A Framework for Estimating Container Flows:

The Case of Manufacturing Import from China

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Contents

Chapter 1

Introduction

1.1 Motivation to develop a basic framework

Since the enormous growth in the container industry, many container related issues have raised and caught attention. The determination of an adequate investment in container handling capacity, the development of the degree of containerisation, and the port selection are instances of these issues. Studies with regard to container related issues appeared. Due to the complexity of these issues an area established where much room is left for researches. The issues related to the container industry are often complex, because there are many relations of development of factors involved. Many of these issues are driven by the uncertainty with regard to the container growth between regions. It is clear that there is need for models to analyse container growth and other related issues. Models have indeed been developed. What the most of these models have in common is the high level of aggregation with regard to the relations between factors. Although the high level of aggregation is coupled with simplicity and thus provides easily understandable models, many relevant relations are omitted in such models. For instance, P. de Langen and M. Nijdam [30] addressed a model with regard to the growth in container volume on the trade between country *a* and *b*, CT_{ab}, as follows:

$$CT_{ab} = \partial_{ab} * \frac{\left(E_a * GDP_a * DT_{ab}\right)}{VD_{ab}}, \tag{1.1}$$

where ∂_{ab} denotes the containerised share of the trade between *a* and *b*, E_a the export quote of country *a*, GDP_a the GDP of country *a*, DT_{ab} the importance of the importing country as trade partner, and VD_{ab} the value density of the trade between *a* and *b*. The relations in this model are correct and, further, this model provides insight in the major relations behind the establishment of the container volume. However, due to the level of aggregation, relations, that may be useful for analyses of other container related issues, are omitted. Such model lacks, for instance, in analyses about driving forces behind the container growth in terms of the composition of the demand for import and the attractiveness of the export country. Due to the lack of relations of a less aggregated level, there is no room for comprehensive analyses. In this thesis a basic framework will be developed, in which relations at a less aggregated level will be taken into account. The presence of these less aggregated relations will contribute in such a way that a basic framework establishes which can be extended and used for analyses of container growth related issues. To determine what relations to include in the framework, investigations about relations at a less aggregated level are required. For this purpose the containerised manufacturing import from China toward the Hamburg/ Le Havre - port range will be analysed. Data analyses with regard to several trade statistics will be done. In this thesis a basic framework will be developed to locate and investigate analyses about container growth related issues and during this process a better understanding of the NBGF-region's manufacturing import from China will be strived for.

1.2 Economic implication of the development of container flows

To develop the desired basic framework, the containerised manufacturing import from China toward the seaports in the Hamburg/ Le Havre - range (HLH-range) will be used as the basis of the analyses. The HLH-port range consists of ports in Hamburg, Bremen, Wilhelmshaven, Amsterdam, Rotterdam, Dordrecht, Moerdijk, Zeeland, Antwerpen, Gent, Zeebrugge, Duinkerken, Calais, Rouen, and Le-Havre. The major characteristic these ports have in common is the continental hinterland they largely serve. The continental hinterland of a port consists of the areas relatively close to the port from which cargo is transported over land [7]. Ports in HLH-range namely serve the continental hinterland largely formed by Netherlands, Belgium, the west of Germany and the north of France. For convenience this region will be named as the NBGF-region. The import of this region from China will be studied. The cargo handled in seaports is directly related to the volume of goods that is supplied or demanded in the hinterland. One of the major appearances of cargo at ports is container. This is reflected in table 1.1. Container is suitable for transportation of many kinds of freight, in particular for manufactured goods. For Netherlands, Belgium, Germany, and France, manufactured goods take a major part in the total imports value. In 2003 manufactured goods of these countries have shares in the total import value of 71.3%, 77.9%, 70.7%, and 77.7%, respectively [27]. With an increasing international trade of manufacturing, it is not odd that the appearance of containers has occurred as dominant appearance of cargo at seaports.

	Hamburg	Bremen	Wilhelmshaven	Amsterdam	Rotterdam
Dry Bulk	27.8	8.7	2.2	44.6	86.0
Liquid Bulk	11.6	1.9	36.8	13.6	152.5
Containers	64.3	31.8	0	0.7	70.6
Separate pieces of cargo	2.6	6.5	0	6.5	18.7
Total	**106.3**	**49.0**	**39.0**	**65.5**	**327.8**

	Antwerpen	Gent	Zeebrugge	Duinkerken	Le Havre
Dry Bulk	25.9	16.9	1.7	25.8	4.9
Liquid Bulk	35.1	3.0	4.9	13.2	44.6
Containers	61.3	0.2	12.3	1.5	19.0
Separate pieces of cargo	20.4	3.3	11.8	9.5	2.9
Total	**142.9**	**23.5**	**30.6**	**50.1**	**71.4**

Table 1.1. Appearances of cargo in the HLH-port range in 2003 (unit: gross weight x 1 million metric) tons). Source: Port of Rotterdam.

A review of the development of container port demand in the entire HLH-port range was considered by Ocean Shipping Consultants Ltd in 2004 [24]. The total development of container port demands in the entire North European region (including the UK) reached a level of some 31.7 million TEUs, which stands for Twenty feet Equivalent Units, containers in 2000. Table 1.2 summaries the development of North European container port demand by national market within the region.

	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003
000TEUs										
UK	3344.8	4629.6	4985.7	5357.8	5775.2	6224.5	6647.8	6610.5	6907.3	7011.1
France – N	1021.5	1161.4	1197.1	1349.3	1499.2	1622.7	1759.0	1822.4	2025.5	2265.3
Belgium	1794.0	2664.7	2983.3	3322.3	3701.6	4085.0	4600.8	4539.6	5143.8	5841.3
Netherlands	3734.9	4878.1	5107.6	5561.9	6054.6	6396.2	6337.1	6157.9	6575.2	7162.6
Germany - W	3166.8	4408.4	4607.0	5057.4	5392.9	6015.3	7054.7	7721.3	8475.3	9374.6
Total	**13062.0**	**17742.2**	**18880.7**	**20648.7**	**22423.5**	**24343.7**	**26399.4**	**26851.7**	**29127.1**	**31654.9**
Percentage										
UK	25.6	26.1	26.4	25.9	25.8	25.6	25.2	24.6	23.7	22.1
France – N	7.8	6.5	6.3	6.5	6.7	6.7	6.7	6.8	7.0	7.2
Belgium	13.7	15.0	15.8	16.1	16.5	16.8	17.4	16.9	17.7	18.5
Netherlands	28.6	27.5	27.1	26.9	27.0	26.3	24.0	22.9	22.6	22.6
Germany - W	24.2	24.8	24.4	24.5	24.1	24.7	26.7	28.8	29.1	29.6
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Table 1.2. The UK/North Continent Lo-Lo Container Port Handling Market 1990/2003. Source: Ocean Shipping Consultants.

‘Lo-Lo’ refers to containers handled by grand cranes and excludes roll-on, roll-off container movements. Between 1995 and 2003 total container volumes handled doubled, with this equating to an annual average growth rate of some 7.5%. The globalisation of trade has been at the centre of this trend and containerisation, referring to the phenomenon that more and more goods are transported with containers, has benefited from these developments. In [24] three categories of container movement are identified, which have each recorded distinct development over the last years:

- Deep-sea container movements include all direct container shipments between the European markets and other world trading regions.

- Transhipment and relay handlings constitute container movements- either as part of regional ‘hub and spoke’ distribution or as a relay operation between deep-sea services.

- Intra-Europe container handling is generated by direct shipments between European markets and is sometimes undertaken at dedicated ‘short-sea’ container terminals.

Reflected from table 1.3, where an overview analysis of the development of North Continent container volumes in terms of type is shown, with regard to deep-sea and transhipment volumes, the enormous growth in container port demand can be related to the increased level of trade between Europe and distant economies.

	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003
000TEUs										
Deep-sea	5502.7	7290.6	7772.6	8314.6	8974.1	9601.0	10383.0	10572.4	11206.0	12439.0
Transship./Relay	1973.2	3192.2	3342.9	3795.8	4201.2	4702.5	5184.1	5389.1	6140.1	6963.7
Inter-Europe	2241.2	2629.8	2779.5	3180.4	3473.0	3815.6	4184.5	4279.7	4873.6	5241.1
Total	**9717.1**	**13112.6**	**13895.0**	**15290.8**	**16648.3**	**18119.1**	**19751.6**	**20241.2**	**22219.7**	**24643.8**
Percentage										
Deep-sea	56.6	55.6	55.9	54.4	53.9	53.0	52.6	52.2	50.4	50.5
Transship./Relay	20.3	24.3	24.1	24.8	25.2	26.0	26.2	26.6	27.6	28.3
Inter-Europe	23.1	20.1	20.0	20.8	20.9	21.1	21.2	21.1	21.9	21.3
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Table 1.3. North Continent Container Port Market by type 1990/2003. Source: Ocean Shipping Consultants

It is clear that container related activities have grown. Container ports constitute an essential part of the international network of production and consumption. They form an important part in the supply chain. Many actors are directly or indirectly involved in the consequences of the container growth development. To analyse a seaport, three perspectives can be distinguished. De Langen and Nijdam [7] mentioned them as follows:

1. a transport node, as a part of a transport and logistics chain.
2. a cluster, referring to a collection of economic activities directly or indirectly related to the arrival of goods and transport mode, including ships.
3. an arena, referring to a node where actors exchange cargo, capital, information, ideas and emotions. The focus is on entrepreneurship, organising capacity and the interaction of various actors.

Depending on the perspective applied, a wide range of actors can be identified. However, irrespectively of which perspective is applied, the actors and their businesses are directly or indirectly influenced by the amount of cargo arrived at the ports. Arisen issues from this context various actors concern are, for instances, port performance management, process optimization, strategic benchmarking, pricing and tariffs, and port governance. These issues and many others are highly related to the container growth. It is necessary to have good understanding of the establishment of the container growth.

1.3 Delimitation

As announced in section 1.1, in this thesis a framework will be developed, which forms a basis for further investigations about container growth related issues. The aim is to include relations between determinants of container growth from a certain aggregation level. For this purpose analyses of trade statistics will be done to determine what relations to include in this framework. The container flows from China to the HLH-port range will be used to develop the desired framework. In this perspective the NBGF-region is seen as the continental hinterland of the HLH-port range. The container flows from China toward this port range are largely determined by the cumulative demand of the NBGF-region for containerised goods from China. Transhipment related issues are omitted from the thesis. To include China as export country is due to its significant role in the container growth. As Wei addressed [10], China took account of over 50% of market share of the container trades from Asia to Europe in 2003. The overwhelming growth of the Chinese economy in the last decades has lead to structural changes in demand for container related activities. Although much kind of commodities can be transported with containers, it is a fact that namely manufactured goods are transported with containers. The development of containerisation itself and the containerisation of different kind of commodities are very interesting. However, these issues will not be studied comprehensively in this thesis. For the development of the basic framework only analyses of manufacturing trade will be taken into account. Nevertheless, once the framework is established, it provides room to include investigations about containerisation related issues. Due to the significant role of manufactured goods in the container business, the NBGF-region's import of manufactured goods from China will get particular attention and it will be used to develop the desired framework.

1.4 Research questions

The aim of the thesis is to develop a framework to provide a basis for further investigations about container growth related issues. Various relations contributing to a better understanding of the container growth will be analysed during the process of the development of the framework, both quantitatively and qualitatively. For this purpose the import of the NBGF-region from China with regard to the manufactured goods will be examined. Analyses of the several trade statistics will be done. With regard to the aim of the thesis several research questions are defined. With these questions the analyses can be arranged conveniently. During the analyses the desired framework will be developed by stepwise extensions of relevant findings.

In this thesis for analyses of the trade, a distinction is made based on the demand side and supply side. In the context of manufacturing import of the NBGF-region from China, the NBGF-region and China are respectively seen as the demand and supply side. The first research question concerns the demand side and will be addressed is as follows:

1. What is the nature of the demand for manufacturing import and the composition with regard to this demand?

The aim of this question is to determine relevant components about the demand to be included in the basic framework. The second research question has to do with the supply side, China, and it has been formulated as follows:

2. What are the motivations to import from China and the composition of the imported manufactured goods?

This question is addressed to examine in which way the desired framework include the development of the supply side, in other words, the export country. With these two research questions analyses about the trade will be done. The next research question to be addressed concerns with the link between trade and growth in container flows:

3. How can the link between trade and container flows be addressed?

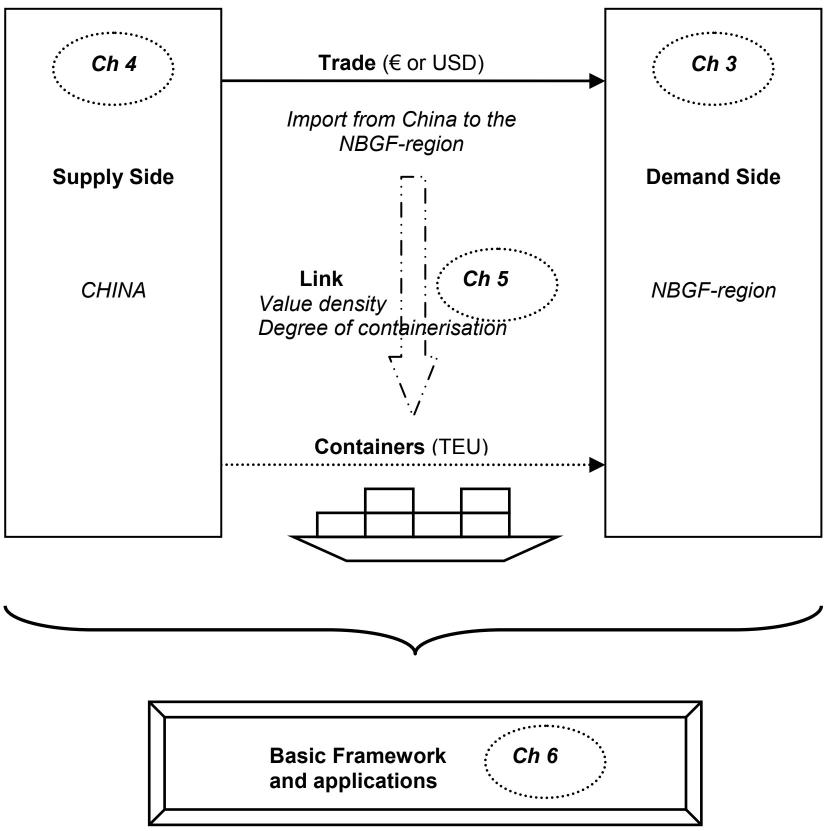
The findings by addressing these three questions provide components for the desired basic framework. The following research question shifts the attention back to the aim of this thesis.

4. How can the findings obtained in the analyses be brought together in a basic framework and what are the possible applications of the framework?

1.5 Methodology

While many studies have appeared that point out the importance of the awareness about the increasing container growth, the related issues to this growth, and the complexity involved in the container growth related issues, there are hardly studies that structure and locate the relations between the relevant factors with regard to the container growth explicitly. This is remarkable, since the rising container related issues are crying out for well developed advanced models and the development of such models requires basic models that have structured and located the relations between the relevant factors explicitly. The lack of these basic models makes the thesis unique. As mentioned, the main goal of the thesis is to develop a basic framework for further investigations about container growth related issues. The thesis strives for the development of a framework including relevant aspects in relation to the establishment of the container growth. The framework includes the supply and demand side of the import trade and the link between trade and container flows. Several statistics will be analysed. Based on analyses of trade statistics, in particular manufacturing trade statistics with regard to the NBGF-region's import from China, the desired framework will be developed. In Chapter 2 attention is paid to the descriptions of the most important used data sources and the applied classifications.

Fig. 1.1. Illustration of the methodology with regard to the development of the basic framework



To arrange the analyses conveniently research questions are formulated. The research questions addressed in section 1.4 functions as guideline for the development of the desired framework. The methodology with regard to the development of the desired framework is illustrated in figure 1.1. Container flows between two regions are derived from the trade between these regions. To get understanding of the container flows, firstly, the establishment of the trade should be taken into account. Chapter 3 and 4 concern the establishment of the NBGF-region's demand with regard to the manufacturing import from China. The distinction between the demand and supply side is made. The NBFG-region is considered as the demand side and China as the supply side. Analyses of these two regions provide better understanding of the relations involved in the establishment of the manufacturing trade. After Chapter 3 and 4, the attention will be shifted to the link between trade and the container flows. In this light, issues like value density and containerised share of the trade get attention. Together with all the findings an overall view, which includes the establishment of the import trade and its relation to the container flows, is formed. The framework arisen from the findings provides a basis to analyse several container growth related issues. Chapter 6 pays attention to possible applications of this framework.

1.6 Outline of the thesis

Chapter 2 describes the main data sources and the classifications applied for industries and manufactured goods. In Chapter 3 and 4 the first and second research question are discussed respectively. The NBGF-region as demand side and China as supply side will be analysed. In Chapter 5 attention will be paid to the third research question, which concerns with the link between trade and growth in container growth. The developed basic framework will be presented in Chapter 6. Possible applications of the framework will be taken into account also. Conclusions and issues for future research will be discussed in Chapter 7.

Chapter 2

Description of Classifications and Data Sources

The aim of the thesis is to settle a basic framework to model container growth and to locate and investigate container growth related issues. Based on analyses of trade statistics, in particular manufacturing trade statistics with regard to the NBGF-region's import from China, the desired framework will be developed. During the analyses several data sources, in which classifications of industries and manufactured goods are applied, will be used. This chapter pays attention to the data sources and the classifications applied for industries and manufactured goods.

2.1 Classifications of industries and manufactured goods

In practice different classification methods have been applied for industries and goods. This thesis deals with data sources that apply the International Standard Industrial Classification Revision 3 (ISIC Rev. 3), the STAN industry list and the Harmonized System Codes Commodity Classification Revision 1 (HS Code Rev. 1).

2.1.1 International Standard Industrial Classification (ISIC)

The International Standard Industrial Classification is a classification of economic activities. In this thesis revision 3 of the ISIC is applied. This classification of economic activities is arranged so that entities can be classified according to the activity they carry out. The categories of ISIC at the most detailed level are delineated according to what is in most countries the customary combination of activities described in statistical units. The major groups and divisions, the successively broader levels of classification, combine the statistical units according to the character, technology, and organization and financing of production. Wide use has been made of ISIC, both nationally and internationally, in classifying data according to kind of economic activity in the fields of population, production, employment, gross domestic product and other economic activities. Table 2.1. shows the major groups and divisions of economic activities according to the ISIC Rev.3.

Table 2.1. The major groups and divisions of economic activities according to the ISIC Rev.3.

The major groups and divisions of economic activities according to ISIC Rev.3
A - Agriculture, hunting and forestry
01 - Agriculture, hunting and related service activities
02 - Forestry, logging and related service activities
B - Fishing
05 - Fishing, operation of fish hatcheries and fish farms; service activities incidental to fishing
C - Mining and quarrying
10 - Mining of coal and lignite; extraction of peat
11 - Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction excluding surveying
12 - Mining of uranium and thorium ores
13 - Mining of metal ores
14 - Other mining and quarrying
D - Manufacturing
15 - Manufacture of food products and beverages
16 - Manufacture of tobacco products
17 - Manufacture of textiles
18 - Manufacture of wearing apparel; dressing and dyeing of fur
19 - Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
20 - Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
21 - Manufacture of paper and paper products
22 - Publishing, printing and reproduction of recorded media
23 - Manufacture of coke, refined petroleum products and nuclear fuel
24 - Manufacture of chemicals and chemical products
25 - Manufacture of rubber and plastics products
26 - Manufacture of other non-metallic mineral products
27 - Manufacture of basic metals
28 - Manufacture of fabricated metal products, except machinery and equipment
29 - Manufacture of machinery and equipment n.e.c.
30 - Manufacture of office, accounting and computing machinery
31 - Manufacture of electrical machinery and apparatus n.e.c.
32 - Manufacture of radio, television and communication equipment and apparatus
33 - Manufacture of medical, precision and optical instruments, watches and clocks
34 - Manufacture of motor vehicles, trailers and semi-trailers
35 - Manufacture of other transport equipment
36 - Manufacture of furniture; manufacturing n.e.c.
37 - Recycling
E - Electricity, gas and water supply
40 - Electricity, gas, steam and hot water supply
41 - Collection, purification and distribution of water
F - Construction

45 - Construction
G - Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods
50 - Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel
51 - Wholesale trade and commission trade, except of motor vehicles and motorcycles
52 - Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods
H - Hotels and restaurants
55 - Hotels and restaurants
I - Transport, storage and communications
60 - Land transport; transport via pipelines
61 - Water transport
62 - Air transport
63 - Supporting and auxiliary transport activities; activities of travel agencies
64 - Post and telecommunications
J - Financial intermediation
65 - Financial intermediation, except insurance and pension funding
66 - Insurance and pension funding, except compulsory social security
67 - Activities auxiliary to financial intermediation
K - Real estate, renting and business activities
70 - Real estate activities
71 - Renting of machinery and equipment without operator and of personal and household goods
72 - Computer and related activities
73 - Research and development
74 - Other business activities
L - Public administration and defence; compulsory social security
75 - Public administration and defence; compulsory social security
M - Education
80 - Education
N - Health and social work
85 - Health and social work
O - Other community, social and personal service activities
90 - Sewage and refuse disposal, sanitation and similar activities
91 - Activities of membership organizations n.e.c.
92 - Recreational, cultural and sporting activities
93 - Other service activities
P - Private households with employed persons
95 - Private households with employed persons
Q - Extra-territorial organizations and bodies
99 - Extra-territorial organizations and bodies

All these groups and division can be clustered as various industries according to a code system. One of such code systems is the code system in the STAN database.

2.1.2 Structural Analysis (STAN) database

The STAN database provides data for analysing industrial performance at a relatively detailed level of activity across countries. It includes annual measures of output, labour input, investment and international trade. An important feature of STAN is the use of a standard industry list for all countries to facilitate international comparisons. ISIC activities are clustered at several detailed levels. Table 2.2 depicts the STAN industry list at a top level.

Table 2.2. STAN industry list at a top level.

Top level Industries	(ISIC Rev. 3)
Agriculture, hunting, forestry and fishing	01-05
Mining and quarrying	10-14
Total manufacturing	15-37
Electricity, gas and water supply	40-41
Total services	50-99

With regard to manufacturing, in this thesis clustering at the aggregated manufacturing level is applied. Within the ISIC Rev. 3 divisions 15 to 37 concern manufacturing activities. According to the code system of the STAN industry list these divisions and their outputs can be clustered in aggregated manufacturing groups as shown in table 2.3. For convenience these groups are denoted by letters in the thesis.

Table 2.3. STAN industry list of aggregated manufacturing groups.

GROUP	(ISIC Rev. 3)	DESCRIPTION
A	15-16	Food products, beverages and tobacco
B	17-19	Textiles, textile products, leather and footwear
C	20	Wood and products of wood and cork
D	21-22	Pulp, paper, paper products, printing and publishing
E	23-25	Chemical, rubber, plastics and fuel products
F	26	Other non-metallic mineral products
G	27-28	Basic metals and fabricated metal products
H	29-33	Machinery and equipment
I	34-35	Transport equipment
J	36-37	Manufacturing nec; recycling

2.1.3 Harmonized Commodity Coding System Classification (HS Code)

The Harmonized Commodity Coding System is intended to serve as a universally accepted classification system for goods, so that countries can administer customs programs and collect trade data on exports and imports. It was developed under the auspices of the World Customs Organization (WCO) [37]. The existence of a common classification system is important for tracking trade and applying tariffs. The Harmonized System is a commodity classification system, in which articles are grouped. The articles are largely grouped, according to the nature of the materials of which they are made. The Harmonized System contains approximately 5000 headings and subheadings covering all articles in trade. These provisions are organized in 96 chapters arranged in 21 sections which, along with the interpretive rules and legal notes to the chapters and sections, form the legal text of the Harmonized System. The basic Harmonized System uses a 6-digit number to identify basic commodities. Each country is allowed to add additional digits for statistical purposes. The basic six digits code is made of three parts. The first two digits identify the chapter the goods are classified in. The next two digits identify the groupings within that chapter, followed by another two digits that identify the groupings more specifically. In this thesis the first two digits of the Harmonized System are used in the analyses with regard to the value density.

2.2 Data sources

To examine the import of the NBGF-region, in particular from China, several data sources are used. The most important ones are the Bilateral Trade Database (BTD), the OECD Input-Output Database (edition 2002), the External Trade Database of the EuroStat, the China-Customs Statistics and the statistics from the Central Bureau of Statistics in the Netherlands.

2.2.1 Bilateral Trade Database (BTD)

The STAN Bilateral Trade Database (BTD) is compiled by the Economic Analysis and Statistics Division (EAS) of the Directorate for Science, Technology and Industry (STI) within the Organisation for Economic Co-operation and Development (OECD). This database is designed to provide information on exports and imports of goods in OECD countries, broken down by partner country and by economic activity. The version used is edition 2005 of the BTD [29]. For this edition of BTD, data are provided for 30 OECD countries. The Netherlands, Belgium, Germany, and France, are included in these countries. For each of these countries, the trade with 48 partner countries and geographical regions is presented. China is included in the database as one of these partner countries. This database uses a STAN industry list, which is described in section 2.1.2. Imports and exports are grouped according to the country of origin and the country of destination of the goods. The values are presented in USD. The data are converted from product classification, namely HS Code, to activity classifications, using a standard conversion key provided by the OECD. In the thesis the Bilateral Trade Database is mainly used in analyses with regard to the changing composition of the import trade toward the NBGF-region and the comparison of the import composition of several regions toward the NBGF-region.

2.2.2 OECD Input-Output Database

The Input-output tables [38] provide a tool where individual cells of matrices (i x j) show the flow of different intermediate products to individual industries. Each column depicts the deliveries of intermediate products from industry j to industry i, X_{ij}. Details on the concepts can be found from the System of National Accounts, available at [39]. Chapter 15 of [39] provides a good explanation of input-output tables. In the thesis the OECD input-output tables are used to obtain insight in the nature of the demand for manufacturing import. To do this, investigations about the different uses and import rates of several manufactured goods among industries are done in Chapter 3.

2.2.3 External Trade Database

The statistics in the external trade database of the EuroStat cover all goods exchanged by the EU Member States with some 250 trading partner countries (extra-EU trade) and between EU Member States (intra-EU trade). It provides access to both recent and historic data from the EU Member States and to statistics of a significant number of third countries. Information on extra-EU trade is collected by the Member States from the statistical copy of the customs declaration. The imported and exported goods are presented according to the HS Code Commodity System. The statistics used in the thesis concern yearly import data from 1995 to 2004, with regard to the NBGF-region's import from China. The values are expressed in euro, quantity in tonnes and, for some products, quantity may be expressed in other units (items, pairs, hectolitres, etc.). The External Trade Database will be used to examine the value-density of the imported goods in Chapter 5.

2.2.4 China-Customs Statistics

The China-Customs Statistics provide information about all maritime export goods from China to the Netherlands, Belgium, Germany and France (NBGF-region). The statistics concern yearly data from 1992 to 2004. The goods are presented according to the HS Code system. In relation to the goods the values are expressed in USD and quantity in tonnes. For some goods, quantity is expressed in other units (items, pairs, hectolitres, etc.). In the thesis both the China-Customs Statistics and the External Trade Database will be used to examine the value-density of the imported goods.

2.2.5 Central Bureau of Statistics

The Central Bureau of Statistics in the Netherlands provides statistics about container traffic between China and the Netherlands with regard to the amount of containers, expressed in TEU, and weight of the containerised cargo. These statistics are used to get insight in the degree of containerisation of the trade. In the following chapters analyses are done mainly basing on the data sources addressed in this chapter.

Chapter 3

The Demand Side: NBGF-region

Since the demand from the NBGF-region for manufactured goods from China has a significant contribution to the driving force behind the container inflows from China toward this region, a good understanding of the nature of this demand is useful. Hereby the structure of the economy, from which this demand is arisen, has to be taken into account. At the end of this chapter understanding with regard to the motivations for manufacturing import and the composition of the demand is strived for. Respectively, section 3.1 and 3.2 concern the motivations for manufacturing import and the composition of the demand.

3.1 Theoretical background of the demand side

With regard to the NBGF-region's import, it is necessary to pay attention to the issues of de-industrialisation and de-location within this region. De-industrialization and de-location are closely related to the development of and the motivation to import.

3.1.1 De-industrialisation

The degree to which de-industrialization takes place reflects a region's economy structure, which influences the development of the demand for import of this region. There is a structural transformation of economy taking place in the NBGF-region. With regard to the development of the economy in the NBGF-region and also in the EU, the European Commission is believed to be facing the process of de-industrialisation [31]. In [31] the EU describes de-industrialisation as a process of structural change of the economy. It is the long-term and not cyclical decline of the manufacturing sector. This implies an absolute decline in employment, production, profitability and capital stock in the manufacturing sector, as well as an absolute decline in exports of manufactured goods and the emergence of persistent manufacturing trade deficits due to the relatively increased import of manufactured goods. However, it should be noticed that absolute de-industrialisation could be distinguished from relative de-industrialisation. The latter is the decline in the share of manufacturing in GDP. This is also a long-term process that reflects the rapid growth in productivity in manufacturing, the consequent increases in real incomes and the rising demand for the output of the service sectors. Under these conditions the decline in the share of manufacturing in GDP reflects a process of structural change towards a service-dominated economy. On the basis of available data the European Commission states [31] that there is no compelling evidence that Europe is undergoing de-industrialisation in an absolute sense. Only a process of relative de-industrialisation, thus not an absolute de-industrialisation, has been taking place in the EU throughout history. Further, the European Commission states that, inevitability, the share of manufacturing in national income and employment will follow a trend decline.

3.1.2 De-localization

Generally the process of de-industrialisation is coupled with the process de-location. De-localization concerns the transfer of production and of other manufacturing activities to locations outside the home country. De-localization has already taken place within and outside the EU and reflects the changing comparative advantage of different locations. Clearly, better cost conditions abroad will inevitably attract industries that are unable to produce in the high-wage environment of modern industrial economies like the NBGF-region. In general de-localisation has been limited to low technology, labour-intensive activities. However, the development of further de-location of other activities is still uncertain and it will be determined by among other things, including the future development of the comparative cost conditions.

3.1.3 Specialization

From above, it is clear that to stay competitive internationally the NBGF-region has to be aware of its own comparative advantage. When comparative advantage for a certain economic activity is missed, import will be considered. The NBGF-region retains and creates jobs that are human capital– and technology–intensive and characterised by high productivity and correspondingly high real wages. The retention and creation of jobs in service areas such as design, marketing and distribution, are reflections of the changing specialization strengthening the service sector.

3.1.4 Linkage with import

The European Commission concluded in [31] that the continuing structural transformation of economies within the NBGF-region, with an ever increasing role for the services sector, is economically inevitable. With this process of de-industrialisation, the process of de-localisation and other adjustments like specialization following the comparative advantage are bound to come. All these processes together determine the structure of the total economy and, in particular, the share of the demand of this economy for manufacturing, which will be imported. This can be denoted as follows:

IR = f (*degree of de-industrialisation, degree of de-location, degree of specialization according comparative advantage, et al.*)

The import rate is dimensionless and denoted by IR, where $0 \leq IR \leq 1$. The total use of manufactured goods in value, TUM, and the share of it that is imported, *IR*, determine the total demand for manufacturing import, TDMI, as follows:

$$TDMI = TUM * IR. \qquad (3.1)$$

With respect to these relations the following can be stated:

TDMI = f (*degree of de-industrialisation, degree of de-location, degree of specialization according comparative advantage, et al.*)

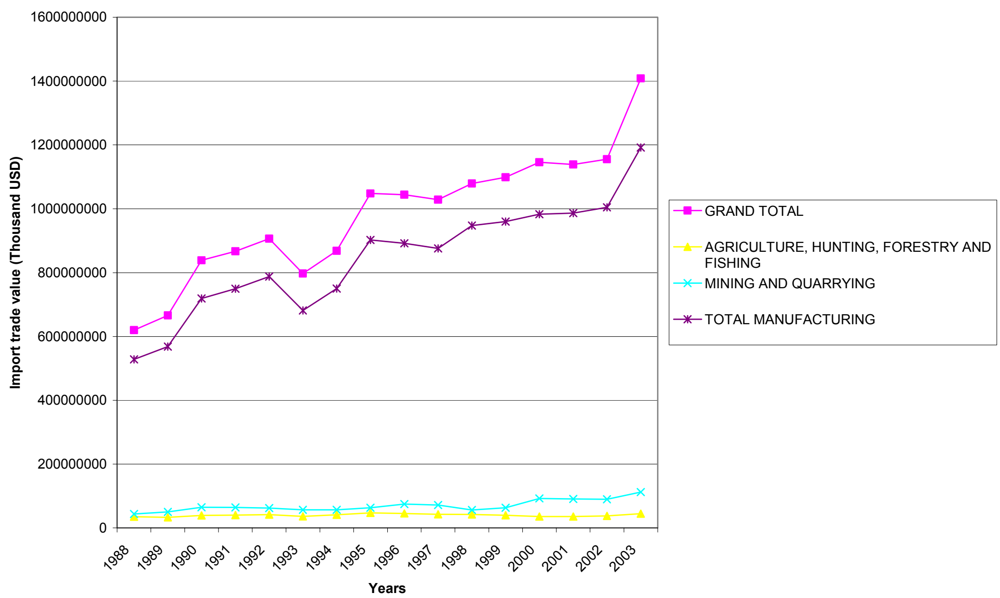
3.2 Composition of the Total Demand for Manufacturing Import (TDMI)

Economic activities can be classified in groups according to the STAN industry list. The consumption of the manufactured goods and the import rate of this consumption differ among the industries defined by the STAN industry list. This is examined based on a certain level of classification of industries. The examination about the differences among industries regarding to the import rate and total consumption of manufactured good are done with the national input/output matrices composed by the Organisation for Economic Co-operation and Development (OECD Input-Output Database, edition 2002). However, national input/output matrices are not available for all countries and for all years. The examination of different uses and import rates of manufactured goods among industries is restricted by availability of data. There are relatively more available data about the Netherlands. In the OECD Input-Output Database of edition 2002 the Dutch national input/output matrices are available from 1995 to 1998 versus the availability of the national input/output matrices of Germany and France for only 1995. Therefore, the findings about the differences are mainly based on the national input/output matrices of the Netherlands. It is assumed that the development of structural transformation of economies in the Netherlands is representative to the rest of the NBGF-region, which refers to Belgium, Germany, and France.

3.2.1 Increasing manufacturing import

Generally NBGF-region's import from the world has only been increasing. Figure 3.1 depicts the increasing import from 1988 to 2003 [29]. The large share of manufacturing in the total import value is remarkable. The NBGF-region's increased degree of de-industrialisation and de-location can partly be indicated with the increasing amount of manufacturing import.

Fig. 3.1. The NBGF-region's import trade value from the world



3.2.2 TDMI constituted by different use and import rate of manufactured goods among industries and non-industries

The degree of de-industrialisation, de-location and other adjustments like specialization as consequences of the continuing structural transformation of economies influence various industries within the region. Each industry has it own operational structure. This structure determines the required amount of manufactured goods and the part of it, which will be imported. Table 3.1 shows the top-15 industries in the Netherlands, arranged by the use of manufactured goods [38]. It reflects the different demand for manufactured goods among various industries. The total use of manufactured goods is constituted by various industries.

Table 3.1. Top-15 industries in the Netherlands, arranged by the use of manufactured goods.

Industries	ISIC Rev.3	Use of Manufacturing (millions euro)
FOOD PRODUCTS, BEVERAGES AND TOBACCO	15-16	51505
CHEMICAL, RUBBER, PLASTICS AND FUEL PRODUCTS	23-25	45091
CONSTRUCTION	45	24354
MACHINERY AND EQUIPMENT	29-33	22481
AGRICULTURE, HUNTING, FORESTRY AND FISHING	01-05	15985
BASIC METALS AND FABRICATED METAL PRODUCTS	27-28	14583
WHOLESALE AND RETAIL TRADE; REPAIRS	50-52	13587
PULP, PAPER, PAPER PRODUCTS, PRINTING AND PUBLISHING	21-22	12593
TRANSPORT EQUIPMENT	34-35	11595
ELECTRICITY, GAS AND WATER SUPPLY	40-41	10987
TRANSPORT AND STORAGE	60-63	6128
OTHER BUSINESS ACTIVITIES	74	6047
OTHER COMMUNITY, SOCIAL AND PERSONAL SERVICES	90-93	5419
HOTELS AND RESTAURANTS	55	5370
HEALTH AND SOCIAL WORK	85	4509

Besides differences in use, there are different import rates of manufactured goods among industries noticed also. This is reflected from table 3.2 [38].

Table 3.2. Top-15 industries in the Netherlands, arranged by the import rate of manufactured goods.

Industries	ISIC Rev.3	Import rate
AGRICULTURE, HUNTING, FORESTRY AND FISHING	01-05	6,38
ELECTRICITY, GAS AND WATER SUPPLY	40-41	5,93
EDUCATION	80	4,28
FINANCE, INSURANCE	65-67	3,64
REAL ESTATE ACTIVITIES	70	3,09
RENTING OF MACHINERY AND EQUIPMENT	71	2,98
COMPUTER AND RELATED ACTIVITIES	72	2,95
PUBLIC ADMIN. AND DEFENCE; COMPULSORY SOCIAL SECURITY	75	2,78
HOTELS AND RESTAURANTS	55	2,75
RESEARCH AND DEVELOPMENT	73	2,60
OTHER BUSINESS ACTIVITIES	74	2,51
FOOD PRODUCTS, BEVERAGES AND TOBACCO	15-16	2,50
CONSTRUCTION	45	2,26
MINING AND QUARRYING	10-14	2,13
OTHER NON-METALLIC MINERAL PRODUCTS	26	2,13

The top-15 industries in the Netherlands, arranged by the import rate of manufactured goods, are shown. The revealed differences in imported rate and use of (different) manufactured goods among industries reflected the different operational structure of industries. Furthermore, these operational structures change and, in this way, the demand for manufacturing from various industries and the related import rates change also. Therefore, in relation to the development of the total demand for manufacturing import, the development of the use of manufactured goods and import rate per industry should be aware of. Derived from these findings, eq. 3.1 is extended. The total demand for manufacturing import trade value by industries in region *m*, $TDMI^{m}_{industries}$, is determined as follows:

$$TDMI^{m}_{industries} = \sum_{k=1}^{K} TUM^{m,k} * IR^{m,k} \qquad \textbf{(3.2)}$$

The total number of industries is denoted by *K*, where *k* = 1,…,*K*. The value of *K* is dependent on the classification of industries used. Further, it is necessary to remark that the total demand for manufacturing import is not only constituted by demand from industries. There is a group of consumers that do not belong to industries. According to the classification within the OECD Input-Output Database (edition 2002), this group includes the following parties; Households Final Consumption (HHFC), Non-Profit Institutions Serving Households (NPISH), General Government Final Consumption (GGFC), Inventories in general (INV), Direct Export (DE), and Gross Fixed Capital Formation (GFCF). Combining the demand for manufacturing import from this group with eq. 3.2, the equation can be extended to determine the total demand for manufacturing import in region *m* as follows:

$$TDMI^{m} = TDMI^{m}_{industries} + TDMI^{m}_{non-industries} \qquad \textbf{(3.3),}$$

where

$$TDMI^{m}_{non-industries} = \sum_{n=1}^{N} TUM^{m,n} * IR^{m,n} \qquad \textbf{(3.4).}$$

The total number of parties in the group of non-industries is denoted by *N*, where n = 1,…,*N*. From equations above, the following can be addressed:

$$TDMI^{m} = \sum_{k=1}^{K} TUM^{m,k} * IR^{m,k} + \sum_{n=1}^{N} TUM^{m,n} * IR^{m,n} \quad \text{(3.5)}.$$

The total demand for manufacturing import is determined by the cumulative use of manufactured goods and different import rates among the industries and non-industries in region *m*.

3.2.3 Demand for aggregated manufacturing groups among various industries and non-industries

So far, the manufactured goods with regard to the use and the import rate are examined as one group. Using the STAN industry list manufactured goods can be grouped in aggregated manufacturing groups.

Table 3.3. Different use and import rates of the aggregated group of textiles, textile products, leather and footwear among twenty-nine industries in 1995.

Industries	ISIC Rev.3	Import value (millions euro)	Use of Manufacturing (millions euro)	Import rate
AGRICULTURE, HUNTING, FORESTRY AND FISHING	01-05	50	68	0,73
MINING AND QUARRYING	10-14	9	13	0,68
FOOD PRODUCTS, BEVERAGES AND TOBACCO	15-16	103	129	0,80
TEXTILES, TEXTILE PRODUCTS, LEATHER AND FOOTWEAR	17-19	1905	2586	0,74
WOOD AND PRODUCTS OF WOOD AND CORK	20	9	13	0,69
PULP, PAPER, PAPER PRODUCTS, PRINTING AND PUBLISHING	21-22	151	185	0,82
CHEMICAL, RUBBER, PLASTICS AND FUEL PRODUCTS	23-25	171	221	0,77
OTHER NON-METALLIC MINERAL PRODUCTS	26	23	31	0,75
BASIC METALS AND FABRICATED METAL PRODUCTS	27-28	22	35	0,63
MACHINERY AND EQUIPMENT	29-33	30	58	0,52
TRANSPORT EQUIPMENT	34-35	8	16	0,51
MANUFACTURING NEC; RECYCLING	36-37	346	459	0,75
ELECTRICITY, GAS AND WATER SUPPLY	40-41	4	8	0,51
CONSTRUCTION	45	43	76	0,56
WHOLESALE AND RETAIL TRADE; REPAIRS	50-52	421	769	0,55
HOTELS AND RESTAURANTS	55	61	71	0,86
TRANSPORT AND STORAGE	60-63	124	158	0,78
POST AND TELECOMMUNICATIONS	64	57	69	0,83
FINANCE, INSURANCE	65-67	20	28	0,71
REAL ESTATE ACTIVITIES	70	6	16	0,38
RENTING OF MACHINERY AND EQUIPMENT	71	2	5	0,38
COMPUTER AND RELATED ACTIVITIES	72	3	3	1,00
RESEARCH AND DEVELOPMENT	73	0	1	0,00
OTHER BUSINESS ACTIVITIES	74	67	92	0,73
PUBLIC ADMIN. AND DEFENCE; COMPULSORY SOCIAL SECURITY	75	122	169	0,72
EDUCATION	80	2	8	0,28
HEALTH AND SOCIAL WORK	85	157	192	0,82
OTHER COMMUNITY, SOCIAL AND PERSONAL SERVICES	90-93	101	124	0,82
PRIVATE HOUSEHOLDS WITH EMPLOYED PERSONS & EXTRA TERRITORRIAL ORGANISATIONS AND BODIES	95-99	0	0	n/a

When the examination of the use and import rate done above is applied to groups of manufactured goods, classified according to the aggregated manufacturing groups, within an industry differences in use and import rates occur with regard to the aggregated manufacturing groups [38]. This can be reflected from table 3.3 and 3.4. Table 3.3 and 3.4 show respectively the different use and import rates of the aggregated group of textiles, textile products, leather and footwear, and the aggregated group of machinery and equipment.

Table 3.4. Different use and import rates of the aggregated group of machinery and equipment among twenty-nine industries in 1995

Industries	ISIC Rev.3	Import value (millions euro)	Use of Manufacturing (millions euro)	Import rate
AGRICULTURE, HUNTING, FORESTRY AND FISHING	01-05	418	996	0,42
MINING AND QUARRYING	10-14	441	742	0,59
FOOD PRODUCTS, BEVERAGES AND TOBACCO	15-16	955	1322	0,72
TEXTILES, TEXTILE PRODUCTS, LEATHER AND FOOTWEAR	17-19	104	162	0,64
WOOD AND PRODUCTS OF WOOD AND CORK	20	63	89	0,71
PULP, PAPER, PAPER PRODUCTS, PRINTING AND PUBLISHING	21-22	591	832	0,71
CHEMICAL, RUBBER, PLASTICS AND FUEL PRODUCTS	23-25	1814	2562	0,71
OTHER NON-METALLIC MINERAL PRODUCTS	26	218	392	0,56
BASIC METALS AND FABRICATED METAL PRODUCTS	27-28	876	1647	0,53
MACHINERY AND EQUIPMENT	29-33	8422	13394	0,63
TRANSPORT EQUIPMENT	34-35	1922	2875	0,67
MANUFACTURING NEC; RECYCLING	36-37	140	319	0,44
ELECTRICITY, GAS AND WATER SUPPLY	40-41	187	391	0,48
CONSTRUCTION	45	2848	4477	0,64
WHOLESALE AND RETAIL TRADE; REPAIRS	50-52	1818	2480	0,73
HOTELS AND RESTAURANTS	55	150	254	0,59
TRANSPORT AND STORAGE	60-63	703	917	0,77
POST AND TELECOMMUNICATIONS	64	903	1211	0,75
FINANCE, INSURANCE	65-67	88	138	0,64
REAL ESTATE ACTIVITIES	70	86	188	0,46
RENTING OF MACHINERY AND EQUIPMENT	71	94	171	0,55
COMPUTER AND RELATED ACTIVITIES	72	47	147	0,32
RESEARCH AND DEVELOPMENT	73	5	10	0,49
OTHER BUSINESS ACTIVITIES	74	683	921	0,74
PUBLIC ADMIN. AND DEFENCE; COMPULSORY SOCIAL SECURITY	75	719	1072	0,67
EDUCATION	80	80	143	0,56
HEALTH AND SOCIAL WORK	85	704	930	0,76
OTHER COMMUNITY, SOCIAL AND PERSONAL SERVICES	90-93	632	863	0,73
PRIVATE HOUSEHOLDS WITH EMPLOYED PERSONS & EXTRA TERRITORRIAL ORGANISATIONS AND BODIES	95-99	0	0	n/a

It is clear that the use of manufactured goods and the import rates differ among the industries. Differences occur also in the group of non-industries also. Further, the differences in use and import rates are not only noticed when manufactured goods are examined as one group, differences occur also among the use and import rated of different groups of the aggregated manufactured goods. The distinction of the demands for import various aggregated manufacturing groups can be made.

Therefore a region's demand for import of a certain aggregated manufacturing group *j*, *DMIj*, can be denoted as follows:

$$DMI_j^m = \sum_{k=1}^{K} TUM_j^{m,k} * IR_j^{m,k} + \sum_{n=1}^{N} TUM_j^{m,n} * IR_j^{m,n} \quad \textbf{(3.6)}.$$

Considering *J* groups of aggregated manufacturing in total, a region's total demand for manufacturing import is as follows:

$$TDMI^m = \sum_{j=1}^{J} DMI_j^m \quad \textbf{(3.7)}.$$

An extension of eq. 3.2, by including the existence of differences among the use and import rate of various aggregated manufacturing groups, takes the establishment of demand for manufacturing import at a more detailed level into account. It is a combination of eq. 3.6 and eq. 3.7. This extension is denoted as follows:

$$TDMI^m = \sum_{j=1}^{J} \left(\sum_{k=1}^{K} TUM_j^{m,k} * IR_j^{m,k} + \sum_{n=1}^{N} TUM_j^{m,n} * IR_j^{m,n} \right) \quad \textbf{(3.8)}.$$

With eq. 3.8 the findings arisen from analyses of the demand side of the NBGF-region's manufacturing import are brought together. Based on the equation, insight in the nature and the composition of the demand arisen from the demand side is gained at a less aggregated level. This is a step toward the establishment of the desired framework. In the next chapter the attention is paid to analyses of the supply side, China.

Chapter 4

The Supply Side: China

The second research question concerns the attractiveness of China to import from and the composition of the imported manufactured goods. China has more and more been associated with the designation of the world's factory. It has been seen largely as a big factory exporting to almost all over the world. 'China is the world's factory'. In this chapter attention will be paid to the establishment of this statement. Understanding of the motivations to import manufacturing from a country, in particular from China, and the changing composition of the imported manufactured goods, will be strived for. Analyses of the imported goods will be done, coupled with a further development of the basic framework.

4.1 Theoretical background of the Emergence

In this section we pay attention to the emergence of China as a significant export power. Since the reform of China in 1978 it has been integrated into the global economy and increased its export. Apparently China is attractive to import from. Generally the China-EU relation has been strengthened. Studies about motives for international trade appeared. In the following the emergence of China as export power will be addressed in the context of the classical and neoclassical trade theory. In relation to the development of the attractiveness of China as country to import various manufactured goods from, attention will be paid to the flying geese model.

4.1.1 China's integration into the global economy since 1978

The People's Republic of China (PRC) was founded in 1949 and the Chinese Communist Party (CCP) has been in power ever since. Since 1978 the free-market economic reforms have transformed the structure of the economy of China. China's economic reform is meant to liberalize the strict control by the state and to introduce market mechanism in economic decision-making. When China opened up to the world two decades ago, it was heralded for being a huge market of more than a billion consumers. Since then the world's retailers and manufacturers have set their focuses on this favourable economy. While China's domestic market is no doubt important and will remain so, China has been seen largely as a prime location to make products at lower cost and to sell them the world over. With a huge amount of population of more than a billion, of course, China is likely to provide an almost unlimited supply of cheap labour. Due to comparative advantage in labour-intensive industries China has largely been seen as a low cost place to make basic, labour-intensive products. While the NBGF-region is concerning the process of de-industrialisation, China has to do with the process of industrialisation. In 1979 industry accounted for nearly 50% of officially measured GDP [1]. Reforms in the early 1980s initially increased the relative share of the agricultural sector. Driven by a sharp rise in the procurement price paid for crops and what amounted to the semi-privatisation of agriculture, the share of agricultural output in total GDP rose from 30% in 1980 to 33% in 1983 [1]. Since then, however, the share of agriculture has fallen fairly steadily. During the 1980s, as agriculture's share in GDP fell, that of the growing services sector rose: the share of tertiary industry in total output increased from around 21% of GDP in 1979 to more than 30% ten years later [1]. The relative share of the services sector has since remained steady, and the continued shrinkage in the relative contribution of agriculture has been reflected in a larger share for the industrial sector. The structure of China's secondary industry changed fundamentally during the 1980s [1].

4.1.2 China-EU relation

Since the establishment of diplomatic relations between China and the EU in 1975, the China-EU relation as a whole has been growing stronger and more mature [14]. In 1988 China and the EU launched their annual summit mechanism. In 2001, the two sides established a full partnership. In order to strengthen and enhance the China-EU relation, it has become an important component of China's foreign policy. As in [14] is addressed, China is committed to develop a dynamic, long term and stable economic cooperation and trade with the EU, expecting the EU to become China's largest trading and investment partner. The European Commission [28] states that in 2004 China remained the EU 2nd biggest trading partner (after the US) and, according to China's statistics, the EU became China's first trading partner (ahead of the US and Japan) China's second biggest trading partner (roughly on the same level as the US, behind Japan). Whereas the EU enjoyed a trade surplus with China at the beginning of the 1980s, the EU-China trade relations are now marked by a sizeable and widening EU deficit with China. In 2004 EU deficit was around €78.5 billion and this is the EU's biggest bilateral trade deficit.

4.1.3 In relation to the Ricardian model of the classical theory

As David Ricardo pointed out the profit for countries raised out trade based on the comparative advantages of countries in his On the Principles of Political Economy and Taxation in 1817, China and its trade partners seem to have understood his theory. The essence of Ricardo's argument was summarized by James Mill in 1821 [3] as follows:

> *"When a country can either import a commodity or produce it at home, it compares the cost of producing at home with the cost of procuring from abroad; if the latter cost is less than the first, it imports. The cost at which a country can import from abroad depends, not upon the cost at which the foreign country produces the commodity, but upon what the commodity costs which it sends in exchange, compared with the cost which it must be at to produce the commodity in question, if it did not import it."*

According to the classical theory, where the Ricardian model belongs to, the technological differences between nations is the driving force behind the international trade. To determine a country's strong sectors based on technology differences only the comparative cost are important. In this light, the labour productivity and so the wage level of a country are important [17]. The implication of all this is that the classical theory pays attention to only one factor of production, namely labour productivity.

4.1.4 In relation to the neoclassical theory

China is a country with a large supply of cheap labour and, in this perspective, enjoys to many countries comparative advantages in labour-intensive industries. While the differences in labour productivity are doubtless very important in relation to the driving force behind the international trade, an explanation of the international trade and the determination of the comparative advantages solely based on one factor of production is too restrictive. The idea is that we should not attribute all value added in goods to only one factor of production: the labour productivity. Comparative advantages in other factors of production also matter. To make this clear van Marrewijk [17] used an example with oil refineries, hairdressers, electronics firms and domestic services. As he stated, some sectors, such as oil refineries, are much more capital intensive than other sectors, such as hairdressers. A larger part of the value added in the oil refinery is used to remunerate the capital investments involved than for the hairdresser. Similarly, some sectors, such as electronics firms, use more highly educated labourers than other sectors, such as domestic services. Differences in remuneration may reflect differences in years of education and skills. Therefore, besides the classical models, there are other models attempting to explain the international trade. While the classical theory only pays attention to one factor of production, the neoclassical theory of international trade takes more than one factor of production into account and it is namely based on four propositions [17]:

- The factor price equalization proposition [21][22], which argues that international free trade of final goods between tow nations leads to an equalization to the rewards of the factors of production in the two nations.

- The Stolper-Samulson proposition [20], which argues that an increase in the price of a final good increases the reward to the factor of production used intensively in the production of that good.

- The Rybczynski proposition [19], which argues that an increase in the supply in a factor of production results in an increase in the output of the final good that uses this factor of production relatively intensively.

- The Heckscher-Ohlin proposition [18], which argues that a country will export the good that intensively uses the relatively abundant factor of production.

The neoclassical driving forces behind international trade flows are based on differences in factor endowments between nations. A country will export those goods and services, which intensively use its abundant factors of production. In the case of China, its emergence as an export powerhouse began in the 1980s. In line with Heckscher-Ohlin proposition, due to the relatively abundant factor of production in China, namely labour in the labour-intensive industries, much of the apparel and toy manufacturing industries of neighbouring Hong Kong moved to southern China to take advantage of low wages. In this way China started to generate export. In the 1990s, this process expanded to other merchandise categories. There was an increasing of more and more capital flows into China. In the context of productivity labour, capital and technology are very important. Due to inflows of capital and technology, coupled with improved infrastructure and labour quality, while wages remained relatively low, China obtained the capability to show comparative cost advantage in other merchandise categories as well. Industrialization occurred and, in fact, it is still taking place in China. In other words, the supply of relative low cost labour, capable of producing of other merchandise categories, increased. As the Rybczynski proposition stated, an increase in the supply in a factor of production results in an increase in the output of the final good that uses this factor of production relatively intensively. The process of improvement of the China's infrastructure and labour quality continued and the relatively low wages remained. As regularity in the business world, rational actors are always looking for ways to mineralise their costs. In this light, overseas Chinese investors from Taiwan and Southeast Asia, as well as investors from Korea and Japan, rapidly shifted much of their manufacturing capacity to China, to make profit arisen from the comparative cost advantages of labour. Later, also investors other than those from Asia shifted manufacturing capacity to China. Coupled with the liberalization of international trade and capital market, the decreasing cost of transport, and the applications of information and communication technology, more and more manufacturing capacity has been moved to China to make profit of the comparative cost advantages of factors of productions [26]. With this global shifting trend, the statement 'China is the world's factory' established.

4.1.5 Shifting of comparative advantage: Flying Geese Model

In general, the comparative cost advantages drive the shifting of manufacturing capacity and in that way they drive the international trade as well. The liberalization of international trade and capital market, the decreasing cost of transport, and the applications of information and communication technology have made it easier to shift manufacturing capacity. In different industries other sets of factors of production are relevant. According to the factor price equalization proposition and the Stolper-Samulson proposition, comparative cost advantages can change. When comparative advantages of producing goods related to a certain industry decrease to a certain level, expectably, manufacturing capacity of that industry would be moved to another place with more comparative advantages. At this moment there is a large scale shifting of manufacturing capacity of labour intensive industry toward China. It is worth to pay attention to see how shifting of industries occurs. About the shifting of industries several studies appeared. The flying geese model [8] pays attention to this shifting. The expansion of economic dynamism form Japan to the Asian NIEs and then further to ASEAN countries and China has come to be known as the flying-geese pattern. Asian NIEs refer to the new industrialised economies Korea, Hongkong, Taiwan, and Singapore, while ASEAN countries include Indonesia, Malaysia, Philippines, Singapore, Thailand, Brunei Darussalam, Vietnam, Laos, Myanmar, and Cambodia. Countries specialize in export of products, in which they enjoy a comparative advantage commensurate with their levels of development, and at the same time they seek to upgrade their industrial structures through augmenting their endowment of capital and technology. Through relocating industries from the more advanced countries to the less developed ones, foreign direct investment from the former to the latter plays a dominant role in sustaining this process. With focus on specific industries in specific countries, the flying-geese model was first used to describe the life cycles of industries in the course of economic development [8]. As Kwan stated in [9], subsequently, the model has been extended to study the dynamic changes in the industrial structure, which refers to the rise and fall of different industries in specific countries, and further to the shift of industries from one country to another. As shown in figure 4.1 the life cycle of a specific industry can be traced by following the time path of an indicator of comparativeness. This usually takes the form of an inverted V-shaped curve, showing that competitiveness first improves and then deteriorates over time.

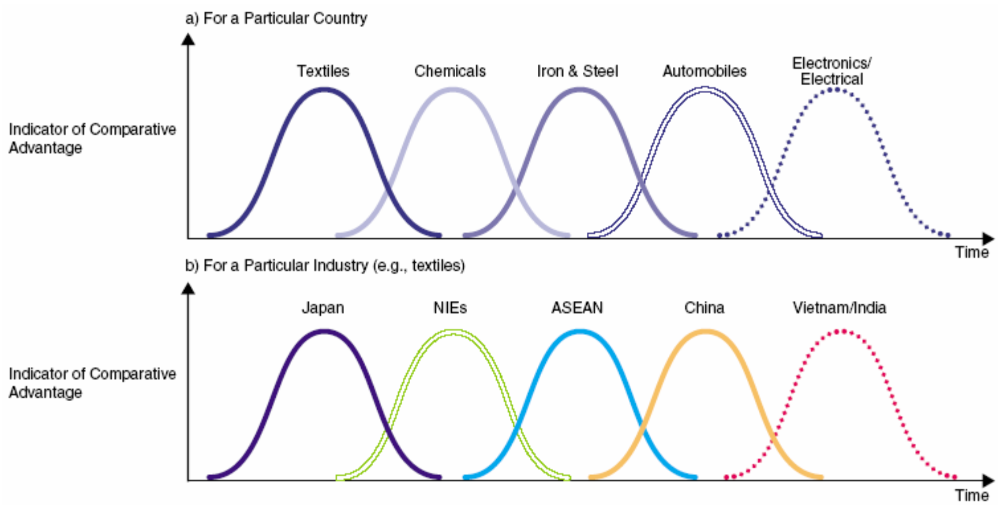


Fig. 4.1. Asia's Flying-Geese Pattern of Economic Development. Source: [9]

The series of V-shaped curves depict the competitiveness of emerging industries, which are usually more capital- and technology-intensive than the preceding ones. The shift from textiles industry to the chemicals industry, and then further to the steel industry, the automobile industry, and the electronics/ electrical industry is a typical sequence seen among Asian countries. In context of an open economy the flying-geese model is used to describe the shifting of industries from more advanced countries to countries catching up from behind. In part b of the figure the inverted V-shaped curves represent the same industry in different countries instead of different industries in the same country. The shifting of textile production from Japan to the Asian NIEs and further to the ASEAN countries and China is a typical example. As Kalish stated in [6], much of the growth of exports from China has been due to reprocessing of components that are imported. In 2000, 55% of exports were processed. Moreover 41% of imports were destined for export processing. This demonstrates the degree to which China has become integrated into the global supply chain due its comparative advantages. Much of the processed export industry is the result of investments made by companies based in other Asian countries. They seek lower cost for assembly of final products. All this is in accordance with the flying geese model theory. This is true of electronics companies from Korea, apparel companies from Hong Kong, and computer manufacturers from Taiwan. In the case of the latter, a vast amount of capacity was shifted during the 1990s from Taiwan to the mainland. This led to a huge increase in Chinese exports of computers and accessories, with 72% of those exports in 2000 accounted for by Taiwanese companies [6].

4.2 Changing composition of manufacturing import

From the previous sections it is clear that comparative advantages with regard to factors of production are important to the attractiveness of a country to import from. The comparative advantages in industries, as the theories behind the flying geese model suggest, develop in accordance with a certain pattern. This pattern is influenced by the capability of a country to produce. Coupled with the developments with regard to the labour, capital and technology in a country, comparative advantages among various industries change. So far in the thesis China's attractiveness in labour-intensive industries has been emphasized. It is a fact also that China has started to be competitive in many more advanced technologies. As Kalish stated in [6], China is challenging the exporting prowess of many other emerging markets around the world. This is reflected from the various manufactured goods China export to the rest of the world. Consider the fact that China produces more than 50% of the world's cameras, 30% of the air conditioners and televisions, 25% of washing machines, and almost 20% of refrigerators, and the list goes on [6]. As the composition of the manufacturing import from China changes, in the context of container growth development and related issues, it is worth to pay attention to. In the following China's attractiveness to import from for the NBGF-region for manufactured goods and the composition of this manufacturing import will get attention. Several trade statistics will be examined.

4.2.1 The dominance of manufacturing import

With regard to the NBGF-region's imported goods from China, comparing with the imported goods from the industry of agriculture, hunting, forestry, and fishing, and the industry of mining and quarrying, imported goods from the industry of manufacturing has always been taking the largest share of the total imported value into account [29]. During years this share of manufactures has only increased. The contribution of manufacturing import in the total import value had risen from 91% in

1988 to 99% in 2003. Almost all of the imported goods from China originated from the manufacturing industry. This is reflected from figure 4.2 and table 4.1.

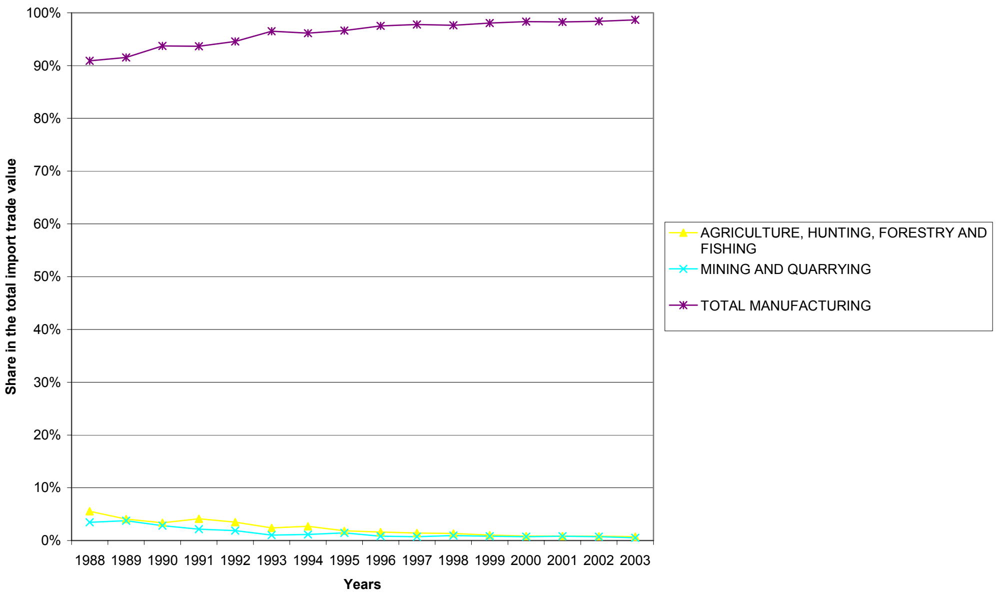


Fig. 4.2. Composition of import trade value from China to the NBGF-region [6].

Industries	1988	1989	1990	1991	1992	1993	1994	1995
Agriculture, hunting, Forestry and fishing	6%	4%	3%	4%	3%	2%	3%	2%
Mining and quarrying	3%	4%	3%	2%	2%	1%	1%	1%
Total manufacturing	91%	92%	94%	94%	95%	97%	96%	97%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Industries	1996	1997	1998	1999	2000	2001	2002	2003
Agriculture, hunting, Forestry and fishing	2%	1%	1%	1%	1%	1%	1%	1%
Mining and quarrying	1%	1%	1%	1%	1%	1%	1%	0%
Total manufacturing	98%	98%	98%	98%	98%	98%	98%	99%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Table 4.1. Composition of the import trade value from China to the NBGF-region [6].

4.2.2 The change of composition within the manufacturing import

Although the development of the share of manufacturing in the total imported trade value for the NBGF-region has been stable, which is reflected from figure 4.2, we should be aware of that the composition within the total manufacturing import might have changed. Knowledge of the compositions of the imported goods is important, because many container related issues has namely to do with the content of containers. As noticed earlier in the thesis, the container growth is driven by the cumulative demand and different import rates for various goods. Mainly the import rate of a certain group of goods is strongly dependant on the development with regard to the attractiveness of the export country for that group of goods. That the attractiveness of various manufactured goods to import from a country differs is partly reflected from the composition of the NBGF-region's import from China. As mentioned in Chapter 2 ten aggregated manufacturing groups can be divided. China's comparative advantage in these groups drives together China's manufacturing export to the NBGF-region. During years the rankings of the manufacturing groups by their shares within China's total manufacturing export value to the NBGF-region have changed [29]. This implies that the composition of the imported manufactured goods from China has been changing. The rankings are shown in the table 4.2. The outrunning of aggregated manufacturing group of machinery and equipment is clearly shown in fig. 4.3.

Table 4.2. Rankings of the aggregated manufacturing groups by their share within China's total manufacturing export trade value to the NBGF-region.

Rank 1988	Manufacturing groups		Share of total manufacturing
1	B	Textiles, textile products, leather and footwear	41%
2	J	Manufacturing nec; recycling	13%
2	E	Chemical, rubber, plastics and fuel products	13%
4	H	Machinery and equipment	12%
5	A	Food products, beverages and tobacco	10%
6	G	Basic metals and fabricated metal products	6%
7	C	Wood and products of wood and cork	3%
8	F	Other non-metallic mineral products	1%
9	I	Transport equipment	0%
9	D	Pulp, paper, paper products, printing and publishing	0%
Rank 1991	**Manufacturing groups**		**Share of total manufacturing**
1	B	Textiles, textile products, leather and footwear	44%
2	H	Machinery and equipment	17%
3	J	Manufacturing nec; recycling	15%
4	E	Chemical, rubber, plastics and fuel products	8%
5	A	Food products, beverages and tobacco	6%
6	G	Basic metals and fabricated metal products	4%
7	I	Transport equipment	2%
7	C	Wood and products of wood and cork	2%
9	F	Other non-metallic mineral products	1%
9	D	Pulp, paper, paper products, printing and publishing	1%
Rank 1994	**Manufacturing groups**		**Share of total manufacturing**
1	B	Textiles, textile products, leather and footwear	37%
2	H	Machinery and equipment	27%
3	J	Manufacturing nec; recycling	15%
4	E	Chemical, rubber, plastics and fuel products	8%
5	G	Basic metals and fabricated metal products	5%
6	A	Food products, beverages and tobacco	4%
7	F	Other non-metallic mineral products	2%
8	C	Wood and products of wood and cork	1%
8	D	Pulp, paper, paper products, printing and publishing	1%
8	I	Transport equipment	1%

Rank 1997	Manufacturing groups	Share of total manufacturing
1	H Machinery and equipment	34%
2	B Textiles, textile products, leather and footwear	29%
3	J Manufacturing nec; recycling	14%
4	E Chemical, rubber, plastics and fuel products	10%
5	G Basic metals and fabricated metal products	6%
6	A Food products, beverages and tobacco	3%
7	F Other non-metallic mineral products	1%
7	C Wood and products of wood and cork	1%
7	D Pulp, paper, paper products, printing and publishing	1%
7	I Transport equipment	1%
Rank 2000	**Manufacturing groups**	**Share of total manufacturing**
1	H Machinery and equipment	44%
2	B Textiles, textile products, leather and footwear	22%
3	J Manufacturing nec; recycling	13%
4	E Chemical, rubber, plastics and fuel products	8%
5	G Basic metals and fabricated metal products	5%
6	A Food products, beverages and tobacco	2%
6	I Transport equipment	2%
6	F Other non-metallic mineral products	2%
9	C Wood and products of wood and cork	1%
9	D Pulp, paper, paper products, printing and publishing	1%

The dominance of the aggregated manufacturing group of textile, textile products, leather and footwear, with regard to the share of the total import value of the NBGF-region from China, shows an obvious decrease, while the group of machinery and equipment increases its share in the total China's export to the NBGF-region and outruns all other manufacturing groups from 1995.

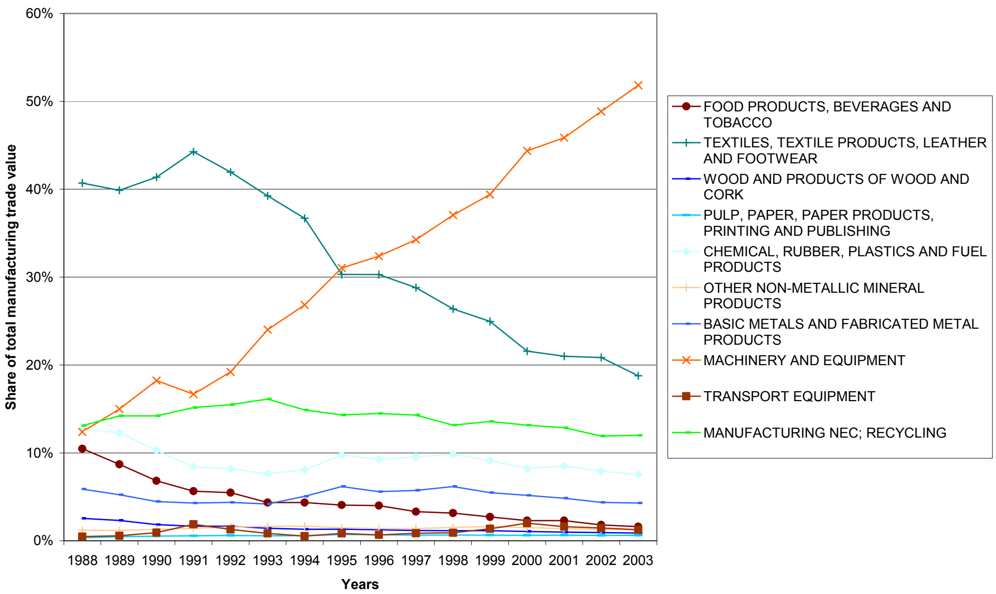


Fig. 4.3. The changing composition of the manufacturing import from China to the NBGF-region.

With figure 4.4 it can be state that the composition of the NBGF-region's import of various aggregated manufacturing goods in total has largely stayed more or less stable. This implies that the shifting within the rankings in table 4.2 reflects the change of the attractiveness of various aggregated manufacturing group to import from China.

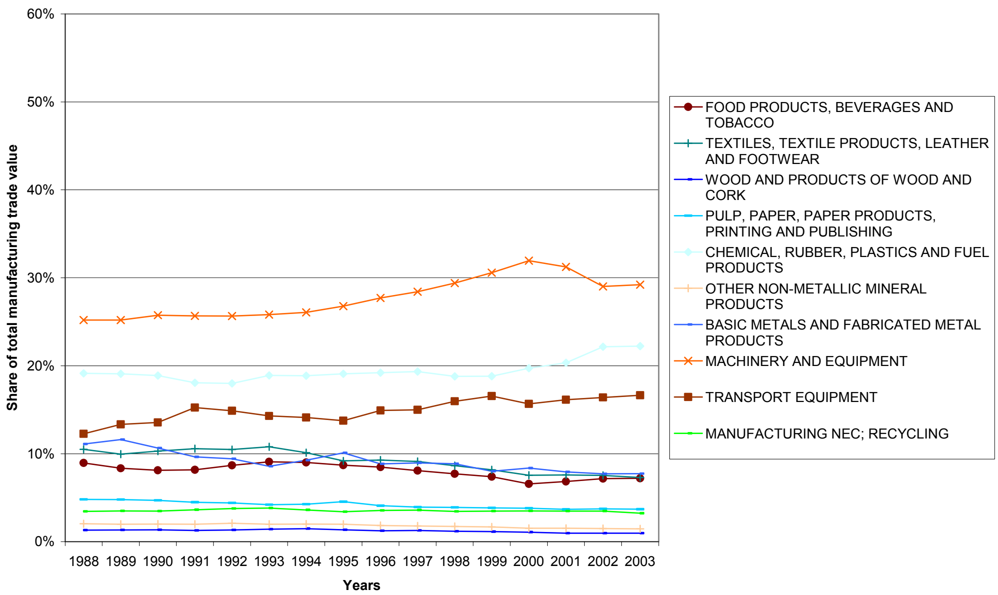


Fig. 4.4. Composition of the NBGF-region's import value from the world with regard to the ten aggregated manufacturing groups.

Figure 4.5 depicts the composition of the NBGF-region's import from NON-OECD countries [29]. These NON-OECD countries refer to less developed countries, since all developed countries are included in the OECD countries class. More about the classification can be found at the official website of the Organisation for Economic Co-operation and Development (OECD). A comparison between the compositions of import from the NON-OECD countries with that from China is interesting because both parties belong to the same category level of development. Reflecting from figure 4.5, it is clear that the composition of manufacturing import from the NON-OECD countries has changed during years also. The attractiveness of various aggregated manufacturing goods to import from the NON-OECD countries has changed too. However, with a closer look at figure 4.5 and figure 4.3, it can be state that the change of composition of manufacturing import from China differs. Since a country will export goods from its strong sector, when an aggregated manufacturing group's share in the total export values gets smaller, it may reflects a sector's decreasing attractiveness.

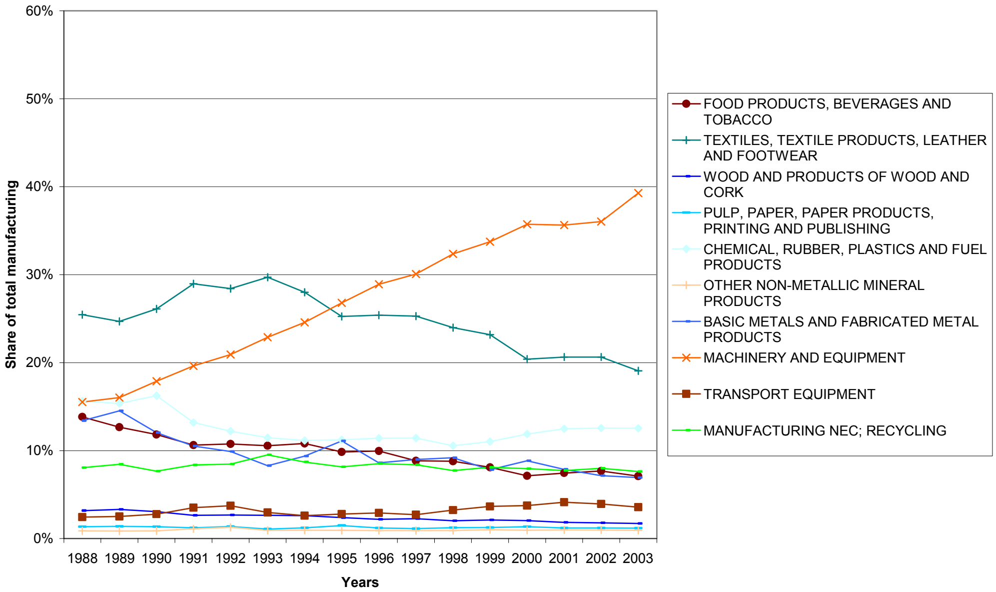


Fig. 4.5. Composition of the NBGF-region's import trade value from NON-OECD countries with regard to the ten aggregated manufacturing groups.

In the context of the flying geese model comparing the aggregated manufacturing groups during years, China's strength in textile, textile products, leather, and footwear manufacturing decreases. The same development of strength applies to the manufacturing group of food products, beverages and tobacco. By contrast, an increasing strength of the group of machinery and equipment occurs. The other aggregated manufacturing groups remain their strength largely at the same level.

4.2.3 Comparing the composition of the manufacturing import

While China enjoys comparative advantage in some industries with respect to the NBGF-region, there are other countries enjoying comparative advantage with respect to the NBGF-region in those industries also. In this light, China is competing with these countries. Generally a country will export more goods from its strong sector. To indicate the strong industry sectors of a country to import from for certain manufacturing groups, examining of the composition of a country's manufacturing export, like figure 4.3, can be useful. Further, by taking comparison of various countries' compositions in manufacturing export, more insight can be gained. For this purpose an indicator of revealed strength can be used. This indicator is an index, that shows the comparison of the revealed strength of a certain industry sector in export country x with respect to the revealed strength of the same industry in another comparable reference country r. It is assumed that a country will export more goods from its strong sector. Thus, an industry sector with a large share in the total export values indicates a country's strong sector. The index is determined by comparing the shares of industry j's contribution in the total export value to a certain import country m for both country x and country r as follows:

$$IS_j^{x,m}(s_j^{x,m}, s_j^{r,m}) = \frac{s_j^{x,m}}{s_j^{r,m}} \quad (4.1).$$

Let $s_j^{x,m}$ and $s_j^{r,m}$ respectively denote the share of industry j in country x exports to country m. The index is comparable to the Balassa Index, which is used to measure the revealed comparative advantage of countries for certain exporting commodities. The Balassa Index was popularised by Bela Balassa [32][33]. In the following the IS-values of the aggregated manufacturing industries will be determined with the NON-OECD countries as reference country and they will be depicted graphically. This implies a comparison of China's composition of the total export of manufacturing toward the NBGF-region with the NON-OECD countries' composition. The NON-OECD countries are assumed to be comparable with China, since both the NON-OECD countries and China belong to less developed countries, and the NON-OECD countries together will be used as the reference country. Using the NON-OECD countries as benchmark insight in the development of the strength of various aggregated manufacturing groups in China with respect to an average NON-OECD country will be strived for. The NBDF-region will be used as the country export to. Therefore the desired IS-values will be determined as follows:

$$IS_j^{CN,NBGF}\left(s_j^{CN,NBGF}, s_j^{NOECD,NBGF}\right) = \frac{s_j^{CN,NBGF}}{s_j^{NOECD,NBGF}} \quad (4.2).$$

A certain aggregated manufacturing group is denoted by j. Respectively, $s_j^{China,NBGF}$ and $s_j^{NON-OECD,NBGF}$ denote the share of aggregated manufacturing group j in China's total manufacturing export value and the share of aggregated manufacturing group *j* in NON-OCED countries' total manufacturing export value to the NBGF-region. With the assumption that a country will export more goods from its strong sector. A high IS-value indicates a relatively strong aggregated manufacturing group in China. The implications of IS values can be summarized in table 4.3.

Table 4.3. The implications of IS values.

$IS_j^{CN,NBGF}(s_j^{CN,NBGF}, s_j^{NOECD,NBGF})$	Implications for aggregated manufacturing group *j*
<1	*Less strong with regard to an average NON-OECD country.*
1	*Comparable with an average NON-OECD country.*
>1	*More strong with regard to an average NON-OECD country.*

Comparing the share of the aggregated manufacturing groups in China's total export value to the NBGF-region [29], it is clear that the aggregated manufacturing group of machinery and equipment is the strongest manufacturing sector, followed by the group of textile, textile products, leather, and footwear and other aggregated manufacturing groups. Figure 4.6 shows the strength of these aggregated

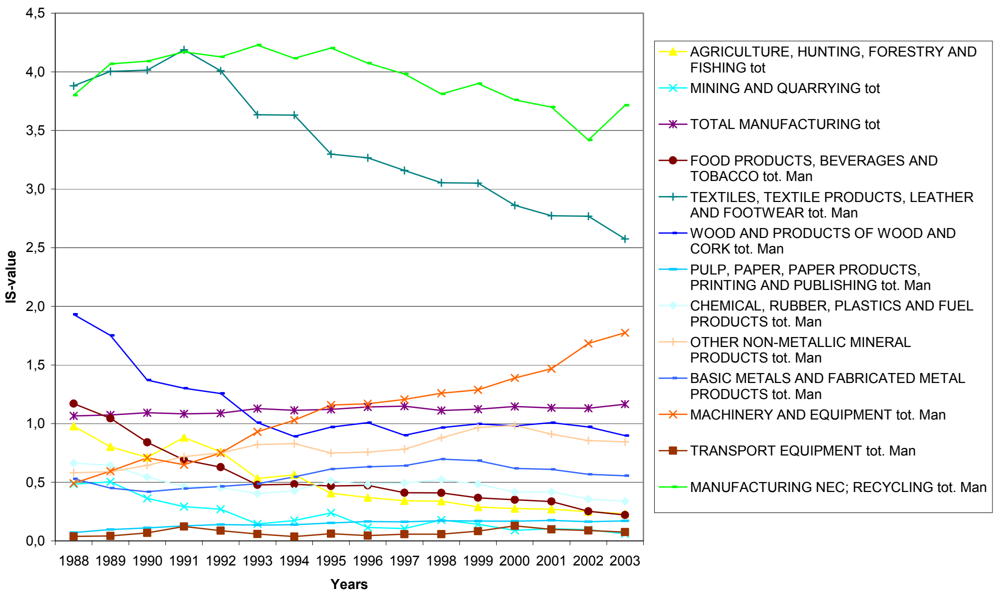


Fig. 4.6. Revealed IS-values in China with regard to manufacturing export to the NBGF-region and using the NON-OECD countries as reference.

Manufacturing groups in China using the NON-OECD countries as a reference region [29]. This comparison reveals the positions of China's aggregated manufacturing groups among an average NON-OECD country. There are four aggregated manufacturing groups with IS-values higher than 1 and six aggregated manufacturing groups with IS-values lower than 1. The implications of all the IS-values are addressed in table 4.4 a and b. The revealed strength of the aggregated manufacturing groups of other non-metallic mineral products and manufacturing nec. and recycling in respect to an average NON-OECD country is remarkable.

Table 4.4. Implications.

a) IS-value > 1

China's comparatively strong aggregated manufacturing groups with regard to an average NON-OECD country (IS-value > 1).	
Manufacturing nec; recycling	*The contribution of this group in the national total export value to the NBGF-region is high compared with an average NON-OECD country, but it is decreasing slightly. This reveals a decreasing strength of this strong manufacturing group.*
Other non-metallic mineral products	*The contribution of this group in the national total export value to the NBGF-region is high compared with an average NON-OECD country, but it is being decreasing. This reveals China's decreasing comparative strength in this manufacturing group.*
Textiles, textile products, leather and footwear	*Although the contribution of this group in the national total export value to the NBGF-region has been higher than an average NON-OECD country, it is obviously decreasing and it is becoming comparable to an average NON-OECD country. This reveals that this group is relatively losing its strength in China.*
Machinery and equipment	*This is the only one group that shows a higher and obvious increasing contribution in the national total than an average NON-OECD country. This reveals the increasing strength of this group in China.*

b) IS-value < 1

<table>
<tr><th colspan="2">China's comparatively weak aggregated manufacturing groups with regard to an average NON-OECD country (IS-value < 1).</th></tr>
<tr><td>Chemical, rubber, plastics and fuel products</td><td rowspan="6">For all these groups their contributions in the national total export value to the NBGF-region are relatively low compared with an average NON-OECD country. China's export to the NBGF-region is less relied on these aggregated manufacturing groups. Although they all have IS-values below 1, these aggregated manufacturing groups distinguish themselves by their increasing or decreasing IS-values. Increasing IS-values may indicate an upcoming strong aggregated manufacturing group.</td></tr>
<tr><td>Basic metals and fabricated metal products</td></tr>
<tr><td>Food products, beverages and tobacco</td></tr>
<tr><td>Transport equipment</td></tr>
<tr><td>Wood and products of wood and cork</td></tr>
<tr><td>Pulp, paper, paper products, printing and publishing</td></tr>
</table>

When instead of the import from the NON-OECD countries the import from the world is used as reference, other IS-values occur. These values are shown graphically in figure 4.7.

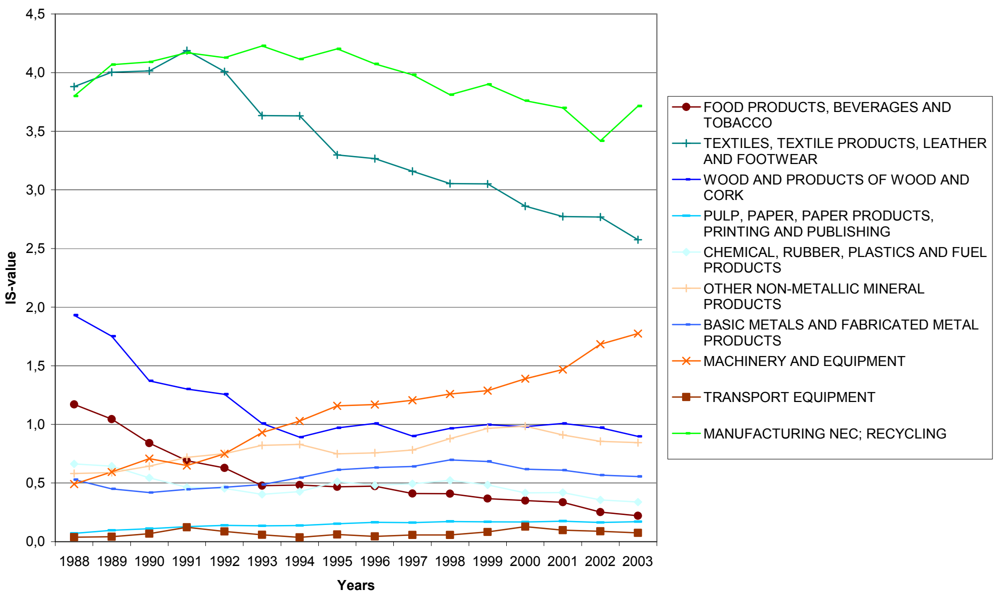


Fig. 4.7. Revealed IS-values in China with regard to manufacutring export to the NBGF-region and using the world as reference.

Compared to an average country in the world, China is relatively strong in the aggregated manufacturing group of manufacturing nec; recycling, the group of textile,

textile products, leather and footwear, and the group of machinery and equipment. Apparently, the group of machinery and equipment is becoming stronger, while an obvious decrease of strength occurs in the group of textile, textile products, leather and footwear. However, all these three groups have IS-values higher than 1, which implies that they are China's relatively strong aggregated manufacturing groups with respect to an average country in the world.

4.3 The attractiveness of various aggregated manufacturing groups to import from a country

The strength of various aggregated manufacturing sectors has changed and so does the composition of the driving force behind China's export to the NBGF-region. To determine a region's import from a certain country, it is clear that besides the development of the demand side the development of an export country's attractiveness to the import country with regard to various manufacturing groups has to be taken into account. Therefore, an extension of the basic framework will be made in this section. Further, the revealed attractiveness of export country China to the NBGF-region and other issues related to the attractiveness to import from a country get attention.

4.3.1 Extension with attractiveness in various aggregated manufacturing groups

As stated, the development of an export country's attractiveness to the import country with regard to various manufacturing groups has to be taken into account. Therefore, to determine the total demand for manufacturing import to a country *m* from country *x* eq. 3.8 will be extended as follows:

$$TDMI^{m,x} = \sum_{j=1}^{J}\left(\sum_{k=1}^{K} TUM_j^{m,k} * IR_j^{m,k} + \sum_{n=1}^{N} TUM_j^{m,n} * IR_j^{m,n}\right) * A_j^{x,m} \qquad \textbf{(4.3)}.$$

$A_j^{x,m}$ is dimensionless and denotes the attractiveness of export country x with respect to import country m for aggregated manufacturing group j, where $0 \leq A_j^{x,m} \leq 1$. With this extension, eq. 4.3 takes both the demand side and the supply side into account to determine the total demand for manufacturing import for country m from country x.

4.3.2 Revealed attractiveness in various aggregated manufacturing groups

The revealed attractiveness of export country x with respect to import country m for aggregated manufacturing group j, when data are available, can afterwards easily be traced with the following equation:

$$A_j^{x,m} = \frac{DMI_j^{m,x}}{DMI_j^m} \quad (4.4).$$

The $A_j^{x,m}$ is revealed by the portion of the demand from import country m for aggregated manufacturing group j, that is imported from export country x. The revealed attractiveness of China in the aggregated manufacturing groups for the NBGF-regions from 1988 to 2003 is depicted in table 4.5 and in figure 4.8 [29].

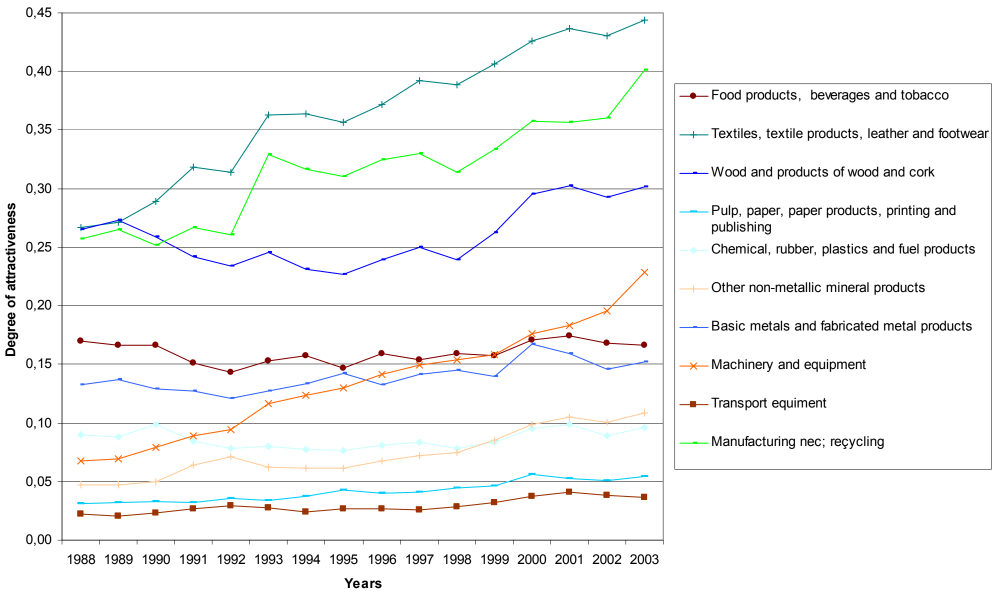


Fig. 4.8. The attractiveness of China for the NBGF-region to import from with regard to the ten aggregated manufacturing groups.

It is obvious that the attractiveness of the aggregated manufacturing groups from is generally increased. The increasing strength of the aggregated manufacturing group of machinery and equipment, depicted in figure 4.6 and 4.7, is reflected in figure 4.8. The attractiveness of this group increased 200%, from 0.07 in 1988 to 0.23 in 2003. The development of the strength of the aggregated manufacturing groups in China undoubtedly has relations to their developments of the attractiveness. However, it is remarkable that the development of the strength of certain groups like the aggregated manufacturing group of food products, beverages, and tobacco, as shown in figure 4.6 and 4.7, is not reflected in figure 4.8. While there is an obvious decrease of revealed strength of the group of food products, beverages, and tobacco, decrease in the attractiveness does not occur in figure 4.8. This is interesting, because it reveals that not only the strength in production of the aggregated manufacturing groups in China determines the attractiveness to import. Reflected from the revealed attractiveness and the revealed strength of production with regard to the aggregated manufacturing groups in China, it is clear that the attractiveness to import from a country is not able to be determined solely based on the strength of production in that country.

Table 4.5. The attractiveness of China for the NBGF-region to import from with regard to the ten aggregated manufacturing groups.

	Food products, beverages and tobacco	Textiles, textile products, leather and footwear	Wood and products of wood and cork	Pulp, paper, paper products, printing and publishing	Chemical, rubber, plastics and fuel products	Other non-metallic mineral products	Basic metals and fabricated metal products	Machinery and equipment	Transport equipment	Manufacturing nec; recycling
1988	0,17	0,27	0,27	0,03	0,09	0,05	0,13	0,07	0,02	0,26
1989	0,17	0,27	0,27	0,03	0,09	0,05	0,14	0,07	0,02	0,26
1990	0,17	0,29	0,26	0,03	0,10	0,05	0,13	0,08	0,02	0,25
1991	0,15	0,32	0,24	0,03	0,08	0,06	0,13	0,09	0,03	0,27
1992	0,14	0,31	0,23	0,04	0,08	0,07	0,12	0,09	0,03	0,26
1993	0,15	0,36	0,25	0,03	0,08	0,06	0,13	0,12	0,03	0,33
1994	0,16	0,36	0,23	0,04	0,08	0,06	0,13	0,12	0,02	0,32
1995	0,15	0,36	0,23	0,04	0,08	0,06	0,14	0,13	0,03	0,31
1996	0,16	0,37	0,24	0,04	0,08	0,07	0,13	0,14	0,03	0,32
1997	0,15	0,39	0,25	0,04	0,08	0,07	0,14	0,15	0,03	0,33
1998	0,16	0,39	0,24	0,04	0,08	0,07	0,15	0,15	0,03	0,31
1999	0,16	0,41	0,26	0,05	0,08	0,09	0,14	0,16	0,03	0,33
2000	0,17	0,43	0,30	0,06	0,09	0,10	0,17	0,18	0,04	0,36
2001	0,17	0,44	0,30	0,05	0,10	0,10	0,16	0,18	0,04	0,36
2002	0,17	0,43	0,29	0,05	0,09	0,10	0,15	0,20	0,04	0,36
2003	0,17	0,44	0,30	0,05	0,10	0,11	0,15	0,23	0,04	0,40

There are simply more factors of cost involved and the developments of these factors are influenced by different environments. In the following sections attention will be paid to these issues.

4.3.3 Other factors of costs

So far, attention has only been paid to the comparative advantages with regard to the factors of production. Production cost is indeed very important for import decisions. In the context of equation 4.3, import decisions directly influence the degree of the import rates and the attractiveness of a country to import for a certain group of goods. However, there are other costs than production cost that will be taken account when an import decision is made. In [34] J. M. Curtis and S. Chen mentioned seven trade margins between the producers' and purchasers' price of goods. These trade margins include wholesale, retail, taxation, transport, gas, pipeline, and storage. They represent the extra costs attached to merchandise trade in addition to import duties charged by importing countries. It is clear that although low production costs in a country occur, if other related costs are high, the attractiveness to import from this country is not by definition high. Advantage in production costs has to be large enough to compensate all other extra related costs to the import decision. For a rational import decision with regard to import of a certain group of goods, which is based on the advantage in production cost in an export country, the following condition will be stated:

$$\textit{Advantage in production costs - all extra costs related to import} \geq 0 \qquad \textbf{(4.5)}$$

This implies that the development of the attractiveness for a certain good to import from a country is complex and depends on the developments of more than only factors of production. Other factors of costs that influence the attractiveness of an export country for certain groups of goods evolve under influences of developments of different environments. Let us consider the economic, social, technological, and political environments. These environments are linked and they influence each other. In the economic environment actors are cost driven with the eventual intention to maximize their profits. The decision to import is solely based on the purpose to minimize costs and maximize the profits. Developments in the environments form constraints in this process of minimizing costs and maximizing profits. Consider the instances of developments in the technological environments, which heavily change the structure of transport and distribution costs, like the invention of container, the increasing containerisation, the increasing capacity of container ships, and the increased efficiency of container handling by the use of Automated Guided Vehicle (AGV). An instance from the social environment is the cultural understanding, which contributes to lower information costs, lower transaction costs, and more opportunities to establish stronger social and business networks abroad. This is very important in the process of de-location. The political environment is special, because developments in this environment have the power to change directly the framework, in which trade takes place, and thus the choice from which country to import from. This is done by legislation. A good example to illustrate this is the Generalised System of Preferences (GSP) scheme [[23]]. In 1968, the United Nations Conference on Trade and Development (UNCTAD) recommended the creation of a Generalised System of Tariff Preferences under which industrialised countries, to which the NBGF-region belongs, would grant trade preferences to all developing countries. This authorises developed countries to establish individual GSP scheme. Under the EU's GSP scheme the EU grants autonomous trade preferences to imports from developing countries. Since China belongs to the developing countries, it has been the main beneficiary with a share of more than 30% of all preferential imports under GSP [23]. The EU's GSP grants products imported from GSP beneficiary countries either duty-free access or a tariff reduction depending on which of the GSP arrangements the country enjoys. The EU's GSP is implemented following cycles of ten years for which general guidelines are drawn up. The present cycle began in 1995 and will expire in 2005. New guidelines for the period 2006 – 2015 are currently being prepared and will certainly affect the role of China as import country to the NBGF-region. From above, it can be stated that an export country's attractiveness to the import country with regard to a manufacturing group is under influences of the developments in different environments, as addressed follows:

$A_j^{x,m}$ = f (*development in the economic, social,*

technological, and political environment)

In this chapter attention has mainly been paid to analyses of attractiveness of the supply side to import from. Chapter 2 and 3 together have provided insights in the establishment of import trade. With eq. 4.3 the desired basic framework starts to take shape. In the next chapter attention is shifted to the link between trade and container flows.

Chapter 5

Container Flows

This chapter concerns the third research question and pays attention to the link between trade and container flows. With the increasing international trade the demand for maritime transport has grown and as a consequence the demand for container related services has grown as well. Wei mentioned in [10] that the container is the most important mode of international transportation of manufactured goods. Trade drives transport and transport drives container flows. In the previous chapters attention has been paid to analyses of trade, in particular the NBGF-region's import trade of manufacturing from China. Based on the trade analyses more insight in the establishment of the manufacturing import has been gained. With the findings in the previous chapters the desired basic framework starts to take shape. In this chapter understanding of the relation between trade and container flows will be strived for. Coupled with this, eq. 4.3 will be extended in order to establish the desired framework. The link between the trade and the container flows will be addressed. A general introduction to container will be given, followed by analyses, which provide insight in the link between trade and containers. The value density and the degree of containerisation will be taken into account.

5.1 Introduction to container

Malcolm McLean (1914-2001) is credited as the inventor of containerised shipping. He was the founder of the Sea-Land Corporation, which is a part of the Maersk Group now. He started out in the trucking industry as an owner-operator and came upon the idea for a special and standardized box containing goods that could be quickly loaded and unloaded. As B. Volk, professor at the Department of Marine Studies at the Fachhochschule in Oldenburg in Germany, remarked in his study Growth Factors in Container Shipping, the inauguration of the container brought about a significant structural change in the international transport system, which still is not completed. In the following the standardization of containers, the advantages of them as transportation mode and the way, in which container contribute to increasing international trade, will get attention.

5.1.1 Standardization of containers

Standardized containers, which can easily be loaded on container ships, railroad cars, and trucks, contribute to a system of intermodal cargo transport. Intermodal is a term that refers to more than one mode of transport. To keep such transport system running smoothly, standardization of the container types and sizes is necessary. Container types and sizes are standardized worldwide by the International Organisation of Standardization (ISO), which registered all types and sizes of containers. There are many types and sizes. The most common container type is the dry cargo container that may be used for a great variety of general cargo. Coupled with technological progress, specialized containers have been developed, which are used for commodities requiring special environments. Nowadays, it is possible to transport almost all kinds of commodities with containers. For instances, there are ventilated containers and even containers for liquid bulk. Ventilated containers are equipped with ventilating ports. They are suitable for heat generating cargo or cargo requiring protection from condensation damage. For the transport of liquid bulk there are tank-type containers for carriage of liquids. However, although almost all commodities can be transported with containers, different degrees of containerisation occur among the commodities. The degree of containerisation indicates the amount of containers that are needed for the transport of the trade volume and it is expressed in TEU per kg. More attention to the degree of containerisation is paid in section 5.2.2. With regard to the standardized sizes of containers, the most common used lengths of containers for the purpose of maritime transport are 20'ft, 30'ft, 40'ft, and 45'f. Containers with length of 20'ft and 40'ft are most used in the maritime sector for container transport. A common used term is TEU. TEU is the abbreviation of Twenty feet Equivalent Unit. TEU is used to express the capacity, for instance the capacity of a containership. FEU is such a similar term and stands for Forty feet Equivalent Unit. Further, containers have a maximum payload. The payload is the maximum weight of the cargo that can be loaded.

5.1.2 Advantages of container as transportation mode

About the advantages of the inauguration of container several studies have appeared. As main advantages of container compared with the traditional method of transporting dry general cargo, Gischler [11] addressed the substantially lower stevedore cost, the reusability due to improved material, a better protection for cargoes, the ease of handling, which refers to transporting cargo with different modes without unpacking or change in transport unit covering the whole transport section, the ease of (un)loading the cargoes and the appropriateness to many kinds of cargoes. In [12] Wijnolst and Wergeland presented advantages as reduction in port time by increased (un)loading speed because of the bigger units and faster stowing, and less required personnel for transhipment of cargo. In addition, the standardized container sizes make easier to realize economies of scale. The capacity expansions of bigger ships and container related facilities are ordinary phenomena nowadays. With regard to several studies, that praise the inauguration of the container, the advantages of container mentioned can easily be summarized as the existence of a mode for international transportation, which is user-friendly and cheap.

5.1.3 Contribution to international trade

The inauguration of the container is an instance of development in the technological environment, which influences the attractiveness to import. Recalling the condition with regard to import decisions, basing on advantage in production costs (eq. 4.5), the inauguration of container has boosted the attractiveness to import by reducing the extra costs related to import. Mainly the transport costs have been reduced due to the advantages mentioned in the previous section.

5.1.4 Container growth in relation to China and the NBGF-region

In 2004 China constituted approximately 6% of the world trade and an estimated 53% and 47% share of all containerised exports from Asia to respectively the US and Europe and this is up from 44% and 25% respectively in 2000 [35]. As the inauguration of container boosts the attractiveness to international trade, trade boosts the increase of container flows between regions. China's growing significance in the container liner shipping sector can be seen from throughputs posted at its main ports, as shown in table 5.1. The total container traffic handled at China's ten leading ports is more than

23 million TEUs. This is, compared with 18.3 million TEUs in the same period of 2003, a rise of 27.8%. The increasing container related activities in the NBGF-region are reflected from the table 1.1. Globalisation of trade is an ongoing trend. As in [25] is addressed, globalisation can be interpreted as the growing economic interdependence of countries worldwide through the increasing volume and variety of cross border transactions in goods and services and of international capital flows

Table 5.1. Throughputs with regard to the main ports in China. Source [35]

Ranking	Port	January/June 2003 (TEU)	January/June 2004 (TEU)	% Change
1	Shanghai	5,199,900	6,738,000	29.6
2	Shenzhen	4,534,300	6,048,000	33.4
3	Qingdao	2,088,000	2,048,000	16.7
4	Tianjin	1,452,900	1,822,000	25.4
5	Ningbo	1,234,100	1,778,000	44.1
6	Guangzhou	1,281,200	1,423,500	11.1
7	Xiamen	1,105,900	1,387,000	25.4
8	Dalian	729,400	953,000	30.7
9	Zhongshan	363,200	423,600	16.6
10	Fuzhou	284,700	338,000	18.7
Total		**18,273,600**	**23,348,100**	**27.8**

and also through the more rapid and widespread diffusion of technology. It affects trade patterns, capital flows and location choices of firms at a regional and global level. It can lead to a drastic shift of production activities to the developing countries. The distance between production and demand, both intermediary and final, determines the demand for transport. The volume of consumption, production and the place of production, which are discussed in the previous chapters, determine eventually the volume of transport, and thus the amount of containers.

5.2 The link to container flows

It is clear that the container growth between two regions is highly related to the development of trade between these regions. Several literatures related to the link between trade and container growth appeared over last decade. According to P. de Langen [7], attention should be paid to two different types of sources of container growth. The first type consists of variables that influence the size of trade flows between two regions and the other one consists of variables that influence the containerised proportion of all trade flows. The size of trade should be taken in terms of volume. As Wei [10] emphasized and explained that in container shipping, the volume rather than value matters. Moreover, there are limitations for containers with regard to volume and not to value. To take volume into account is understandable, since the trade volume, and not the trade value, determines the amount of containers that are required for the transport. The volume of trade often, and in the following will, refers to the weight of the commodities. The link between trade value and container flows consists of three relations; namely, the relation between the trade value and the trade volume, the containerised share of the trade volume and the relation between the containerised trade volume and the amount of containers, expressed in the amount of TEUs. The variables and the units, in which they are expressed, are depicted in figure 5.1.

Fig. 5.1. Variables and units involved in the link between trade and container.

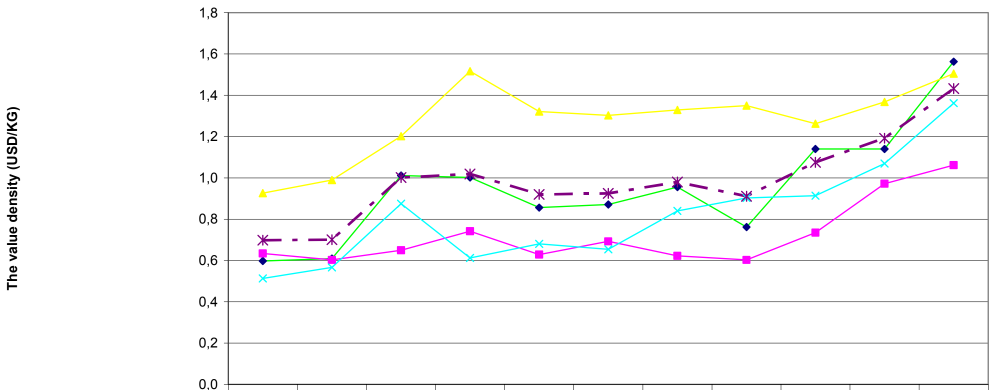
Variable:	Trade Value	*Value Density* →	Trade Volume	*Containerised share* →	Containerised Trade Volume	*Conversion factor* →	Containers
Unit:	Euro or USD	*Euro/kg or USD/kg*	kg (or TON)	*%*	kg (or TON)	*TEU/TON*	TEU

The relation between value and volume is denoted by the value density of the commodities, the containerised share of the trade volume is a percentage and the relation between containerised trade volume and the amount of containers by the average weight of one container. The degree of containerisation refers to the link between the trade volume and the amount of containers and, therefore, involves the containerised share of the trade volume and the average weight of one container. In the following attention will be paid to the value density and the degree of the containerisation striving for understanding of the link between trade and container flows. Analyses of trade statistics will be done.

5.2.1 Value density

The relation between the trade value and the trade volume is revealed in the value density, which is expressed in Euro per kg or USD per kg. Analyses of the China-Customs Statistics' maritime trade database, which contains trade value and volume statistics about China's maritime export to the NBGF-region, shows a general increase of the value density of the NBGF-region's maritime import from China. The increase is depicted in figure 5.2. The increase implies that the maritime import trade value per kg has generally increased. Inflation and increased transport of commodities with a higher value could have been the reasons. Reflected from figure 5.2, during the last decade the development of the value density of China's maritime export to the Netherlands has largely been comparable to the development of the value density of China's maritime export to the NBGF-region. However, this analyse includes not only manufacturing import, but all import trade from China to the NBGF-region.

Fig. 5.2. The development of value density with regard to import from China to the Netherlands, Belgium, Germany, and France. Source: China-Customs Statistics.



	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
CN >> The Netherlands	0,6	0,6	1,0	1,0	0,9	0,9	1,0	0,8	1,1	1,1	1,6
CN >> Belgium	0,6	0,6	0,6	0,7	0,6	0,7	0,6	0,6	0,7	1,0	1,1
CN >> Germany	0,9	1,0	1,2	1,5	1,3	1,3	1,3	1,3	1,3	1,4	1,5
CN >> France	0,5	0,6	0,9	0,6	0,7	0,7	0,8	0,9	0,9	1,1	1,4
CN >> NBGF-region	0,7	0,7	1,0	1,0	0,9	0,9	1,0	0,9	1,1	1,2	1,4

Years

Let us now consider the value density development of various aggregated manufacturing groups. For this purpose attention will be paid to the top five groups of aggregated manufacturing, ranked by their shares in the NBFG-region's total manufacturing import value from China in 2003. This includes the following five groups, listed with their shares:

- Machinery and equipment (52%)
- Textiles, textile products, leather and footwear (19%)
- Manufacturing nec; recycling (12%)
- Chemical, rubber, plastics and fuel products (8%)
- Basic metals and fabricated metal products (4%)

These groups together constitute about 95% of the NBGF-region's total manufacturing import value from China. To gain insight in the development of the value density of these groups, statistics in the external trade database of the EuroStat and a conversion table are used. The external trade database contains the value and the weight of all imported commodities, registered according to the Harmonized System Codes Commodity Classification at several digit-level. The larger the digit-level the more the classification of commodities at a detailed level is. The OECD provides a standard conversion key table, which addresses the link between the aggregated manufacturing groups and the registered commodities these groups consist of. Using the standard OECD conversion key table the registered commodities can be linked to the aggregated manufacturing groups exactly. However, in that case the classification of the commodities has to be taken at a very large digit-level. Since the purpose of this part of the thesis is to show aggregated manufacturing groups dealing with different value density and with different development of the value density, instead of getting the very accurate values, another simplified conversion table is used. This conversion table is depicted as table 5.2 and composed largely based on the OECD key table.

Table 5.2. Simplified conversion table.

Aggregated Manufacturing Group	HS Code	Description HS product
Machinery and equipment	63	MADE-UP TEXTILE ARTICLES NESOI, NEEDLECRAFT SETS, WORN CLOTHING, RAGS
	73	RTICLES OF IRON OR STEEL
	74	COPPER & ARTICLES THEREOF
	84	NUCLEAR REACTORS, BOILERS, MACHINERY & MECHANICAL APPLIANCES, COMPUTERS
	84	NUCLEAR REACTORS, BOILERS, MACHINERY & MECHANICAL APPLIANCES, COMPUTERS
	85	ELECTRICAL MACHINERY & EQUIP. & PARTS, TELECOMMUNICATIONS EQUIP., SOUND RECORDERS, TELEVISION RECORDERS
	85	ELECTRICAL MACHINERY & EQUIP. & PARTS, TELECOMMUNICATIONS EQUIP., SOUND RECORDERS, TELEVISION RECORDERS
	87	VEHICLES OTHER THAN RAILWAY OR TRAMWAY ROLLING STOCK
	90	OPTICAL, PHOTOGRAPHIC, CINEMATOGRAPHIC, MEASURING, CHECKING, PRECISION, MEDICAL OR SURGICAL INSTRUMENTS & ACCESSORIES
	91	CLOCKS & WATCHES & PARTS THEREOF
	93	ARMS & AMMUNITION, PARTS & ACCESSORIES
	94	FURNITURE, BEDDING, CUSHIONS, LAMPS & LIGHTING FITTINGS NESOI, ILLUMINATED SIGNS, NAMEPLATES & THE LIKE, PREFABRICATED BUILDINGS

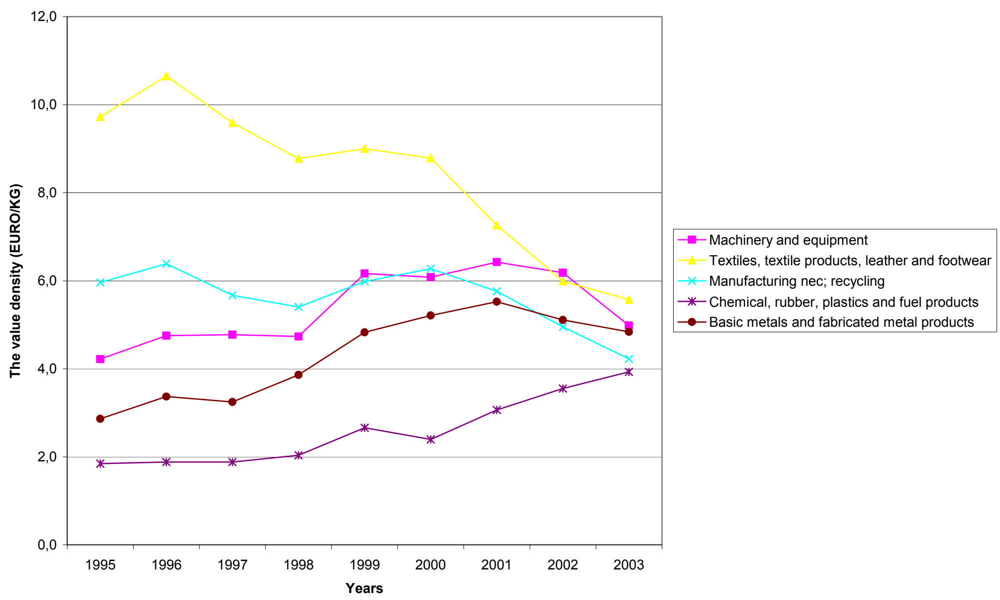
Textiles, textile products, leather and footwear	41	RAW HIDES & SKINS & LEATHER
	42	ARTICLES OF LEATHER, SADDLERY & HARNESS, TRAVEL GOODS, HANDBAGS, ARTICLES OF GUT
	43	FURSKINS & ARTIFICIAL FUR, MANUFACTURES
	50	SILK, INC. YARNS & WOVEN FABRICS THEREOF
	51	WOOL & FINE OR COARSE ANIMAL HAIR, INC. YARNS & WOVEN FABRICS THEREOF
	52	COTTON, INC. YARNS & WOVEN FABRICS THEREOF
	53	VEG. TEXTILE FIBERS NESOI, YARNS & WOVEN ETC.
	54	MAN-MADE FILAMENTS, INC. YARNS & WOVEN ETC.
	55	MAN-MADE STAPLE FIBERS, INC. YARNS ETC.
	56	WADDING, FELT & NONWOVENS, SPECIAL YARNS, TWINE, CORDAGE, ROPES & CABLES & ARTICLES
	57	CARPETS & OTHER TEXTILE FLOOR COVERINGS
	58	SPECIAL WOVEN FABRICS, TUFTED TEXTILES, LACE
	59	IMPREGNATED, COATED, COVERED, OR LAMINATED TEXTILE PROD, TEXTILE PROD FOR INDUSTRIAL USE
	60	KNITTED OR CROCHETED FABRICS
	61	ARTICLES OF APPAREL & CLOTHING ACCESSORIES-KNITTED OR CROCHETED
	62	ARTICLES OF APPAREL & CLOTHING ACCESSORIES-NOT KNITTED OR CROCHETED
	63	MADE-UP TEXTILE ARTICLES NESOI, NEEDLECRAFT SETS, WORN CLOTHING, RAGS
	64	FOOTWEAR, GAITERS, & THE
	65	HEADGEAR & OTHER PARTS
	70	GLASS & GLASSWARE
	91	CLOCKS & WATCHES & PARTS THEREOF
	94	FURNITURE, BEDDING, CUSHIONS, LAMPS & LIGHTING FITTINGS NESOI, ILLUMINATED SIGNS, NAMEPLATES & THE LIKE, PREFABRICATED BUILDINGS
	96	MISCELLANEOUS MANUFACTURED ARTICLES
Manufacturing nec; recycling	34	SOAPS, WAXES, SCOURING PRODUCTS, CANDLES, MODELING PASTES, DENTAL WAXES
	36	EXPLOSIVES, MATCHES, PYROTECHNIC PRODUCTS
	42	ARTICLES OF LEATHER, SADDLERY & HARNESS, TRAVEL GOODS, HANDBAGS, ARTICLES OF GUT
	59	IMPREGNATED, COATED, COVERED, OR LAMINATED TEXTILE PROD, TEXTILE PROD FOR INDUSTRIAL USE
	63	MADE-UP TEXTILE ARTICLES NESOI, NEEDLECRAFT SETS, WORN CLOTHING, RAGS
	66	UMBRELLAS, SUN UMBRELLAS, WALKING-STICKS, WHIPS, RIDING-CROPS & PARTS
	67	PREPARED FEATHERS, HUMAN HAIR & ARTICLES THEREOF, ARTIFICIAL FLOWERS
	71	PEARLS, STONES, PREC. METALS, IMITATION JEWELRY, COINS
	87	VEHICLES OTHER THAN RAILWAY OR TRAMWAY ROLLING STOCK
	92	MUSICAL INSTRUMENTS, PARTS & ACCESSORIES
	94	FURNITURE, BEDDING, CUSHIONS, LAMPS & LIGHTING FITTINGS NESOI, ILLUMINATED SIGNS, NAMEPLATES & THE LIKE, PREFABRICATED BUILDINGS
	95	TOYS, GAMES & SPORTS EQUIP, PARTS & ACCES.
	96	MISCELLANEOUS MANUFACTURED ARTICLES
Chemical, rubber, plastics and fuel products	15	ANIMAL OR VEGETABLE FATS, OILS & WAXES
	25	SALT, SULPHUR, EARTH & STONE, LIME & CEMENT
	26	ORES SLAG & ASH
	27	MINERAL FUELS, OILS, WAXES & BITUMINOUS SUB
	28	INORGANIC CHEM, ORG/INORG COMPOUNDS OF PRECIOUS METALS, ISOTOPES
	29	ORGANIC CHEMICALS
	30	PHARMACEUTICAL PRODUCTS
	31	FERTILIZERS

	32	TANNING OR DYEING EXTRACTS, DYES, PIGMENTS, PAINTS & VARNISHES, PUTTY, & INKS
	33	OILS & RESINOIDS, PERFUMERY, COSMETIC OR TOILET PREPARATIONS
	34	SOAPS, WAXES, SCOURING PRODUCTS, CANDLES, MODELING PASTES, DENTAL WAXES
	35	ALBUMINOIDAL SUB, STARCHES, GLUES, ENZYMES
	36	EXPLOSIVES, MATCHES, PYROTECHNIC PRODUCTS
	37	PHOTOGRAPHIC OR CINEMATOGRAPHIC GOODS
	38	MISCELLANEOUS CHEMICAL PRODUCTS
	39	PLASTICS & ARTICLES THEREOF
	40	RUBBERS & ARTICLES THEREOF
	44	WOOD & ARTICLES OF WOOD, WOOD CHARCOAL
	54	MAN-MADE FILAMENTS, INC. YARNS & WOVEN ETC.
	55	MAN-MADE STAPLE FIBERS, INC. YARNS ETC.
	59	IMPREGNATED, COATED, COVERED, OR LAMINATED TEXTILE PROD, TEXTILE PROD FOR INDUSTRIAL USE
	65	HEADGEAR & OTHER PARTS
	71	PEARLS, STONES, PREC. METALS, IMITATION JEWELRY, COINS
	84	NUCLEAR REACTORS, BOILERS, MACHINERY & MECHANICAL APPLIANCES, COMPUTERS
	85	ELECTRICAL MACHINERY & EQUIP. & PARTS, TELECOMMUNICATIONS EQUIP., SOUND RECORDERS, TELEVISION RECORDERS
	94	FURNITURE, BEDDING, CUSHIONS, LAMPS & LIGHTING FITTINGS NESOI, ILLUMINATED SIGNS, NAMEPLATES & THE LIKE, PREFABRICATED BUILDINGS
Basic metals and fabricated metal products	26	ORES SLAG & ASH
	28	INORGANIC CHEM, ORG/INORG COMPOUNDS OF PRECIOUS METALS, ISOTOPES
	71	PEARLS, STONES, PREC. METALS, IMITATION JEWELRY, COINS
	72	PEARLS, STONES, PREC. METALS, IMITATION JEWELRY, COINS
	73	RTICLES OF IRON OR STEEL
	74	COPPER & ARTICLES THEREOF
	75	NICKEL & ARTICLES THEREOF
	76	ALUMINUM & ARTICLES THEREOF
	78	LEAD & ARTICLES THEREOF
	79	ZINC & ARTICLES THEREOF
	80	TIN & ARTICLES THEREOF
	81	BASE METALS NESOI, CERMETS, ARTICLES ETC.
	82	TOOLS, SPOONS & FORKS OF BASE METAL
	83	MISCELLANEOUS ARTICLES OF BASE METAL
	84	NUCLEAR REACTORS, BOILERS, MACHINERY & MECHANICAL APPLIANCES, COMPUTERS
	93	ARMS & AMMUNITION, PARTS & ACCESSORIES
	94	FURNITURE, BEDDING, CUSHIONS, LAMPS & LIGHTING FITTINGS NESOI, ILLUMINATED SIGNS, NAMEPLATES & THE LIKE, PREFABRICATED BUILDINGS

Table 5.2 is simplified in such a way that all registered commodities are taken into account at the two digits level. As consequences of the simplification, the results with conversion table 5.2 will not be as accurate as results with the OECD key table. For purposes to get more accurate estimations of the value density of various groups, it is recommended to use the OCED key table. Using the external trade database and on the basis of the conversion table 5.2 development of the value density with regard to the five aggregated manufacturing groups, imported from China to the NBGF-region,

is examined. Various developments of value density among the groups are depicted in figure 5.3.

Fig. 5.3. The developments of value density among five aggregated manufactured groups imported from China to the NBGF-region.



On the basis of conversion table, reflecting from figure 5.3, it seems that the value densities of various aggregated manufacturing groups converge. However, to find out whether it converges, the key table of the OECD should be used. Comparing with figure 5.2, it is clear that the five aggregated manufacturing groups have a higher value density than other transported commodities. This may be one of the factors that contribute to the well-known high degree of containerisation of manufactured goods. There is apparently a threshold with regard to the value density in relation to the decision whether to transport with containers. It is namely not worth to transport goods in containers, if the container related costs are much higher than the value of the goods itself. From above, it is clear that various developments of the value density occur among the imported commodities. To convert the trade value of the aggregated manufacturing groups to trade volume, the value density of these groups should be taken into account. By dividing the total demand for manufacturing import from export country x to import country $m, TDMI^{m,x}$, with the value density, $VD_j^{m,x}$, with regard to various aggregated manufacturing groups, the total demand of manufacturing import volume, $TDMIV^{m,x}$, can be determined as follows:

$$TDMIV^{m,x} = \sum_{j=1}^{J} \frac{\left(\sum_{k=1}^{K} TUM_j^{m,k} * IR_j^{m,k} + \sum_{n=1}^{N} TUM_j^{m,n} * IR_j^{m,n} \right) * A_j^{x,m}}{VD_j^{m,x}} \quad \textbf{(5.1).}$$

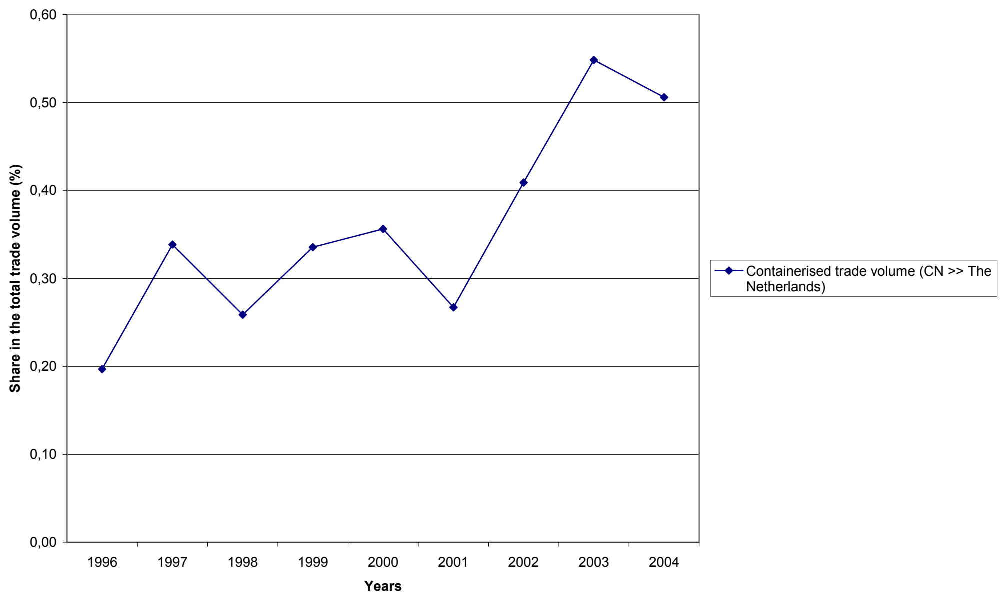
5.2.2 The degree of the containerisation

As the relation between the trade value and the trade volume is revealed in the value density, the relation between the trade volume and the amount of containers used to transport this volume is revealed in the degree of containerisation. The degree of containerisation is dependant on the containerised share of the various commodities and a factor that denotes the conversion of the containerised trade volume to the number of TEU. This can be denoted as follows:

The degree of containerisation = f (*Containerised share of trade volume,*
Conversion factor)

The containerised share of the trade volume refers to the percentage of the trade volume that is transported with containers, while the conversion factor is used to determine the amount of containers that are needed to transport the containerised volume. The statistics from the Central Bureau of Statistics are analysed. Considering the revealed containerised share of the total maritime import volume from China to the Netherlands, which is reflected from figure 5.4, the containerised share of the total maritime import volume has increased. The increasing awareness of the advantages of container as transportation mode and the technological progress, which, for instances, increases the ease with regard to the use of containers and inaugurates different types of container, contribute to the increasing containerised share. So far, the attention has been paid to the containerised share of import volume as a whole. According to analyses, done by Deloitte Port Services [36], various containerised shares of trade are revealed among the commodities and they differ among countries also. The containerised share of trade volume is higher with regard to the trade between the more developed countries.

Fig. 5.4. The revealed containerised share of the total trade volume with regard to import from China to the Netherlands.

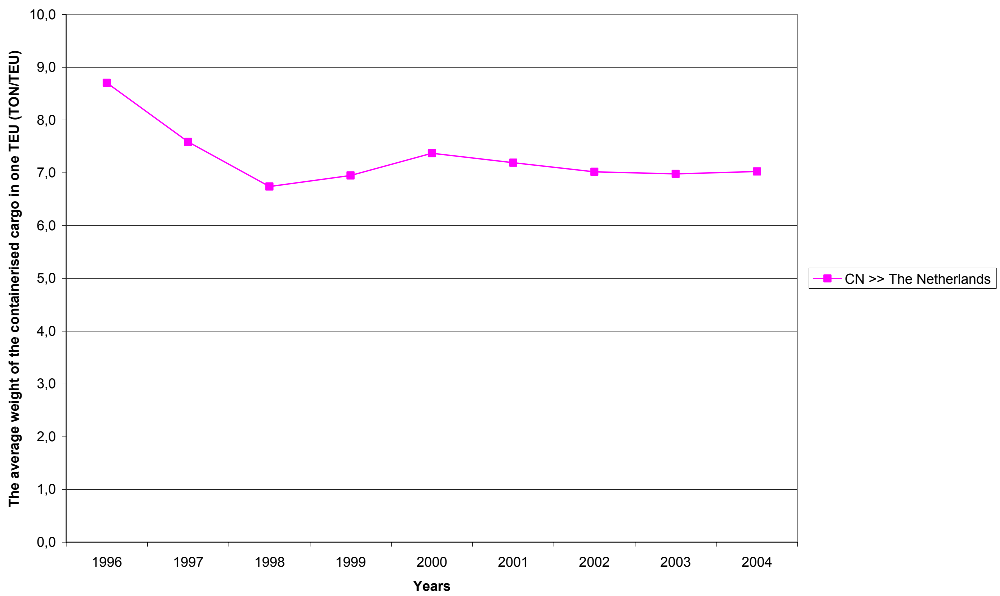


To determine the containerised volume of the total demand for manufacturing import from country x to country m, $CVTDMI^{m,x}$, the containerised shares of various commodities related to this import trade, $\delta_j^{x,m}$, have to be taken into account as follows:

$$CVTDMI^{m,x} = \sum_{j=1}^{J} \frac{\left(\sum_{k=1}^{K} TUM_j^{m,k} * IR_j^{m,k} + \sum_{n=1}^{N} TUM_j^{m,n} * IR_j^{m,n} \right) * A_j^{x,m} * \delta_j^{x,m}}{VD_j^{m,x}} \quad \textbf{(5.2).}$$

In relation to the degree of containerisation, besides the containerised shares of various commodities, the conversion factor is important. The conversion factor is expressed in TEU/kg and indicates how many TEUs one kg containerised trade volume required. To get insight in the conversion factor attention is paid to the average weight of the containerised volume in one TEU. The amount of containers, expressed in TEUs, from China to the Netherlands and the weight of the commodities within these containers are examined and the development of the average containerised volume, expressed in kg/TEU, is shown in figure 5.5.

Fig. 5.5. The average weight of the containerised cargo in one TEU with regard to containers from China to the Netherlands.



From figure 5.5 it is reflected that the average containerised volume in one TEU has more or less been stable. On average the containerised volume of one TEU is around 7 kg. The revealed conversion factor, *RCF*, is determined as follows:

$$RCF = 1 \;/\; \textit{Average containerised volume in one TEU}$$

The revealed conversion factor, based on the amount of containers from China to the Netherlands, is depicted in figure 5.6. The stability in the development of the average containerised volume in one TEU is reflected in the stable development of the conversion factor in the last years. Taking the maritime trade volume as a whole and considering the revealed conversion factor, depicted in figure 5.5, the revealed degree of containerisation is determined and shown in figure 5.7. This is the revealed degree of containerisation of the total maritime import from China to the Netherlands. It is calculated by the containerised share and the revealed conversion factor.

Fig. 5.6. The revealed values of the conversion factor based on the total import from China to the Netherlands.

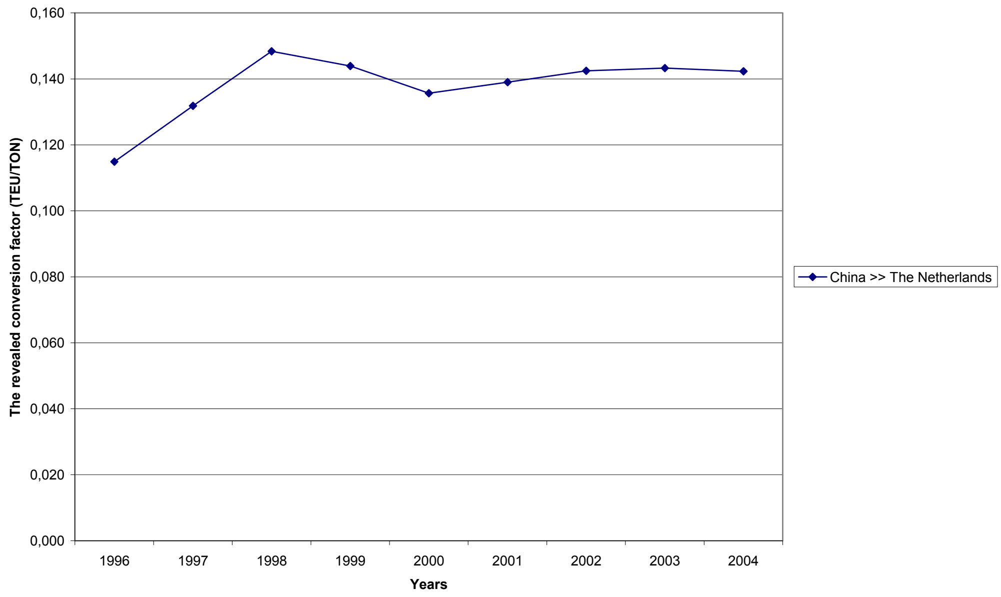
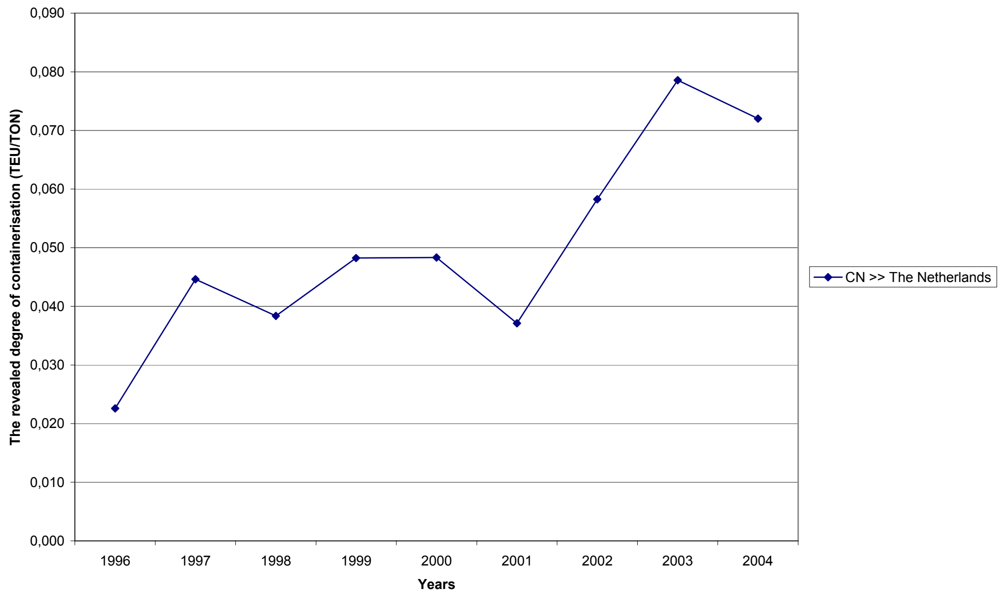


Fig. 5.7. The revealed degree of containerisation based on the total import from China to the Netherlands.



From above it is clear, that the conversion factor is used to convert containerised share of the trade volume in the amount of containers. The conversion takes place as follows:

$$CTM^{m,x}_{manufacturing} = \chi^{m,x} * CTDMIV^{m,x} \tag{5.3}$$

$CTM^{m,x}_{manufacturing}$ denotes the amount of containers, expressed in TEU, arisen from the total import of manufacturing from export country x to import country m, while $\chi^{m,x}$ denotes the conversion factor, expressed in TEU/kg. Extension of eq. 5.2 can take place, as follows:

$$CTM^{m,x}_{manufacturing} = \chi^{m,x} * \sum_{j=1}^{J} \frac{\left(\sum_{k=1}^{K} TUM_j^{m,k} * IR_j^{m,k} + \sum_{n=1}^{N} TUM_j^{m,n} * IR_j^{m,n}\right) * A_j^{x,m} * \delta_j^{x,m}}{VD_j^{m,x}} \tag{5.4}$$

Together with the previous chapters, attention has been paid to the establishment of the import trade of manufacturing and its link to the amount containers arisen from this import trade. Further, a framework, referring to eq. 5.4, has been developed that structures that establishment of containers arisen from the manufacturing import. In the next chapter, the desired basic framework will be presented and possible applications of the framework will be discussed.

Chapter 6

The Basic Framework and Applications

In the previous chapters attention has been paid to the establishment of import trade from a certain country and the link between trade and the amount of containers arisen from the import trade. Based on the findings and insights gained during that process, the relevant elements with regard to the establishment of container growth arisen from import trade, in particular import of manufactured goods, between two regions have been pointed out and convert into a framework (eq. 5.4). This framework boosts analyses of container growth related issues arisen from manufacturing trade. A further development of the framework to provide room for analyses of container growth related issues arisen from other trade than manufacturing trade and insight in the possible applications of the framework are strived for. Section 6.1 concerns the further development of the desired basic framework and section 6.2 the possible applications of the framework

6.1 The basic framework

The issues related to the container growth are often complex, because of many relations of development of factors involved. The framework (eq. 5.4) provides a tool to locate and to arrange the development of various relevant factors concerning container growth as consequences of manufacturing import. In the following attention is paid to this framework and the possibility of it to locate and investigate issues at several aggregation levels and the possible extension to concern containers arisen from the total import trade.

6.1.1 Framework for containers arisen from manufacturing import

In Chapter 5 a framework (eq. 5.4) has been settled with regard to the establishment of the amount of containers, expressed in TEU, arisen from the total import of manufacturing from export country x to import country m. In relation to the determination of this amount of containers, the framework takes six factors and three parameters into account, where the values of the three parameters define the level of aggregation at which the factors will be examined. The six factors include:

Factor 1 - The total use of the J groups of manufactured goods by the K industries and N non-industries, TUM, expressed in value.

Factor 2 - The import rates, IR, in relation to factor 1, which is dimensionless, and ≥ 0 and ≤ 1.

Factor 3 - The attractiveness, A, for import country m to import the J groups of manufactured goods from a certain country x, which is dimensionless and ≥ 0 and ≤ 1.

Factor 4 - The value density, VD, of the J groups of the imported manufactured goods, expressed in €/kg or USD/kg.

Factor 5 - The containerised share, δ, of the total imported trade volume of the J groups of manufactured goods, which is dimensionless and ≥ 0 and ≤ 1.

Factor 6 - The amount of containers required for the imported containerised trade volume, χ, expressed in TEU/kg or TEU/TON.

The relations between these factors are depicted in eq. 5.4, as below:

$$CTM_{manufacturing}^{m,x} = \chi^{m,x} * \sum_{j=1}^{J} \frac{\left(\sum_{k=1}^{K} TUM_j^{m,k} * IR_j^{m,k} + \sum_{n=1}^{N} TUM_j^{m,n} * IR_j^{m,n} \right) * A_j^{x,m} * \delta_j^{x,m}}{VD_j^{m,x}}$$

6.1.2 Level of aggregation

With the framework presented in the section 6.1.1, in relation to several container growth related issues, there is space left to analyses at different aggregation level. The parameters K and N define at which aggregation level, respectively, the industries and the non-industries will be examined with regard to the use and import rates of the manufactured goods. Both parameter K and N concern several consumer groups of the J groups of imported goods. The total amount of consumer groups, G, is $K + N$. Therefore, the equation 5.4 can be rewritten as follows:

$$CTM^{m,x}_{manufacturing} = \chi^{m,x} * \sum_{j=1}^{J} \frac{\left(\sum_{g=1}^{G} TUM_j^{m,g} * IR_j^{m,g} \right) * A_j^{x,m} * \delta_j^{x,m}}{VD_j^{m,x}} \quad \textbf{(6.1)}$$

where $g = 1,\ldots,G$ and denotes the consumer groups of the J groups of imported goods. The parameter J defines the aggregation level at which the manufactured goods will be taken into account. The choice with respect to the value of the parameters will be dependent on the nature of the issues to be analysed, thus the purpose the framework is aimed to use, and the availability of data. The larger the values of these parameters, the more disaggregated the level at which the container growth will be analysed.

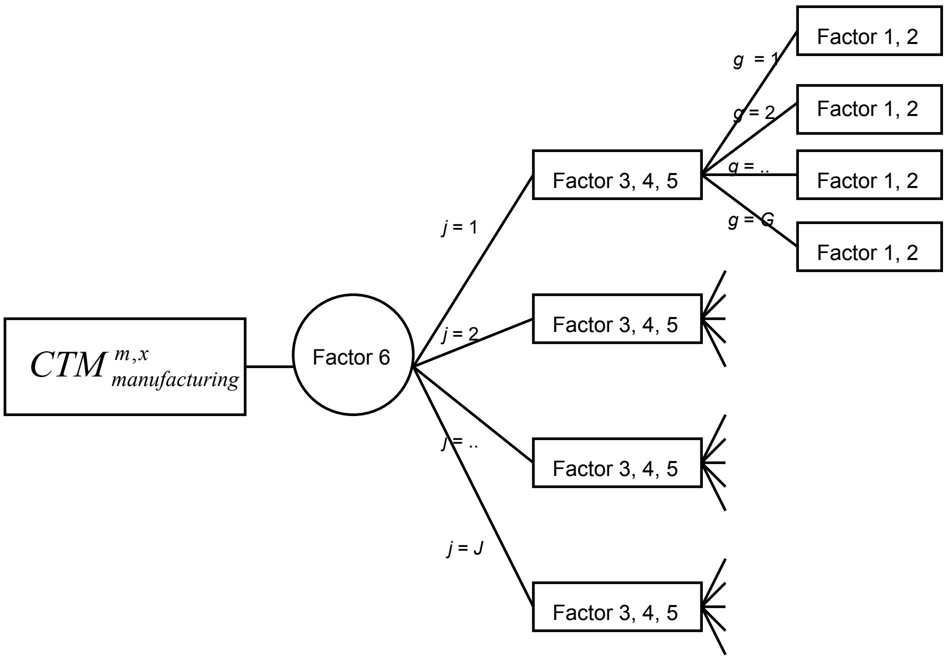


Fig. 6.1. Illustration of the possibility to locate and investigate issues at different aggregation level.

In Chapter 3, 4, and 5, the *J*-value is taken as 10, referring to the ten aggregated manufacturing groups within the total manufacturing import. Further, the *K*-value is 29 and the *N*-value 6, referring to the twenty-nine parties in the group of industry and the six parties in the group of non-industry, respectively. Figure 6.1 illustrates the possibility to work with several aggregation levels.

6.1.3 Framework for containers arisen from total import

In this part the desired basic framework is presented. As mentioned in the beginning of the thesis, the framework arisen from the analyses of manufacturing import will provide space for extension to analyse container growth related issues arisen from other trade than manufacturing trade. At this point, this extension is made. So far, attention has been paid to the amount of containers arisen from the import of manufacturing. Manufacturing is just one of the commodities which are involved in trade. With this in mind, the framework that is depicted with eq. 6.1, can easily be transformed to include container growth established through import of all other commodities, like agriculture and mining products. For this purpose a parameter can be introduced to define the aggregation level at which the classification of commodities will be made. The larger the value of this parameter, the more disaggregate the level at which the commodities are classified. This parameter is denoted by p, where $p = 1,\ldots,P$. As the amount of containers arisen from the total import of the commodity group of manufacturing from export country x to import country m is denoted by $CTM^{m,x}_{manufacturing}$, the amount of containers arisen from the total import of commodity group p is denoted by $CTM^{m,x}_{p}$. This is denoted as follows:

$$CTM^{m,x}_{p} = \chi^{m,x,p} * \sum_{j=1}^{J} \frac{\left(\sum_{g=1}^{G} TU^{m,g,p}_{j} * IR^{m,g,p}_{j} \right) * A^{x,m,p}_{j} * \delta^{x,m,p}_{j}}{VD^{m,x,p}_{j}} \qquad \textbf{(6.2).}$$

$TU^{m,g,p}_{j}$ denotes the total use of group j of commodity group p with regard to the industry g in country m. The amount of containers arisen from the total import from country x to m, $CTM^{m,x}$, is determined as follows:

$$CTM^{m,x} = \sum_{p=1}^{P} CTM_p^{m,x} \quad \textbf{(6.3)},$$

in other words,

$$CTM^{m,x} = \sum_{p=1}^{P} \chi^{m,x,p} * \sum_{j=1}^{J} \frac{\left(\sum_{g=1}^{G} TU_j^{m,g,p} * IR_j^{m,g,p} \right) * A_j^{x,m,p} * \delta_j^{x,m,p}}{VD_j^{m,x,p}} \quad \textbf{(6.4)}.$$

The desired basic framework is presented by eq. 6.4. Figure 6.2 illustrates eq. 6.4 with the help of figure 6.1.

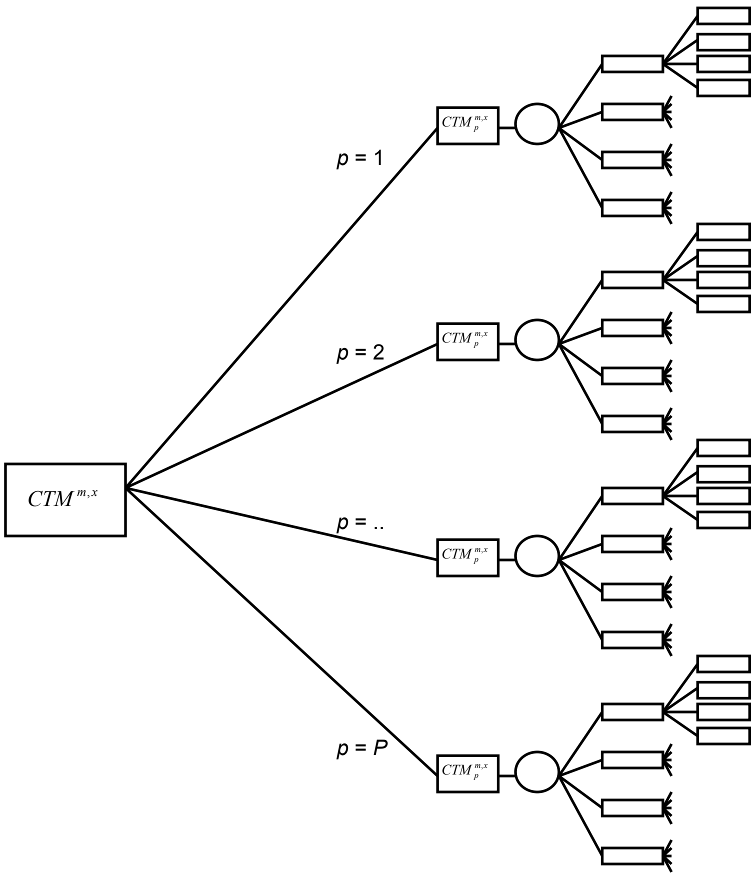


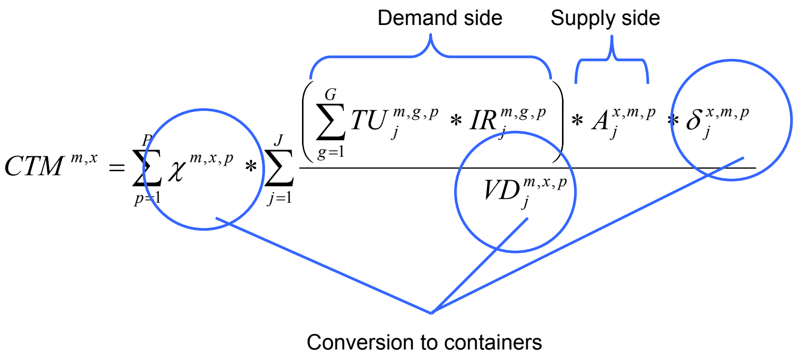
Fig. 6.2. Illustration of the basic framework.

6.2 Possible applications

To provide a better understanding of the relevance of the basic framework, in this section, the attention will be paid to several possible applications of the basic framework. Applications refer to container growth related issues, which can be analysed with help of the framework.

6.2.1 Basis to arrange relations between factors

The most important feature of the basic framework is the foundation it provides for further comprehensive investigations of container growth related issues. The basic framework is a tool to structure development of various relevant factors to container growth and to link these factors together. Figure 6.3 makes clear that the basic framework includes all relevant relations with regard to the establishment of container arisen from import. Relations with regard to the demand and supply side of the import trade and several elements required for the conversion of trade value to the amount of containers are included.



$$CTM^{m,x} = \sum_{p=1}^{P} \chi^{m,x,p} * \sum_{j=1}^{J} \frac{\left(\sum_{g=1}^{G} TU_j^{m,g,p} * IR_j^{m,g,p} \right) * A_j^{x,m,p} * \delta_j^{x,m,p}}{VD_j^{m,x,p}}$$

Fig. 6.3. The basic framework involves both the demand and supply side of the trade and the conversion to the amount of containers arisen from this context.

With the framework, the development of various relevant factors can be located easily in the context of container growth. The appeared studies about these factors separately can be brought together by the use of the framework. This contributes to further understanding of the container growth. It reveals also areas, which require investigations in order to understand the container growth better.

6.2.2 Prognosis of container growth

Reflecting from the basic framework it is clear that the development of the six factors, listed in section 6.1.1, determines the container growth. For the purpose of prognosis of container growth the development of these six factors has to be examined. The amount of containers arisen from the import trade from country x to country m at moment t is determined by the states of the six factors at t, as follows:

$$CTM^{m,x,t} = \sum_{p=1}^{P} \chi_t^{m,x,p}(\ ) * \sum_{j=1}^{J} \frac{\left(\sum_{g=1}^{G} TU_{j,t}^{m,g,p}(\ ) * IR_{j,t}^{m,g,p}(\ )\right) * A_{j,t}^{x,m,p}(\ ) * \delta_{j,t}^{x,m,p}(\ )}{VD_{j,t}^{m,x,p}(\ )} \quad \textbf{(6.5)}$$

As eq. 6.5 depicts, the six factors, separately, involve their own functions that influence their developments and states at t. This is depicted below:

$TU_{j,t}^{m,g,p}(\ )$ = f (… …)

$IR_{j,t}^{m,g,p}(\ )$ = f (… …)

$A_{j,t}^{x,m,p}(\ )$ = f (… …)

$\delta_{j,t}^{x,m,p}(\ )$ = f (… …)

$VD_{j,t}^{m,x,p}(\ )$ = f (… …)

$\chi_t^{m,x,p}(\ )$ = f (… …).

To determine $CTM^{m,x,t}$, at a certain aggregation level, predictions with regard to the state of the six factors at t have to be made. For this purpose, investigations about relevant variables, that determine the state of the six factors, the indicators of these variables and the relations between them, have to be done. In this light, the phenomenon to be predicted, referring to the amount of containers, is split up in six other factors that have to be predicted. This is illustrated in figure 6.4.

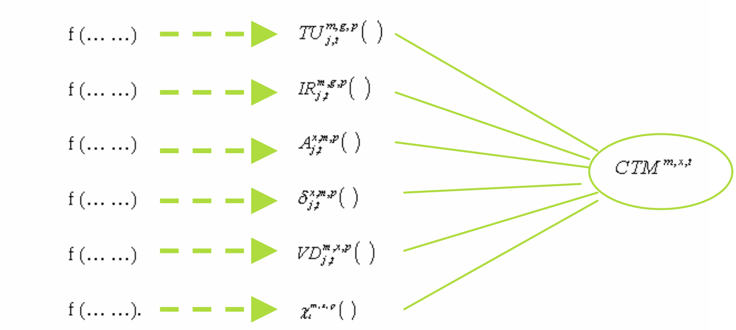


Fig. 6.4. Illustration of the splitting up with regard to the phenomenon to be predicted.

6.2.3 The saturation of container growth

One of the container growth related issues, that have risen and caught attention, is the saturation of the container growth. This is not odd, since the enormous growth of containers in the last decade. Although the amount of containers arisen from trade is still increasing, it is a fact that saturation of the container growth will come. The basic framework provides a basis to locate and investigate issues related to saturation of the container growth. From the basic framework it is clear that in relation to the container growth there are factors involved which concern limits. This implies that the possibility of saturation of container growth from these factors occurs. Consider eq. 6.5. The factors $IR_{j,t}^{m,g,p}(\ )$, $A_{j,t}^{x,m,p}(\ )$, and $\delta_{j,t}^{x,m,p}(\ )$ are all dimensionless and their values are ≥ 0 and ≤ 1. With regard to the conversion factor $\chi_t^{m,x,p}(\ )$, which is expressed in TEU/TON, its value is mainly dependent on the development in the technological environment. It concerns the average weight of goods transported in one TEU. Further, with respect to $TU_{j,t}^{m,g,p}(\ )$ and $VD_{j,t}^{m,x,p}(\ )$, theoretically, their values are unlimited. Studies about the development of all these factors together will provide insight in the revealed high container growth and the state of possible saturation of the growth.

6.2.4 Explorations of opportunities

The framework provides a basis for explorations of opportunities as well. Based on the framework several comprehensive analyses can be done. With regard to the revealed structure of the demand and supply side and the revealed degree of containerisation, various business opportunities, in particular container industry related ones, can be discovered. Based on the revealed information, for instance, it will become clear which industries are the major drivers of the imported containers and which commodities lack in containerisation. With this information business strategies can be optimized further. For instances, the determination of adequate infrastructure investments and adjustments in marketing strategy of logistics service providers. Besides business opportunities, the framework provides a basis to explore research opportunities. The framework reveals the missing links between the relevant factors with regard to the development of the container growth and other related issues. Interesting research opportunities will arise from these missing links.

6.2.5 Extensions and other applications

The basic framework can be extended to larger and more complex models. Due to the clearance, provided by the framework, in the structure and the relations with regard to various relevant factors in relation to container growth, advanced models can easily be built upon the framework. Advanced models refer to models based on advanced modelling techniques, such as modelling techniques from the artificial and computational intelligence, and econometry. From the field of artificial and computational intelligence, and econometry, there are learning algorithms and techniques developed, aiming to investigations of relations between factors. Artificial neural networks, fuzzy inference systems, and classification and regression trees are instances of methods from the artificial and computational intelligence [16]. They can forecast, recognise, classify, and analyse what they have learnt. For instance, investigations about the relations between the six factors from the framework and the development of the transhipment behaviour, referring to all transhipment related issues, with regard to containers from a certain country may reveal insight in the characteristics of transhipment behaviour. Based on such insights and characteristics, extension of the framework leads to models that provide understanding of the transhipment behaviour. Further, the basic framework can function as a component of other existing complex models. An instance of such existing model is the market share model. Such market share model, like the logit model, addressed by Ecorys [15], estimates the distribution of the total amount of the arriving containers over a certain port range. For this purpose, such model requires the amount of containers arisen from a certain import trade as input. An application of the basic framework addressed in section 6.2.2, namely eq. 6.4, may function as an input module for such market share models. By extensions and combinations with other existing models, the basic framework contributes to a better understanding of container growth related issues. Further, it is clear that the basic framework provides a solid basis for development of applications that increase the further understanding of container growth related issues.

Chapter 7

Conclusions and Future Research

7.1 Conclusions

In the previous chapters analyses have been done to investigate the establishment of the NBGF-region's import and its link to the container arisen from this import. In particular, manufacturing import from China has got the attention. The aim of the thesis is to develop a basic framework to locate and investigate container growth related issues. Recalling the aim of the thesis and the research questions addressed in Chapter 1, the following conclusions are drawn.

The first research question concerns the nature of the demand for manufacturing import and the composition with regard to this demand. With regard to the nature of the demand for manufacturing, it has become clear that the total demand for import is composed by different uses and import rates among industries and non-industries in the import region. The development of the total demand for import is dependant on the changing structure of the economy in this import region.

In relation to the second research question which concerns the motivations to import from a certain export country, in this thesis this is China, and the composition of the imported manufactured goods. The cost advantages to produce abroad have largely been seen as the main motivation to import. Reflecting from the changing composition of the imported goods, it has become clear that the attractiveness of an export country for various groups of commodities changes and has impact on the import decisions.

With the third research question the link between trade and container flows has been considered. In the container industry volume rather than value matters. Different value densities occur among the imported groups of commodities. Since the composition of the imported commodities changes, the development of their value densities has to been taken into account. Besides the value density, the containerised shares of the imported trade volume differ among the groups of commodities. For the purpose to understand the container growth better, the development of the containerised shares of commodities should be taken into account also. Further, in the world of containers the amount of containers is often expressed in TEU. The containerised volume of the import can be converted to TEU by a conversion factor.

The last and the most important research question addressed in Chapter 1 shifts the attention back to the aim of the thesis. The findings obtained in the analyses have to be brought together in a basic framework, based on which applications will be developed. During the analyses of the establishment of the demand, the changing attractiveness of the supply side for certain groups of commodities and the link between trade and the amount of containers arisen from this trade, insights and findings have been obtained to form the desired basic framework, which is presented as eq. 6.4 in Chapter 6. A basic framework is established which provides clearance in the structure of relations between factors in the aspect of trade and container flows. Further, with respect to the level of classifications within the commodities, the groups within commodities and the consumers of these commodities to work with, the framework provides room to work at different aggregation levels. When there is chosen to work with a high aggregation level, with this framework it can be traced easily what assumptions underpin the possibility to work at a high level of aggregation. With regard to several possible applications that can be derived from the framework, various suggestions are done in the thesis. Although the mentioned applications have not been developed in this thesis and their effectiveness has not been tested, it can be concluded that a foundation is made for investigation to gain further understanding of the container growth and to develop relevant applications. With regard to the applicability of this foundation, Deloitte [36] has applied insights arisen from the framework to do analyses for clients. One of such analyses is the prognosis analyse, made for various development alternatives for the Westershelde Container Terminal in the Netherlands.

The developed basic framework in this thesis provides clearance in the structure of the establishment of container arisen from import trade. By means of this clearance, it reveals areas that cry out for investigations. At the same time it has become clear that the availability of data is very important for developments of container growth related models. Without data further investigations about the relations between relevant factors in the context of container growth are impossible to be executed. The availability of data can be marked as a bottleneck for investigations for the further understanding of the container growth.

7.2 Future research

With the developed framework, there is room created to do future research. In relation to future research, there are mainly two areas that provide room for future research.

The first area concerns the further development of the framework. Existing knowledge and studies with regard to the six factors in the framework should be brought together via the relations addressed in the framework. Investigations of determinants and indicators of the six factors will bring us more insight in the development of container growth. Due to the Since the importance of data for the further development of the framework and the further understanding of the container growth, investigations to the need and availability of data are desired. In this context the consistency of the data among data sources is important. With regard to the data collection process, investigations to the determination of the optimal level of aggregation to work with in the framework are meaningful.

The second area that provides room for future research concerns the applications of the developed framework. In Chapter 6 several possible applications has been mentioned. It is clear that the developed framework settles a basis for the development of applications. It is interesting to investigate the possibilities and effectiveness of the applications arisen from the insights and relations provided by the framework. Coupled with this, insights in the requirements of data will be gained also.

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