the lowest segments of the value chain at the primary stage due to favorable trade agreements, cheap labor, and other advantages. To accelerate the industry other factors like the establishment of the textile industry, apparel manufacturing, etc. matter a lot. This study has elaborated on how the apparel industry has been influenced by trade policies and how the change in those policies affected the value chain for developing countries like Bangladesh and Sri Lanka. (Fernandez-Stark, Frederick & Gereffi, 2011).

Among the SMEs (Small and Medium Enterprise) of Bangladesh, the plastic industry has shown significant growth in the last few years. The market size was 1 billion USD in 2008 and is projected to be 2 billion USD by 2015 and 4 billion USD by 2020 (Economic and Social Commission for Asia and the Pacific, 2011). To create a value chain in this industry, Bangladesh plastic industrialists and policymakers took some steps like developing national brands, collaborating with BUET (Bangladesh University of Engineering and Technology) for quality testing and technological support, simplifying govt. process, easy access to training facilities, better financial support, and sustainable waste management. This study has also suggested that regional alignment and assistance are important for establishing a Global Value Chain for this region. For instance, establishing a Global Value Chain development center for the south Asia region, technical assistance, and business development assistance is a must for value chain development (Economic and Social Commission for Asia and the Pacific, 2011).

Another uprising industry in Bangladesh is the Light engineering industry which is a core part of the SME sector. This industry is important because it plays a supportive role in all other industries including agriculture, RMG, transportation, construction, etc. There are 34 LE (Light Engineering) Clusters in 18 districts of Bangladesh where there are a total of 40,000 companies creating employment for 6,00,000 people. (Bangladesh Investment Development Authority, 2021) This industry is growing but there is scope for exponential growth as currently it only meets 50% of the total demand of the country (the total domestic demand is 12 billion USD) and the other half is fulfilled by importing from different countries. The products of this industry in Bangladesh are parts of the machine, metal products, spare parts, foundry products, equipment, etc. The entire product line of the Light

engineering industry is classified into 11 sectors that benefit different industries including transportation, construction, electrical and electronics, pharma, food processing industry, etc. (Sourcing Bangladesh, 2021). The major exportable elements of the Light engineering industry in Bangladesh are engineering equipment, electrical products, bicycles, iron steel, etc. Fulfilling the domestic demand and attempting export in significant volume is possible for Bangladesh LE industry for some reasons like:

- The middle-income class is growing in Bangladesh which results in more demand for modern equipment. The development of Bangladesh has assured electrification in rural areas and urbanization is also going on full-fledged so there is a surge of improvement in the lifestyle of people.
- Bangladesh has a huge portion of youth who joins the workforce and cheap labor is a competitive advantage for Bangladesh over all other Asian countries. If utilized properly, this advantage can take the Light engineering industry of Bangladesh to the next level.
- Bangladesh has Duty free access to 52 countries including the UK, Japan, Canada, Australia, and Russia as per GSP (Generalized System of Preference) which is to encourage and assist developing and underdeveloped countries to grow economically. It is a huge opportunity for Bangladesh to enter and grow in the foreign market.
- The policies and regulations of Bangladesh are very supportive towards the Light engineering industry. Cash incentives and tax waiver has been announced by the

government of Bangladesh to encourage LE export. Corporate income tax has also been waived for 10 years (till 2030) to encourage growing industries. The Light engineering industry is being assisted by supporting industry associations such as the Bangladesh Engineering Industry Owners Association (BEIOA), Automobiles Components & Accessories Manufacturers Association (ACAMA), and Bangladesh Electrical Merchandise Manufacturer Association (BEMMA). This industry is also being supported by 3 ministries or institutions of the Government of Bangladesh which are the Bangladesh Industrial Technical Assistance Center (BITAC), Pilot Plant and Process Development Center (PP & PDC), and Training Institute of the Bangladesh Engineering Industry Owners Association (Bangladesh Investment Development Authority, 2021).

- Recently the Bangladesh Government has developed a policy consisting of 11 strategic targets named “Light Engineering Industry Development Policy 2022” to incentivize and financial support to develop the industry as a major exporting industry by the year 2027. (Halder, 2022). The target is to achieve a 40% contribution to GDP by the year 2027 from this sector. This policy will help investors to get Tax rebates, cash incentives, Insurance benefits, etc.
- The light engineering industry of Bangladesh is supporting other manufacturing-based industries to grab the untapped markets. For instance, Bangladesh is doing great in the international export market of Clocks. The export was 1650 million BDT (Bangladesh Taka) in 2011 with a net growth of 121%. It has become possible because of the support from the light engineering industry as it provided plastic

molding machines at a cheap price. It has become so trustworthy that foreign buyers are ordering wall clocks from local manufacturers and then selling with their own brand name. There are other sectors like home appliances, electrical, etc. which are growing with the compliance of the Light Engineering industry.

A recent study on the electronics industry has stated the importance of the electronics industry on the rise of GVC. It mentioned the Asian electronic giants (China, Singapore, and Taiwan) and their role in the electronic Value Chain. It has also explained how the global crisis has shifted the entire value chain for this industry. For instance, developing countries have started manufacturing and assembling of their own rather than depending on the electronics production of developed countries. It has also given opportunities to the low-cost locations to grow this industry by being present in different manufacturing stages like having agreements with global suppliers, regional suppliers in newly developed economies, and operations of the global supplier in developing economies (Sturgeon & Kawakami, 2011).

One of the most prominent sectors of the light engineering industry is the refrigerator industry of Bangladesh. A few years back Bangladesh was an entirely import-dependent country in the refrigerator industry. Then it started assembling refrigerators with imported parts and eventually started to manufacture fully. Now this industry is growing fast with a market of 900 million USD which aims to become a billion-dollar industry by 2024-25 (Halder, 2021). The refrigerator market scenario has changed drastically. In 2010 the total domestic market was dominated by foreign companies with 80% market share whereas 80% market share is possessed by local companies in 2020. It has become possible due to the increase in domestic demand for electric products and refrigerators which started booming

in the last decade. This industry is growing consistently because of some reasons like rapid urbanization, countrywide electrification, and a growing no. of the middle class along with some government support strategies like tax exemption till 2031, higher import duties of finished products, lower duties on raw material imports and vat exemption on refrigerators. In 2010 only 60% of the total population had electricity whereas it was ensured by the government that nearly 100% of the population had access to this basic requirement. Also, the per capita income has grown by 9% from the last fiscal year to USD 2227 in 2022 which was only \$ 800 in 2010. As per UCB asset management, the middle-class income people will be increased to 34 million in population which indicates the increased purchasing power and increased demand for refrigerators in the Bangladesh local market. (Babu, 2021) Local electronics brands are succeeding in the local market and have achieved people's trust. Walton is leading the refrigerator sector followed by Jamuna, Minister, Vision, and Orion. Foreign brands like Singer, LG, and Samsung are also operating full-fledged.

International companies assessed the opportunity of the refrigerator sector of Bangladesh and started taking actions to be part of the growth. Japan, one of the most cooperative partners for the economic growth of Bangladesh, has expressed its interest to invest in technologically advanced industries. There is an imbalance in export imports between Japan and Bangladesh and this step can help Bangladesh to mitigate the imbalance and export more to Japan.

A Global electronic giant, Samsung, planned to invest 1.25 billion USD in Bangladesh's high-tech industries focusing on electronics and home appliances. This step can help fulfill the domestic demand as well as export from Bangladesh. It will also help to

grow the Bangladesh economy and create employment for thousands of youths. Popular electronics brand, Huawei, has been operating in Bangladesh since 1998 and became the country's one of the most important suppliers of electronics items. It aims to sell products worth \$ 10 billion by 2021. Another Korean company LG has decided to invest particularly in the home appliance sector of Bangladesh. It intends to set up a factory and invest \$ 500 million to manufacture refrigerators, ovens, and televisions in Bangladesh. This giant investment can help boost the economy and by reinvesting that amount, new employment, and new opportunities can be assured.

2.2 Bangladesh Economy and Industrialization

The economic growth of Bangladesh can be easily described by the flying geese model which intends to explain the growth process of developing economies and catching up with the developed ones gradually. This model illustrates two patterns; 1) Basic Pattern which refers to the growth of one industry and secondly, 2) Variant pattern which illustrates the progress of more than one industry and the upgrading of the economy from manufacturing consumer goods to capital goods and more sophisticated products (Camilleri, 2017). In the case of Bangladesh, it's the variant pattern because the reason behind the economic success of Bangladesh is diversification. Bangladesh diversified its economy very fast from an agricultural country to an industry-based economy. To grow fast it diversified in various industries like the leather industry, readymade garments, light engineering, ICT, and many more.

For sustainable development of any country, in-depth development of an industry is very important. Sustainable development of an economy is a result of sustainable entrepreneurship. Entrepreneurship refers to a novel and innovative way of solving a problem with the motive of earning profit. Sustainability has different meanings in different industries. Previously, every industry had only one motive which is to earn money. Now the time has changed, and industries are becoming aware of how they can give back to society. Corporate Sustainability means businesses are inspired to restructure their entire business operation including procurement, production, distribution, promotion, human resource management, and all other operations with responsible behavior (Camilleri, 2017). Businesses should add value to the stakeholder's socioeconomic life and that is the core meaning of sustainability. Because nowadays consumers are aware of the entire value chain and the principles companies follow and violate. They accept or reject businesses based on the principles those businesses have, not only the quality of servings they offer. That's why businesses must invest their skills, resources, and management capacity to lead to social progress.

As per Akamatsu (1962), the first stage of the flying geese model is when a country enters the global economy, it starts to export products of its specialization which are primary products and imports industrial products and advanced products from developed countries. In the second stage, the developing country gets ready to produce from the imported goods and develop a domestic market for that product which eventually leads to a full-fledged manufacturing industry of that product. The scenario of Bangladesh's refrigerator sector is the same. As a new country, Bangladesh developed the agriculture industry first as its most competitive industry. It developed rice, jute, paddy, fish, and fruit sectors well established and started exporting these goods on the international market. On the other hand, it imported

all the important products with an advanced manufacturing process. The refrigerator sector was fully import based, then eventually Bangladesh started to assemble and sell in the domestic market and now it manufactures and exports to foreign countries.

The Intra Industry Aspects

The intra-industry aspect of the flying geese model refers to the product development of a specific sector from 3 aspects, import, production, and export. When the demand was created in the local market, Bangladesh started importing from India, China, Singapore, the UK, Germany, Denmark, and some other countries. The refrigerator market is dominated by China, the USA, and India where China covers 36% of the total volume. (Indexbox, 2022) All the foreign brands started having their own operation in the Bangladeshi market including Samsung, LG, Hitachi, etc. Since last decade, Bangladesh started focusing on producing refrigerators and now 80% of the domestic market is dominated by local manufacturing brands. The shift in Bangladesh's economy by the growing portion of the middle class has had a great impact on refrigerator manufacturing. Enabling household electricity facilities, increasing no. of small families and fast urbanization also influenced the domestic market. Now Bangladesh is getting big in the export of refrigerators. As per EPB (Export Promotion Bureau), the export of refrigerators in July- June 2020- 2021 is approximately 12.27 million USD (Indexbox, 2022).

The Inter Industry Aspects

It illustrates the development of industries in a developing country with the transformation of industries from consumer goods to capital goods. Bangladesh has transformed from an entirely agriculture-based economy to an industrialized economy. There are many established and uprising industries in Bangladesh among which the light engineering industry is one of the most prominent. Light engineering industry is highly capital-intensive industry because it takes modern technological equipment and machinery set up, skilled labor force and management consisting of qualified executives and industry experts. The light engineering industry is growing fast along with the most prominent sector of this industry, the refrigerator sector. Refrigerator industry requires a lot of parts to be assembled and manufactured which Bangladesh is successfully gaining control over. Now Bangladesh has 10 local companies producing refrigerators which covers 80% of the domestic market altogether. Walton is the market leader in refrigerator sector of Bangladesh Followed by Jamuna, Vision, Minister and marcel. (Chakma, 2022) This sector is growing so big that international brands are also setting up infrastructure for local manufacturing and assembling.

International Aspects

It refers to the change of geographic location of industries from advanced to developing countries. The developed countries start paying less attention to established industries and inspires the developing countries to take over the charge of these industries. As a result, the developed economy can focus on more complicated and technologically advanced industries and dominate the new and potential industries whereas the developing

countries get the opportunity to diversify and grow their economy. For instance, the Refrigerator sector was entirely dominated by the USA in the beginning followed by some European countries like Germany, Italy, and others. Now this industry is dominated by China which is the top exporter with market worth of 12.8 billion USD. The other dominating countries are Mexico, South Korea, Italy, and Germany (KeepRite Refrigeration, n.d.). As the developed economies are leaving the space, there is a window of opportunity for developing countries. Bangladesh is grabbing the opportunity and growing fast in this sector.

The flying geese model is a great model to explain the economic growth of the Asian Countries. There is some resourceful research on this model and its implications. Akamatsu (1962) is very significant research which illustrates the economic growth of East Asia including Laos, the Philippines, Myanmar, Cambodia, Brunei, Indonesia, Thailand, Singapore, Malaysia, Japan and China and Korea using the flying geese model. This research is holistic and relevant in a sense that it focuses on the origin, theoretical extension and the inefficiencies of this model. It illustrates both the basic pattern and the variant pattern of development.

Recent research (Majumder & Dey, 2020) illustrates the significance of the Light Engineering industry of Bangladesh. It has a detailed discussion on the prospects and limitations of this industry. This study has collected and analyzed primary data from 35 light engineering industry hubs located in Bangladesh. It has shown some challenges of this industry like unskilled labor, cheap electronic products imported from different countries, lack of financial support, policy inefficiency, lack of technological expertise etc. It has also

described the opportunities of this industry including growing domestic demand, increasing export opportunity etc.

Development need assessment of light engineering sector is another prominent study about the light engineering sector of Bangladesh. This study reflects the importance of the direct and indirect assistance of other industries with the Light engineering industry. It also discussed different obstacles and crucial factors for the development of light engineering industry including the financial policy, marketing policy, new product development, informational and technology barrier etc. are the main issues for this industry in Bangladesh. This study suggested that to develop light engineering industry of Bangladesh it is a must to mitigate the financial barrier and make loans more investment friendly in commercial Banks. All types of Value Added Tax should be very low or waived to assure lower price of engineering products. In brief, authority should assure all sort of assistance to business owners in this sector to assure a progress of this industry.

There are some studies about the Global, Value Chain of electrical industry. The study conducted by states the strategies taken by Malaysia to create impact in the Global Value Chain (Oikawa, 2011). Malaysia focused on TNC operations which means offering international products with foreign investment or financing from multiple countries. It includes infrastructure set up in developing countries for sourcing cheap material, land, and labor. This strategy has also been taken by other countries like Singapore, Indonesia, Thailand, and the Philippines. This study also analyzed how it helped Malaysia to achieve long term sustainability in this industry by three criteria which are, the outsourcing strategy, the local entrepreneurial strength and government policies of the host country. It also

explained how FDI has played a vital role in the economic development of Malaysia. The unskilled cheap labor force has attracted the FDIs to invest and develop the industry of Malaysia to develop their GVC linkage. It is also feasible for Bangladesh to follow this strategy to grow the light engineering industry.

Natsuda et al. (2020) studied the industrial development of Thailand, a Southeast Asian country, and Czechia, a Central European country, and how different policies have achieved these countries to assure economic strength in the automotive industry. This is to assess the policies taken by the two countries to improve their industrial conditions of these countries. Industrial policies can be divided into two aspects, vertical and horizontal. The horizontal policy includes the development of all the industries, and the vertical one refers to the development of a particular industry or sectors of the industry. There are both hard policies and soft policies helping different sort of industrialization. Hard policies are non-sector specific and applicable for all whereas the soft policies are industry specific and designed to improve a particular industry. The automotive policy of Thai government has had a great impact on this industry in Thailand. The government provided various incentives to the investors of this industry for research and development, and they also reduced excise tax. The government encouraged people through the first-time car buyer program. The incentives provided to supply side partners has made sure that giant global players such as Toyota, and Isuzu start investing in Thailand. As for the development of Czech automotive industry, technological development and privatization policy helped the industry improve its investment climate.

3. Machinery industry of Bangladesh

3.1 An Overview of Machinery Industry of Bangladesh

The electrical machinery industry is one of the most potential industries in Bangladesh. It was referred to “thrust sector” in the national industrial policy 2010 and “booster sector” in the SME policy strategy 2005. This industry started booming after the independence of Bangladesh. As the economic growth and urbanization is developing rapidly, so is this industry. An initial investment after independence of Bangladesh in 1976-77 by 1000 investors has helped this industry set up. This industry is leading with producing import substitute products with the motive of manufacturing more products locally and reducing dependency on import. Most of the firms in this sector are owned by SME and some of the firms are operated by the large companies.

The electrical machinery industry grows bigger every year with tremendous growth. The machineries equipment, parts, and all other accessories had cumulative value of 2.541 billion USD in 2014-15 which increased to 4.551 billion USD in 2020-21 (BBS, 2021) The electrical domestic application had production of 19.79 million metric ton in 2014-15 which has turned into 35.06 million metric ton in 2020-21. The machinery equipment category is also growing in a fast pace as the production was 12.47 million metric ton in 2014-15 which has escalated to 56.24 million metric ton in 2020-21 (BBS, 2021). This consistency of growth reflects the increasing domestic demand of machineries and equipment. The imbalance of export and import is also reducing day by day and the machineries industry is playing a significant role in it. For instance, machineries and other capital equipment export was 232.44 million USD in 2014-15 which was escalated to 541 million USD in 2020-21. The import of

machineries and other capital equipment was 7.712 billion USD in 2014-15 which was reduced to 6 billion USD in 2020-21. As the demand is increasing but the import of machineries is decreasing it can indicate only one thing which is the increase of machineries production in Bangladesh. On the other hand, Parts and accessories import was 1.445 billion USD which has increased to 2.717 billion USD in 2020-21 (BBS, 2021) which indicates the usage of capital goods in manufacturing consumer goods.

Table 1: Export and Import of Machinery and Other Capital Equipment

(Million USD)

Export				Import			
2016-17	2017-18	2018-19	2020-21	2016-17	2017-18	2018-19	2020-21
239.1	437.8	542.72	556.8	7914.4	7301	5600	6242

Source: BBS (2021).

Table 2: Export and Import of Parts and Accessories

(Million USD)

Export				Import			
2016-17	2017-18	2018-19		2016-17	2017-18	2018-19	2020-21
75.26	87.35	55.35		1486.39	1896.71	1701.56	2795.8

Source: BBS (2021).

Light engineering sector is also a part of the machinery industry which has a great potential. The local manufacturers produce worth of 146 million USD where the domestic demand is of approximately 194 million USD (Rahman & Abdin, n. d.). There are 2500 companies producing electrical products of 75 types. These products are under HS code 84, 85, 90 and 94 which covers electronic fan, refrigerator, cooler, Air conditioner, generator, television and parts, and other household equipment and accessories. This industry can be divided into two sub sectors based on usage volume which are industrial sector and household sector. The major parts offered for the industrial sectors are cable, transformer, industrial fan, main switch, switch gear, electric iron, heat, and speed control system etc. The main products offered for the household usage are fan, bulb, plug, light, switch and the consumer electronics items like refrigerator, cooler, freezer, microwave oven, air conditioning machine etc.

The light engineering sector is another potential sector of the machinery industry which is recognized as “Product of the year” for its goods by Bangladesh government. The reason behind this appreciation is tremendous growth of 50.4% in 2021-22 fiscal year. (Shishir, 2022) The starting of this sector and the entire machinery industry is deeply connected with the place named Dholaikhal which is near to Dhaka. Zinzira, Mirpur and Syedpur are some other places where this industry started to thrive. With the initial assistance from the government this sector thrived. Bangladesh Small and Cottage industry Association (BSCIC) provided low interest loan to address the initial funding issue of this industry. Despite all the crisis, lack of modern technology and skilled labor force this industry has successfully drawn attention of different stakeholders. After observing the growth of this sector govt. decided to incentivize this sector to assure growth.

The entire machinery industry of Bangladesh is divided into a few clusters which also concentrated on different sub sectors. The Rangpur, Dinajpur and Bagura clusters are focused on railway, mills, and factory maintenance, agro-machinery, and spare parts. Dhaka, Narayanganj and Gazipur are mostly focused on capital machinery, bicycle, automobile, consumer electronics, spare parts etc. The Sylhet and Barisal region is focused on spare parts of mills, factories, and spare parts whereas the Chittagong region is active on ship breaking, spare parts of automobiles and factories. (Ahmed & Bakht, 2010).

Walton: The Pioneer of The Electronics Industry

Walton is the pioneer in the consumer electronics industry of Bangladesh. This company was established in 1977 and growing with great reputation ever since. Now this company is dominating the electronics market of Bangladesh including Motorcycle, Refrigerator, Television & Air conditioner. This Company started its electronic business in 1995. It has one of the most advanced technological plants of south Asia located in Gazipur, Dhaka covering 700 acres of factory area with the capacity of manufacturing 10 million units per year. Walton has a workforce of more than 30000 people. Now the domestic market is heavily dominated by Walton as 60% of the appliance market is covered by this company. Walton has started exporting and developing its foreign market gradually. In the electronics industry, Walton is the highest revenue earning company of Bangladesh. It exports to 20 countries of the world including European countries like Greece, Germany along with Africa, Asia, and Middle east countries. Walton is also planning to expand its export by exporting to Europe, Australia, Singapore, South Africa, and other countries. (Walton, 2011) Walton aims to export product worth of 100 million USD to the international market by 2021-22 fiscal

year (Dhaka Tribune, 2021) .Walton has already drawn attention of international companies and consumers due to its consistent performance. Due to the contribution of Walton in export of Bangladesh it avails the facility of duty-free export to Nepal. (Shah, 2022).

Global giant like Panasonic has long term plans partnering Walton. Panasonic has been adding value to Walton by training its engineers and providing other supports such as quality control and research and development etc. As a futuristic company Walton does not want to stop here. It set goal to export product worth of 3 billion USD within 2025. Which will make this company one of the top five electronics brand in the world.

Other Companies with Significant Role in the Market

There are other reputed companies in Bangladesh which are supporting the electronic industry to uprise. Rahimafrooz is one of these. Rahimafrooz group is one of the largest groups of Bangladesh operating in four segments including storage power, electronics and automotive, energy and retail. This company is operating for more than 65 years and exporting to 45 countries in the world. Globatt is a high-tech battery of Bangladesh manufactured and marketed by Rahimafrooz. This battery has become a global success and it has high demand in industrialized countries like Japan, China etc. Offering maintenance free battery to the global market has given a competitive edge to this company. This export is helping the economy of Bangladesh as relationship with the fastest growing economy can open the window of opportunity for other companies as well. (Abedin, 2013). Vision, a concern of Pran-RFL group is also showing remarkable progress in the electronics industry. It currently offers TV, refrigerator, home, and kitchen appliances etc. Jamuna Electronics,

Marcel, Minister, and other local brands are improving day by day and increasing their production capacity to cope up with the demand.

Steps Taken for Future Growth

Local companies are working relentlessly to improve the market and offer better products. Walton has recently signed a MOU (Memorandum of Understanding) with a South Korean design house to bring extraordinary changes in design and quality of electronics products. It has also set up a research and innovation center in South Korea which will help to plan and execute cutting edge technological practices in Walton (Star Report, 2022).

Bangladesh government is trying its level best to develop the machinery industry and make it export ready. It has taken some initiatives such as Setting up ten industrial parks in eight districts with the affiliation of Bangladesh Small and Cottage Industries Corporation (BSCIC) to fulfill the domestic need of industrial products and part and to export in the international market. (Hossain, 2021) This industry is mostly focused on repairing and maintenance of the industries whereas the target is to increase the portion of manufacturing firms under this industry. Currently the manufacturing firms covers only 10% of the industry whereas the repair and maintenance firms cover 90%. (Shishir, 2022) Another great initiative of the government is providing 10 years tax holiday for entrepreneurs producing small parts in factory use.

3.2 Refrigerator Industry of Bangladesh

Current Scenario of the Refrigerator Industry of Bangladesh

The refrigerator market of Bangladesh has seen a lot of changes in last decade. It has shifted from an import dependent industry to a domestic company-oriented industry within just one decade. The transition is also a witness of the economic growth of Bangladesh and the raise of better lifestyle for majority of the population of Bangladesh. This industry is ever growing and surprisingly the effect of pandemic was not severe for this industry. The sale was fallen dramatically due to the lockdown on COVID 19. As a significant portion of population was struggling to survive, this industry faced a serious challenge, but it eventually turned around. Despite the impact of Covid 19, Walton has peaked its highest sale in 2021. Walton sold 24.69 lakh units of refrigerators in 2021-2022 fiscal year with financial value of approximately 52 million USD.

The Role of Bangladesh Government to Promote the Refrigerator Industry

Bangladesh government has focused on the diversification of the economy and put emphasis on industries other than the already established ones like Readymade garment and agriculture. It also plans to establish the “Made in Bangladesh” as a global brand for the economy of Bangladesh. For that it focuses on industries like refrigerator where there is a lot of scope to improve and flourish.

To encourage local manufacturing and industrial development, Value added Tax (VAT) and supplementary duty has been waived from the import of raw materials of to make compressors (Parvez, 2018). This step taken by National Board of Revenue (NBR) is to encourage the manufacturing and assembling of refrigerator locally. On the other hand, the tax authority has also reduced tax for the refrigerator and compressor making companies till June 2032 which is to encourage the electrical industry. Currently the non-listed companies pay 30% corporate tax, and the listed companies pay 22.5%. To enjoy this opportunity, eligible companies must reinvest at least 10% of the waived tax to enhance production capacity or establish new set up or buying new equipment. (Star Business Report, 2021). It will assure the growth of the industry along with the improvement of the manufacturing companies.

In the recent budget of fiscal year 2022-2023, the tariff on spare parts of the refrigerator industry has significantly reduced (FE Online Desk, 2022). To boost the economy, focusing on domestic manufacturing and assembling is more important than importing ready products. Tariff reduction on spare parts will increase local assembling plants but the manufacturing companies may hamper for this decision. In an SRO (Statutory Regulatory Order) there are two types of refrigerator companies which are Category 1 and Category 2. Category 1 refers to the ones who manufacture the main components or the most important components of the refrigerator. Category 2 refers to the ones which produces the body cabinet of the refrigerator. After this announcement, category 2 companies will get equal benefits like category 1. It reflects the growth of assembling companies and higher import of spare parts to meet the local demand.

The supportive notion of Bangladesh government has given local companies a huge advantage over the foreign companies as the local companies were enjoying VAT (Value Added Tax) exemption since 2010. And they will get the advantage of importing without import duty of raw materials till 2025 (Tribune Report, 2022). The reason behind this support for the industry was to help establish a strong and potential industry in Bangladesh. Now that the industry is growing fast, Bangladesh government has imposed 5% VAT for the locally manufactured refrigerators (Tribune Report, 2022). It will help the industry to be more competitive and help the government to earn revenue from this money generating industry. It will increase the price of local refrigerators which might be a challenge for the local companies.

Walton: The Game Changer of the Refrigerator Industry

Walton is the market leader of the refrigerator sector of Bangladesh among all the local and international brands. It is the first local company to manufacture refrigerator. They entered refrigerator business by importing compressor in 2008 but now it is a fully independent refrigerator manufacturing company with the largest market share in Bangladesh. Now Walton has approximately 70% market share of the domestic refrigerator market of Bangladesh (New Age Bangladesh, 2021). Walton is certified by the global bodies like ISO, RoHS, Saudi Arabia Standard Organization etc. which reflects high standard of Walton refrigerators. Walton currently manufactures four types of refrigerators which are direct cool refrigerator, non-frost refrigerator, freezers, and coolers. Walton sells refrigerator within a price range of BDT 10,000 - BDT 110,000. The current manufacturing plant of Walton has the capacity of producing 10,000 units of refrigerator per day. Walton also plans

to extent the manufacturing capacity of refrigerator with a new plant which will produce 6,00,000 units of refrigerator per year (Walton, 2022).

Walton is being appreciated by the users due to the technological advancement it has achieved and the satisfaction it provides to the customers within affordable price point. Inverter technology is one of the main reasons behind the success of Walton in the domestic market. It is one of the latest inventions in refrigerator market. Inverter technology refers to the system which maintains the required temperature all the time and helps to reduce electricity wastage. It is cost efficient and high performing refrigerator which fits the requirement of the local market perfectly.

The nano silver technology is another reason behind the success of Walton refrigerators. The nano technology protects food from bacteria. Bacteria has cell membranes and nucleus which are negative ion whereas nano technology has positive ion which destroys the disease-causing bacteria. That's how the food is kept safe using the modern technology in Walton refrigerators.

Durability is another characteristic of Walton refrigerator; Walton refrigerators are manufactured to sustain for 20-30 years (Walton, 2011). Besides, Walton is the only local company of Bangladesh producing compressor. This plant of Walton has given Bangladesh the honor of being 8th largest compressor manufacturing country in Asia and 15th largest in the world. (TBS Report, 2020) Walton compressors factory has high end facilities like Hemi Anechoic Acoustic Chamber to assure lowest level of noise in compressor. It also has advanced equipped machineries and international standard QC (Quality control) laboratories.

Walton has long term plan regarding compressor for the refrigerator and AC, as a part of that plan recently it has taken over one of the oldest European compressor manufacturer companies named Italia Wanbao- ACC. This company has the capacity of manufacturing 3.2 million compressors per year, and it operates in 57 countries in the world. After the acquisition, Walton will have the capacity to produce 4.8 million compressor per year (Tuhin & Noyon, 2022). After the acquisition Walton will possess the ownership of machineries, trademark, and patents of this company. Walton also finalized purchasing of two more brands which are Zanussi Elettromeccanica (ZEM) and Verdichter (VOE).

A refrigerator called a "Direct Cool Refrigerator" uses convection to naturally provide cooling. This process takes place from the chilled surfaces in the insulated cooling compartment. whenever the vaporized water interacts with a chilled surface and cools. With the aid of an outside source, this type of refrigerator naturally cools the food inside. As a result, the user does not have to bother about managing the refrigerator's temperature. Therefore, to manually defrost a food item, simply clicking the defrosting switch works. This technology is used mostly in single-door refrigerators. It is getting popularity in Bangladesh due to the cost effectiveness in terms of electricity and the affordability.

The term "non-frost refrigerator" refers to a type of refrigerator in which food does not develop any frost on its surface. This crucial element ensures that the food is always fresh since it prevents freezer burn. Foods can develop a disease called freezer burn, particularly if they have been harmed. The food was not properly wrapped in an airtight container, which causes dehydration and oxidation to occur. The users won't have to worry about freezer burn or manually defrosting the food while using a non-frost refrigerator. Non frost refrigerator is

more popular in the urban areas and Walton is the only local company to offer non frost refrigerator to customers. As these refrigerators are comparatively high price, consumers look for trustworthy brands to purchase one of this kind. Walton has successfully achieved that position.

Large quantities of food products can be stored in freezers under the category of freezer. Freezers maintain a steady temperature in the negative Fahrenheit range. This has come to light now that the refrigerator has enough space to accommodate the freezer for frozen items. The cause is the lack of a sizable refrigerator with ample space and unique characteristics to maintain the proper temperature for convenience foods. Walton freezers are also used mostly by retail outlets and supermarkets along with the households for storing meat and fish. The demand of freezer is higher in the Eid ul Adha time when there are a lot of meat available due to animal sacrifice. (Hasan & Mahmud, 2019) The other use is by the FMCG (Fast Moving Consumer Goods) companies who offer frozen foods, ice creams, cake, and other items.

Cooler is a special type of refrigerator which is used to store beverage. It consumes less energy compared to refrigerator. It is also more effective because it helps the beverage to chill evenly. Coolers are mostly used in hotel, restaurants, coffee shop, supermarket, and retail stores. This is a unique way of branding for the beverage companies. There are many beverage companies in Bangladesh including Coka Cola, Pepsico and other local companies like Akij Food and Beverage Ltd. (AFBL), Pran, Partex Beverage Ltd. etc. These companies target the retail stores to do their marketing promotion and cooler is a strong way for them. They decorate the cooler with their branding and product pack shot which attracts the

consumers. Coolers also ensure the presence of a particular soft drink brand in the market. It is also easier to showcase their brands through cooler than through refrigerator. Cooler management also helps them to reach new market and get placement in the existing ones by acquiring new outlets with their branded coolers. The more beverage cooler of a company in the market, the more consumption of that brand or company. As the beverage market is growing, the importance of cooler is also increasing. Other than the beverage companies, the retailers are also major customers of coolers. They can easily store other products like butter, cheese, yogurt etc. in the cooler. Walton is leading the local market of beverage cooler with the 3 models of coolers it offers. It has drawn attention of the customers (mostly commercial users) because of super-fast cooling, bright interior, energy saving, auto closing door, adjustable racks and cost effectiveness.

Other Major Companies in the Domestic Market

Vision Electronics is a sister concern of Pran-RFL group which is one of the largest FMCG companies in Bangladesh. Vision electronics inaugurated its journey in March of 2013. It also produces home and kitchen appliances along with refrigerators. Pran- RFL has one of the strongest distribution networks in Bangladesh, its distribution network gives Vision a competitive edge. Customers rely on this brand as this is from a trustworthy group. Vision refrigerators are produced in three manufacturing plants of Vision which are in Ghorashal, Danga and Habiganj. Now vision manufactures more than 100 models of refrigerators which are successfully marketed all over the country through 300+ exclusive showrooms and 270+ Vision emporium showrooms. Vision currently manufactures 1000 unit of refrigerator per day. (Chakma, 2019) Excellent service and true value or money has

helped Vision to achieve a significant position in the domestic refrigerator market of Bangladesh.

Jamuna Refrigerator is another brand that is winning hearts of customers in the local market. Recently this brand is being appreciated due to its high performance. It was certified by Bangladesh University of Engineering and Technology (BUET) as the best cooling locally produced refrigerator in the country. It can keep food fresh for 72 hours and save energy up to 70 percent. (TBS Report, 2022) Jamuna Electronics and Automobiles provides a variety of refrigerators and other small appliances in a variety of sizes, elegant styles, and colors to suit lifestyle of its customers. Jamuna provides solution for the latest refrigeration technology or extra fresh or frozen food storage.

Apart from its distinct designs, one of Jamuna's most distinguishing features is the stabilizer-free operation of its refrigerators. As the name implies, refrigerators and freezers with stabilizer-free operation structures save money on purchasing a separate stabilizer for refrigerator. It was made possible using specialized compressors. Refrigerators equipped with such features will continue to protect appliance from voltage fluctuations. The compressor in the Jamuna Refrigerator has a higher energy efficiency ratio, uses less power, and does not require a stabilizer. The overall performance of Jamuna refrigerator is satisfactory as per consumer feedback.

Other local brands are also succeeding in the domestic market and exporting through small consignments. Minister, my one and other local brands are also taking grasp of the domestic market. To meet the growing demand of the domestic market, Minister has

established Minister hi tech park with an investment of approximately 50 million USD in Trishal, Mymensingh in 2018. (Nabi, 2018). With full operation, it has the capability to manufacture 10,000 units of refrigerator per day. Price is one of the main differences of these brands with the established ones. These brands offer refrigerator at a comparatively low price. These are known for moderate to high performance, but durability of these brands is still an issue. These brands run marketing campaigns and promotional activities to draw attention of people. So far, they have been successful to raise brand awareness and create customer base for their refrigerators.

Future of the Refrigerator Industry of Bangladesh

The demand for consumer electronics is growing higher every year, as a major component of that industry the market for refrigerator is also going up. Countrywide electrification was assured in last decade which now includes approximately 100% of the country. Per capita gross national income is also going up which is 2620 USD in 2021. Also, the number of people moving towards city is growing fast. These are the indicators that show the future of refrigerator industry of Bangladesh is spectacular.

To help this industry Bangladesh government is taking necessary steps regarding policy making such as

- Imported refrigerator has been announced as non-essential good and the import duty on refrigerator is 136% (Star Business Report, 2012). A recent report by Bangladesh Trade and Tariff Commission suggests that import of non-essential goods should

have more duties imposed (Uddin & Ali, 2022). This will reduce the import of refrigerator and increase the opportunity of local manufacturing companies.

- Around 200 types of raw materials are needed for making compressor. For that the importers must pay 5% -25% tariff. Government has also proposed 5% Vat on locally manufactured refrigerators in the budget of 2022-23 fiscal year (TBS Report, 2022).
- The female contribution in income has increased in a remarkable way, female labor force participation in Bangladesh has increased to 38.7% whereas it is 23.6% in South Asia. As the number of working women grows, the demand for refrigerator grows. To cope up with that, the local and global brands are setting up their manufacturing plants and enhancing capacities which is a good sign of growth in the market.
- Technological upgradation is being noticed and demanded by the users and manufacturers are also getting used to these challenges. Keeping food last longer, top notch design, smart fridge with IoT (Internet of Things), energy efficient and durable compressor etc. are getting common in the market (Ayon, 2022). Bangladeshi manufacturers are trying to cope up with the modern upgradation of the refrigerator industry.

4. Data Analysis

4.1 Data and Methodology

This research is conducted using the secondary data, which was collected from Global Trade Atlas, one of the most comprehensive data sources for international trade is the exact source of data for this research. Import and export data of HS code 8418 (Refrigerator) and 841899 (Parts of Refrigerator) were extracted from the source and used for further analysis. International trade data of Bangladesh for last two decade (1997-2021) has been collected for that purpose. The trade data (import and export) of the partner countries have also utilized to get a precise idea of the refrigerator and parts export import of Bangladesh. To get precise idea, the indirect import and export data with various countries was used for this research.

In this research, the unit of analysis is the import of refrigerator and refrigerator parts for last two decades. Bangladesh was an import-oriented country for refrigerator. The data of last 24 years will be analyzed how and why the import of refrigerator has fallen and the import of refrigerator parts has increased over the years. The export data will also be analyzed to assess the export of refrigerator from Bangladesh and its future prospect.

The author believes that the refrigerator industry of Bangladesh is showing groundbreaking change. For this study, import is the dependent variable and year is the independent variable. To answer third research question (whether the refrigerator sector of Bangladesh can achieve international competitiveness or not), the export data of refrigerator was used.

4.2 Empirical Analysis

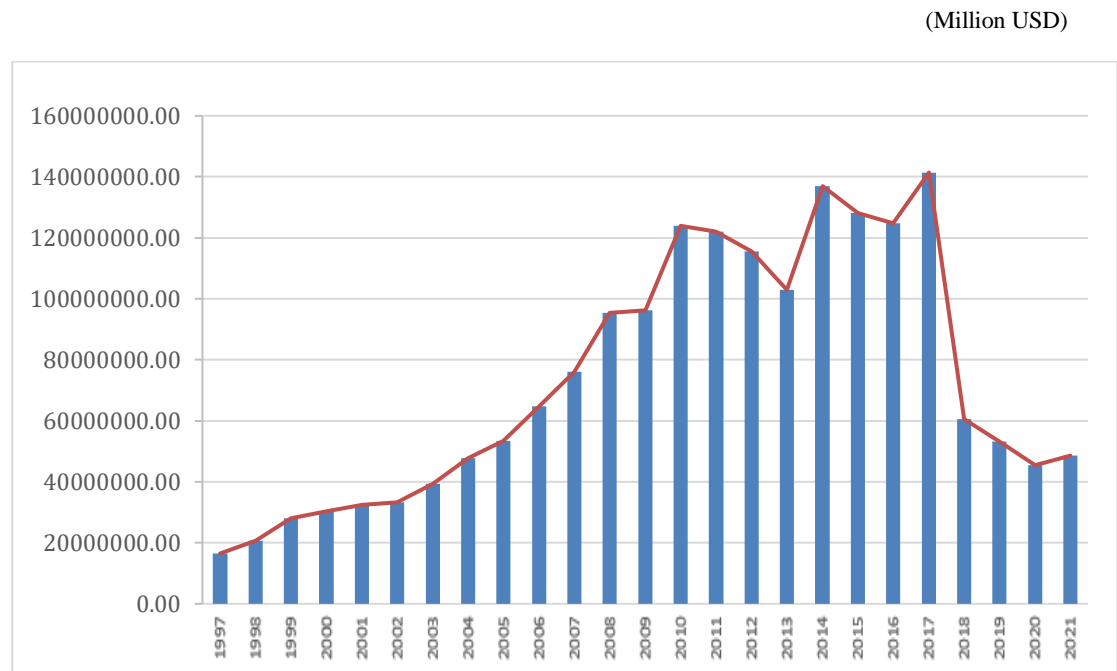
4.2.1 International Competitiveness Phase

Import of Refrigerator

Figure 1 shows the time trend of import of refrigerator in Bangladesh. It is shown that there was sharp decline in import after steady growth till 2017.

If we plot the histogram of Import of Refrigerator (Indirect Export of Refrigerator), we see a left skew in this data, meaning the many of cases are bunched at higher values, but then the import again deteriorates.

Figure 1: Refrigerator Import (Unit: USD)



Data Source: Global Trade Atlas.

To handle situations like this, we can logarithmically transform variables to use those in a regression model. It is a very common way where a non-linear relationship exists between the independent and dependent variables.

Transforming one or more variables with logarithm, makes the effective relationship non-linear, while still preserving the linear model.

To assess the relationship between the variables here, we can use a quadratic log model. The model used here is:

$$\ln M_t = \beta_0 + \beta_1 t + \beta_2 t^2 + u_t$$

M signifies the amount of import of refrigerators, while t stands for years.

To run this regression in SPSS, we take the natural logarithm of “Import of Refrigerator” as the dependent variable and the year count and its quadratic form as independent variables.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.939 ^a	0.882	0.871	0.22826

a. Predictors: (Constant), t^2 , and t

ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	8.532	2	4.266	81.876	.000
	Residual	1.146	22	0.052		
	Total	9.679	24			

a. Dependent Variable: Ln_M

b. Predictors: (Constant), t^2 , and t

Coefficients

Model	Unstandardized		Standardized Coefficients	t^2	Sig	95.0% Confidence Interval for β	
	Coefficients					Lower Bound	Upper Bound
	β	Std. Error					
(Constant)	16.145	0.149		108.6	0	15.84	16.45
t	0.292	0.026	3.383	11.08	0	0.237	0.347
t^2	-0.009	0.001	-2.813	-9.211	0	-0.011	-0.007

a. Dependent Variable: Ln_M

Here, the model is stated as below:

$$\ln M_t = 16.145 + 0.292 t - 0.009 t^2$$

To test the validity of the model and its parameters we require Hypothesis Testing.

Hypothesis Testing Using “Overall F Test”:

H_0 : All coefficients are equal to zero.

H_A : At least one coefficient is not zero.

As we can see from the above ANOVA table, at 95% significance level, *Significance F* is

$Significance F = 0.000 < 0.05$ Thus, we can reject the null hypothesis. So, the model is valid

Now we test individual coefficients,

Hypothesis Testing Using “Individual T Test”:

$H_0: \beta_0 = 0$.

$H_A: \beta_0 \neq 0$.

As we can see from the above ANOVA table, at 95% significance level, p-value of the estimate of β_0 is,

$$p = 0.000 < 0.05$$

Thus, we can reject the null hypothesis. So, the intercept β_0 is valid.

$$H_0: \beta_1 = 0.$$

$$H_A: \beta_1 \neq 0.$$

As we can see from the above ANOVA table, at 95% significance level, p-value of the estimate of β_1 is,

$$p = 0.000 < 0.05$$

Thus, we can reject the null hypothesis. So, the slope coefficient β_1 is valid and has some effect on the model.

$$H_0: \beta_2 = 0.$$

$$H_A: \beta_2 \neq 0.$$

As we can see from the above ANOVA table, at 95% significance level, p-value of the estimate of β_2 is,

$$p = 0.000 < 0.05$$

Thus, we can reject the null hypothesis. So, the slope coefficient β_2 is valid and has some effect on the model.

Here, R Square is 0.88. This indicates the growth in Import of Refrigerator has a very strong positive correlation with the passing time.

And Adjusted R Square is 0.871 indicates that the regression model can explain 87.1% variation in the Refrigerator Import.

Now,

$\beta_0 = 16.145$ indicates that, irrespective of the time i.e., in the absence of the time factor, on an average the Import of Refrigerator should be $e^{16.145}$

$\beta_1 = 0.292$ indicates that, with 1 unit increase in t (time), on an average Import of Refrigerator (M) will increase by 29.2%.

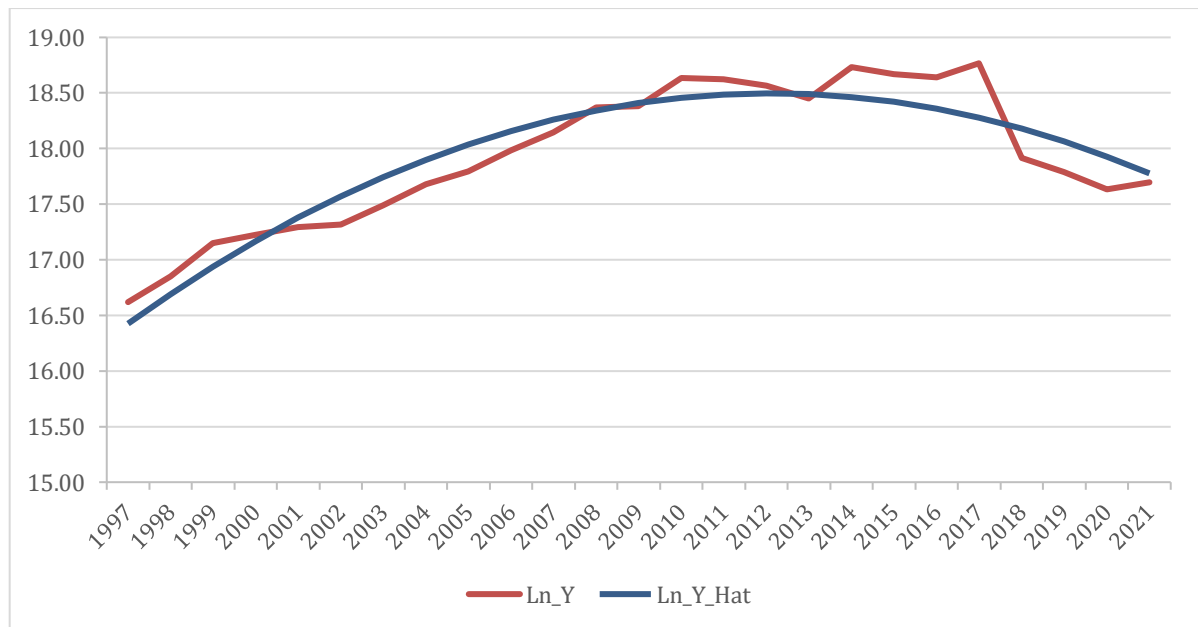
$\beta_2 = -0.009$ indicates that, with 1 unit increase in t^2 , on an average Import of Refrigerator (M) will decrease by 0.9%.

As t^2 is the squared term of t , with the passage of time the weight of effect of t^2 in the model increases. The negative value of β_2 and the increasing weight of t^2 jointly indicates that, at some point of time the Import of Refrigerator (M) will start declining.

Let us plot the estimated values along with the observed values in scatter plot:

Figure 2: Estimated Loglinear Regression Line of Refrigerator Import

(Million USD)



Note: The original data is from Global Trade Atlas. The estimated loglinear regression was done by the author.

We can see that, after 2013-2014 the Loglinear regression line $\widehat{\ln M}$ is facing downward slope. From the regression, this is what we are to expect. Besides β_1 is significantly positive and β_2 is significantly negative which implies that import of

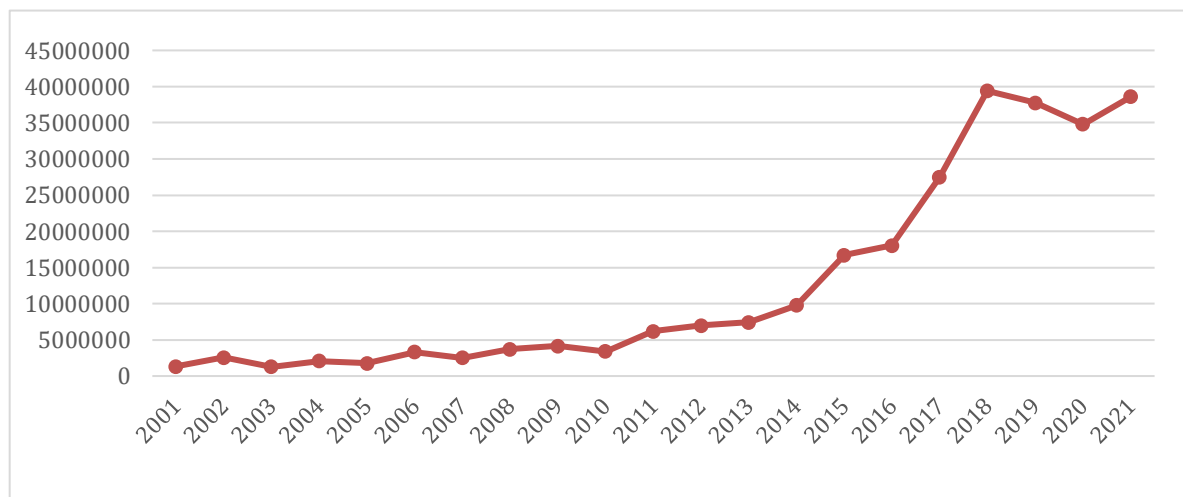
refrigerator follows a quadratic relation in year (t). As the domestic demand is increasing constantly, it means the dependency on import from other countries is decreasing and local manufacturing is increasing. The scenario clearly indicates that a raise in international competitiveness is being taken place for the refrigerator industry of Bangladesh.

Import of Refrigerator Parts

Plotting the parts import data in graph, we see a growing trend. By mere visualization we get a fair idea that the import of refrigerator parts is growing with time.

Figure 3: Refrigerator parts import of Bangladesh

(Million USD)



Data Source: Global Trade Atlas.

To analyze further, a simple regression analysis was performed in SPSS taking “Year Count” as independent variable and “Parts Import in dollars” as dependent variable.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig.F Change
	.882	0.778	0.767	6748214.656	0.778	66.724	1	19	0

Note. Predictors: (Constant), Year Count.

ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
	Regression	3.0385E+15	1	3.0385E+15	66.724	.000
	Residual	8.6523E+14	19	4.55384E+13		
	Total	3.90373E+15	20			

- a. Dependent Variable: Import
- b. Predictors: (Constant), Year Count

Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
(Constant)	-9033128.66	3053609.297		-2.958	0.008	-15424406.4	-2641850.949
Year Count	1986479.14	243188.776	0.882	8.168	0	1477479.179	2495479.093

- a. Dependent Variable: Import

Here, the model is state as below:

$$y_t = \beta_0 + \beta t + u_t$$

$$y = -9033128.66 + 1986479.136 t$$

To test the validity of the model and its parameters we require Hypothesis Testing.

Hypothesis Testing Using “Overall F Test”:

H_0 : All coefficients are equal to zero.

H_A : At least one coefficient is not zero.

As we can see from the above ANOVA table, at 95% significance level, *Significance F* is

$$\text{Significance } F = .000 < 0.05$$

Thus, we can reject the null hypothesis. So, the model is valid.

Now we test individual coefficients,

Hypothesis Testing Using “Individual T Test”:

$H_0: \beta_0 = 0$.

$H_A: \beta_0 \neq 0$.

As we can see from the above ANOVA table, at 95% significance level, p-value of the estimate of β_0 is,

$$p = 0.008 < 0.05$$

Thus, we can reject the null hypothesis. So, the intercept β_0 is valid.

$H_0: \beta_1 = 0$.

$H_A: \beta_1 \neq 0$.

As we can see from the above ANOVA table, at 95% significance level, p-value of the estimate of β_1 is,

$$p = 0.000 < 0.05$$

Thus, we can reject the null hypothesis. So, the slope coefficient β_1 is valid and has effect on the model.

Here, R Square is 0.778. This indicates the growth in Parts Import has a very strongly positive correlation with the passing time.

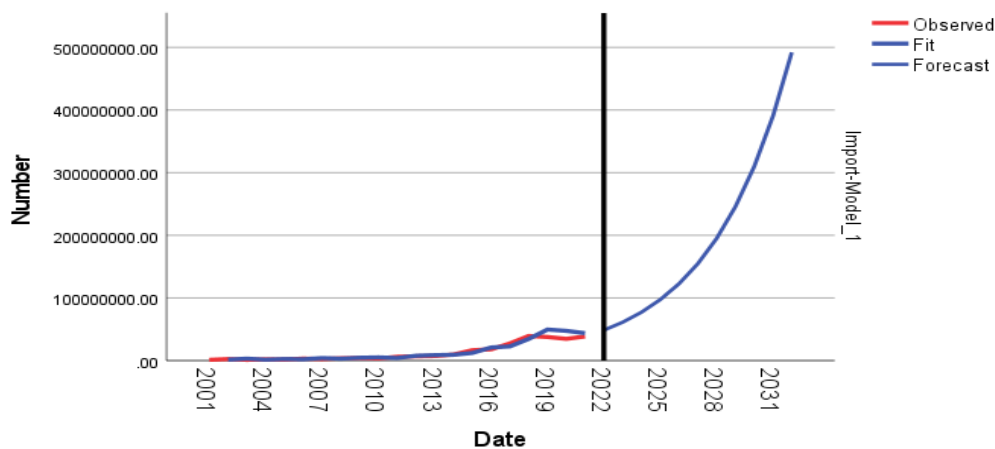
And Adjusted R Square is 0.766692644 which indicates that the regression model can explain 76.67% variation in the Refrigerator Parts Import.

As the model and all the coefficients are individually valid and the correlation between the variables is positive and very strong. Hence, we can affirm that the growth in import of Refrigerator Parts is very significant.

If we further go into forecasting with ARIMA (Auto-Regressive Integrated Moving Average), we see a huge growth forecasted in the coming years. This indicates that, the Refrigerator Parts Import will increase in multitude *ceteris paribus*.

Figure 4: Forecasted Import of Refrigerator Parts

(Million USD)



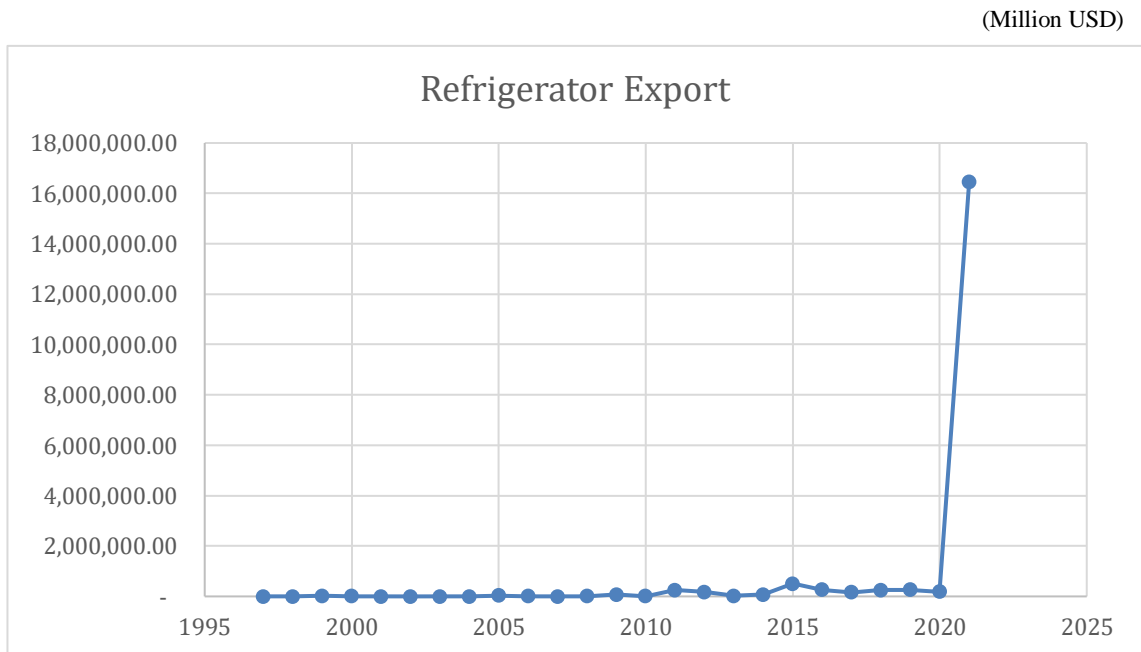
Note: Forecast developed by author, based on the data sourced from Global Trade Atlas.

4.2.2 Export Extension Phase

Refrigerator Export

As the import of Refrigerator Parts increased, so did the amount of refrigerator assembly. In the below figure it is evident that; the export of Refrigerators took a huge turn in 2021. By mere visualization, there must be some unusual events that brought forth the export value.

Figure 5: Refrigerator export of Bangladesh



Data Source: Global Trade Atlas.

Prior to 2021, the export amount was USD 0.5 million in 2015, which was highest ever Refrigerator export value from Bangladesh. But in 2021 it increased more than 30 times.

To test if the export in 2021 was really an outlier or not, we compare the export value in 2021 and the historical mean plus three times the standard deviation of the series. If the

former is greater than the latter, it is proven that the refrigerator export in 2021 is significantly and positively different from the mean of the series for 1997-2020.

Table 3: Export Value of Refrigerator

(Million USD)

Year	Export Value	Year	Export Value
1997	52.00	2009	75,955.97
1998	421.71	2010	9,237.88
1999	19,713.20	2011	247,407.58
2000	6,451.10	2012	169,344.48
2001	95.00	2013	15,486.88
2002	31.00	2014	68,246.07
2003	162.00	2015	503,999.14
2004	650.00	2016	266,729.73
2005	32,363.80	2017	158,681.39
2006	11,273.77	2018	254,451.85
2007	1,477.56	2019	263,567.89
2008	14,285.58	2020	189,314.94
		2021	16,441,067.12

Data Source: Global Trade Atlas.

The average export value of refrigerators for 1997-2020 was 96,225.02 million USD. Its standard deviation was 129,199.97 USD. Taking 3 standard deviation as the threshold for an outlier, be considered within the range of data from 1997 to 2020, the value has to be within the following range:

$$96,225.02 - (3 \times 129,199.97) \leq x \leq 96,225.02 + (3 \times 129,199.97)$$

$$0 \leq x \leq 483,824.93 < 16,441,067.12$$

As the above inequality shows, the export value in 2021 is unusually high in the history of Bangladesh refrigerator export. Year 2021 was not an easy year for the global economy especially for a developing country like Bangladesh due to the outbreak of COVID 19 and consequential global economic crisis and instability. Despite all these difficulties, extraordinary export performance in 2021 makes a positive impression of the refrigerator industry of Bangladesh and seems a potential source of export revenue for the economy of Bangladesh in the foreseeable future. As per the export data of Bangladesh in 2021, the refrigerator industry is showing sign of growth in the international market and grab the global refrigerator market as it has done in the domestic market.

4.2.3 Comparison Between Refrigerator Import and Refrigerator Parts Import

Bangladesh has been importing refrigerator for a long time as this country was entirely import dependent for the electrical machines. The main source of import was the renowned electronics brands in the world. It was a common market practice to import refrigerators and the local population was habituated to buying imported refrigerators. The scenario changed when Bangladesh started to assemble refrigerators locally. After Walton and other local companies started assembling refrigerators in the late 2000s, the import of refrigerator parts has increased significantly. Within a few years these local companies developed their capacity and started manufacturing refrigerators. The entire situation of refrigerator market shifted within a decade. After 2010, the domestic refrigerator market started being dominated by local companies like Walton, Jamuna, Minister etc. At this point

the import of refrigerators has decreased significantly and the import of refrigerator parts has increased consistently to accelerate the local manufacturing of refrigerators.

Table 4: Parts import vs Refrigerator import

(Million USD)

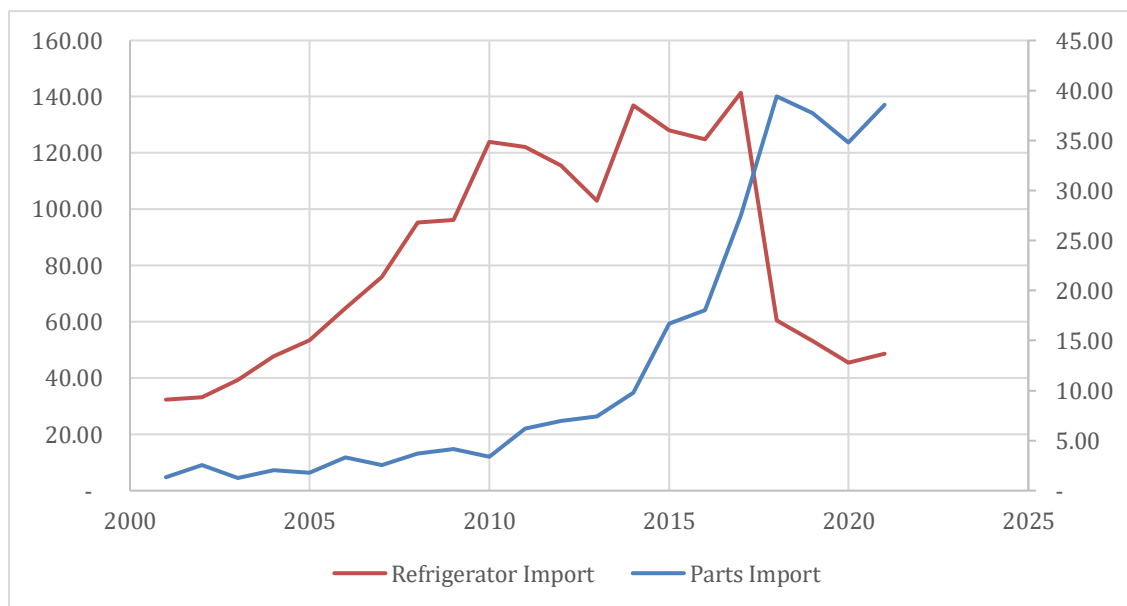
Year	Parts Import (Million USD)	% Change Parts	Refrigerator Import (Million USD)	% Change Refrigerator
2001	1.32		32.34	
2002	2.54	93.32	33.20	2.66
2003	1.26	(50.49)	39.33	18.48
2004	2.06	63.41	47.66	21.16
2005	1.76	(14.42)	53.40	12.05
2006	3.31	87.95	64.80	21.34
2007	2.53	(23.68)	76.02	17.32
2008	3.70	46.49	95.33	25.40
2009	4.15	12.24	96.16	0.87
2010	3.39	(18.52)	123.88	28.83
2011	6.20	83.29	122.12	(1.41)
2012	6.97	12.37	115.50	(5.42)
2013	7.43	6.56	102.95	(10.87)
2014	9.77	31.43	136.91	32.98
2015	16.69	70.94	128.12	(6.42)
2016	18.03	8.04	124.76	(2.63)
2017	27.50	52.48	141.40	13.34
2018	39.41	43.31	60.48	(57.23)
2019	37.75	(4.20)	53.22	(12.00)
2020	34.81	(7.80)	45.45	(14.60)
2021	38.59	10.87	48.55	6.81

Data Source: Global Trade Atlas.

As said before, if we look closely at the data, we can see an increasing trend in import of refrigerator parts. As the import of refrigerator parts increased, naturally the assembling of the parts into refrigerators rose locally, and the import of refrigerators decrease. That is what happened in Bangladesh.

Figure 6: Refrigerator Import vs Parts Import

(Million USD)

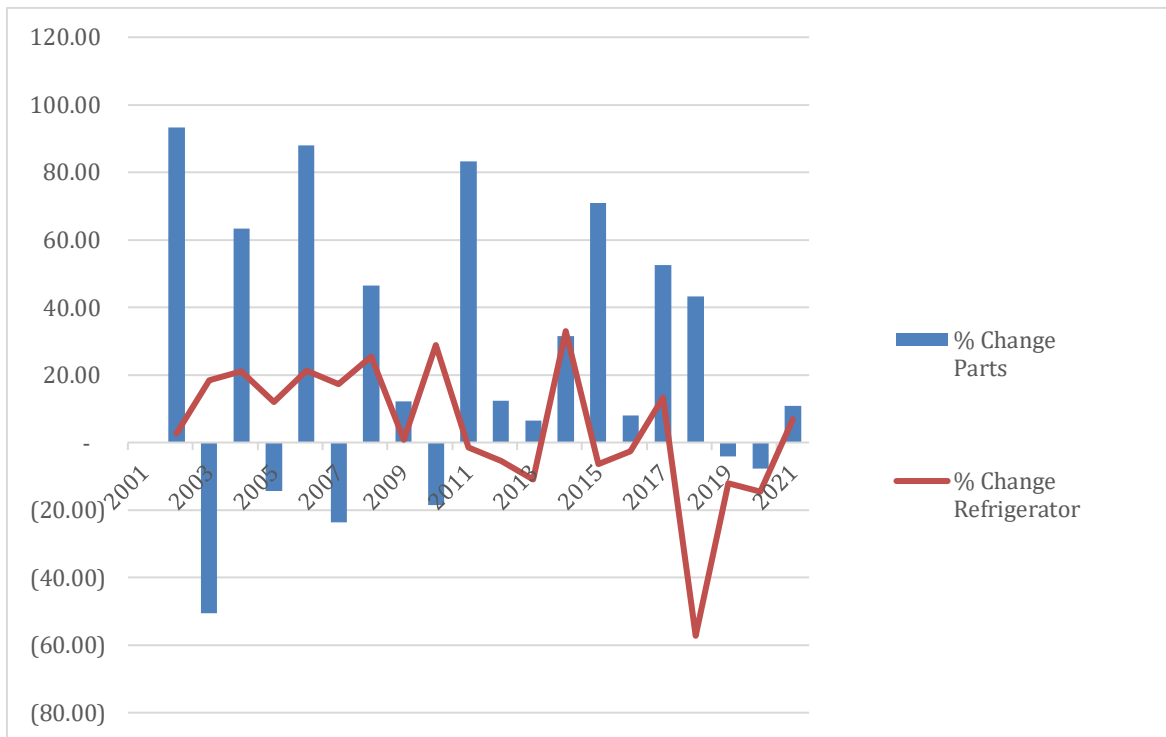


Data Source: Global Trade Atlas.

In the above line chart, we notice a huge jump in Import of Refrigerator Parts during 2017 and 2018. USD 18.03 million worth refrigerator parts were imported in 2016, whereas in 2017 the amount rose to USD 27.50 million, with 52% increase and in 2018 the amount rose to USD 39.41 million, with further 43% increase in import value.

During that period, the import of refrigerators itself shrank down from USD 141.40 million in 2017 to USD 60.48 million in 2018 and it kept on shrinking more in following years.

Figure 7: Percentage change in Parts Import vs Refrigerator Import



Note: The original data is from Global Trade Atlas. The rate of changes was prepared by the author.

Looking at the percentage change in the above diagram, we also notice that during the period 2017-18, parts import rose and held nearly constant in the following years. Whereas for refrigerator import the situation reversed. During 2017-18, there was a steep fall in refrigerator import and it also held nearly constant in the following years.

5. Conclusion

This research report intends to find out the growth prospective of the refrigerator industry of Bangladesh and assess its future prospect in the international market by Global Value Chain (GVC) analysis. It found that the import of refrigerators in Bangladesh has decreased, and at the same time, the import of refrigerator parts has increased significantly. In addition, Bangladesh has also started exporting refrigerators in recent years. This research is significant as it added insights into the steady development of the refrigerator industry as a major part of the machinery industry as well as the growth of the entire economy of Bangladesh.

To make the research insightful for the industrialization of Bangladesh beyond the refrigerator industry, this paper referred to relevant studies based on GVC (Global Value Chain) and the flying geese model which are very appropriate to describe the processes and mechanism of industrialization of any developing country. Although previous studies of GVC and flying geese model are helpful and effective, those on uprising industries in Bangladesh have not been plenty. Therefore, the GVC framework and the flying geese model offered novel and meaningful interpretations of the mechanism of development of the refrigerator industry in Bangladesh. A uniqueness of this research is that the author used tailor-made data of the import and export of refrigerators and its parts for this analysis. More concretely, HS six-digit level trade data was compiled from trade partner countries of Bangladesh since the trade data of Bangladesh does not get released on time. As a result, up-

to-date import and export data became available and used to come to a prospective conclusion regarding the export of Bangladeshi refrigerator.

To assess the purpose of the research, an empirical analysis was conducted, using the above-mentioned data set. The export value of Bangladesh in 2021 was outstanding to that up to previous years and shows a symptom that Bangladesh is becoming a refrigerator exporting country in near future.

The results obtained by this research allow us to have a positive view on the further development of the refrigerator industry of Bangladesh going global and the export of “Made in Bangladesh” refrigerators have onboarded with immense potential. As a new participant in the Global Value Chain the of refrigerator industry, Bangladesh will face challenges such as material sourcing and upgrading to the next level of technological ladders in domestic and global markets. Bangladesh may be able to add new strengths to the global machinery value chain beyond refrigerators sometime soon.

The role of the refrigerator industry in the machinery sector is incredibly significant. The recent drop in refrigerator import, the significant increase in production to cater the domestic market and commence of export in the international market show the growth and potential of the refrigerator market of Bangladesh. Bangladesh is stepping into the next level of the Global Value Chain (GVC) as local companies are upgrading their production capacity and skill for example, Walton has started manufacturing compressors locally. This upgrading indicates the growth of the refrigerator industry and the development of the machinery industry in general.

The support of government in policymaking and implementation has played a vital role in the growth of this industry. The government is still promoting this industry by incentivizing and minimizing duty for the local companies to eliminate dependency on export and to develop international competitiveness. Local consumers have also shown their interest and reliance on local refrigerators for the last decade. This supportive role of government, the enthusiasm of local manufacturing companies, and the support of the domestic users can help the refrigerator industry to become an export-oriented industry in the near future which will create a new window of opportunity for the economy of Bangladesh.

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Appendices

Appendix 1: Refrigerator Parts Imported by year (Amount in USD)

Year	Parts Import (\$)
2001	1,316,183.78
2002	2,544,446.18
2003	1,259,659.55
2004	2,058,471.86
2005	1,761,645.37
2006	3,310,975.53
2007	2,526,837.26
2008	3,701,546.28
2009	4,154,627.43
2010	3,385,060.12
2011	6,204,487.56
2012	6,972,272.55
2013	7,429,975.25
2014	9,765,007.37
2015	16,692,036.33
2016	18,033,987.78
2017	27,498,287.25
2018	39,408,571.58
2019	37,752,878.83
2020	34,809,871.12
2021	38,594,149.56

Source: Global Trade Atlas.

Appendix 2: Refrigerator Exported by year (Amount in USD)

Year	Refrigerator Export
1997	52.00
1998	421.71
1999	19,713.20
2000	6,451.10
2001	95.00
2002	31.00
2003	162.00
2004	650.00
2005	32,363.80
2006	11,273.77
2007	1,477.56
2008	14,285.58
2009	75,955.97
2010	9,237.88
2011	247,407.58
2012	169,344.48
2013	15,486.88
2014	68,246.07
2015	503,999.14
2016	266,729.73
2017	158,681.39
2018	254,451.85
2019	263,567.89
2020	189,314.94
2021	16,441,067.12

Source: Global Trade Atlas.

Appendix 3: Refrigerator Imported by year (Amount in USD)

Year	Refrigerator Import
1990	234,905.85
1991	262,779.36
1992	186,160.99
1993	436,810.72
1994	1,188,634.32
1995	4,508,213.78
1996	9,130,622.38
1997	16,506,296.14
1998	20,786,354.20
1999	27,987,165.69
2000	30,298,684.33
2001	32,338,634.28
2002	33,197,496.41
2003	39,333,001.02
2004	47,656,389.21
2005	53,399,386.34
2006	64,796,494.13
2007	76,018,283.68
2008	95,328,961.35
2009	96,155,446.10
2010	123,876,927.95
2011	122,124,799.08
2012	115,504,750.92
2013	102,950,668.46
2014	136,907,114.29
2015	128,123,106.30
2016	124,759,472.51
2017	141,397,651.55
2018	60,481,142.40
2019	53,222,619.68
2020	45,454,762.00
2021	48,548,937.27

Source: Global Trade Atlas.

Appendix 4: ARIMA Model for Refrigerator Parts Import

Model Fit

Fit Statistic	Mean	SE	Minimum	Maximum	Percentile							
					5	10	25	50	75	90	95	
Stationary R-squared	3.33E-16	-	3.33E-16	3.33E-16	3.33E-16	3.33E-16	3.33E-16	3.33E-16	3.33E-16	3.33E-16	3.33E-16	3.33E-16
R-squared	0.887	-	0.887	0.887	0.887	0.887	0.887	0.887	0.887	0.887	0.887	0.887
RMSE	4737564.23	-	4737564.23	4737564.23	4737564.23	4737564.23	4737564.23	4737564.23	4737564.23	4737564.23	4737564.23	4737564.23
MAPE	32.931	-	32.931	32.931	32.931	32.931	32.931	32.931	32.931	32.931	32.931	32.931
Max APE	154.593	-	154.593	154.593	154.593	154.593	154.593	154.593	154.593	154.593	154.593	154.593
MAE	3058729.58	-	3058729.58	3058729.58	3058729.58	3058729.58	3058729.58	3058729.58	3058729.58	3058729.58	3058729.58	3058729.58
Max AE	12773683.7	-	12773683.7	12773683.7	12773683.7	12773683.7	12773683.7	12773683.7	12773683.7	12773683.7	12773683.7	12773683.7
Normalized BIC	30.892	-	30.892	30.892	30.892	30.892	30.892	30.892	30.892	30.892	30.892	30.892

Appendix 5: Forecast of Refrigerator Parts Import with ARIMA Model

Forecast												
Model	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
Import-Model_1	Forecast	48643889	61310533	77275514	97397703	1.23E+08	1.55E+08	1.95E+08	2.46E+08	3.10E+08	3.90E+08	4.92E+08
	UCL	95780364	1.54E+08	2.31E+08	3.33E+08	4.70E+08	6.52E+08	8.92E+08	1.21E+09	1.63E+09	2.17E+09	2.88E+09
	LCL	21801529	18998580	17779935	17265253	17165726	17355206	17771030	18380689	19168115	20127251	21258781

Note: The original data is from Global Trade Atlas. The Forecast was done by the author. For each model, forecasts start after the last non-missing in the range of the requested estimation period, and end at the last period for which non-missing values of all the predictors are available or at the end date of the requested forecast period, whichever is earlier.